EMPIRICAL DETERMINATION OF LABOUR OUTPUT FOR FLOOR SCREED AND TILE FINISHES FOR CONSTRUCTION WORK IN ABUJA

BY

Alhassan Muhammad SANI PGD (A.T.B.U. BAUCHI) 2007
M.SC/ENV-DESIGN/6507/2010-2011

DEPARTMENT OF QUANTITY SURVEYING,
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A THESIS SUBMITTED TO THE SCHOOL OF POSTGRADUATE STUDIES, AHMADU BELLO UNIVERSITY, ZARIA IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE AWARD OF A MASTERS DEGREE IN PROJECT MANAGEMENT

DEPARTMENT OF QUANTITY SURVEYING,
FACULTY OF ENVIRONMENTAL DESIGN
AHMADU BELLO UNIVERSITY, ZARIA
NIGERIA

October, 2014

DECLARATION

I declare that the work in this Thesis titled "EMPIRICAL DETERMINATION OF LABOUR OUTPUT FOR FLOOR SCREED AND TILE FINISHES FOR CONSTRUCTION WORK IN ABUJA" has been carried out by me in the Department of Quantity Surveying. The information derived from the literature has been duly acknowledged in the text and a list of references provided. No part of this thesis was previously presented for another degree or diploma at this or any other institution.

Alhassan Muhammad SANI	_____	_____
Name of Student	Signature	Date

CERTIFICATION

This thesis titled EMPIRICAL DETERMINATION OF LABOUR OUTPUT FOR FLOOR SCREED AND TILE FINISHES FOR CONSTRUCTION WORK IN ABUJA by Alhassan Muhammad SANI meets the regulations governing the award of the degree of Master of Science (Project Management) of the Ahmadu Bello University, and is approved for its contribution to knowledge and literary presentation.

Dr.. A. D. Ibrahim (Chairman, Supervisory Committee)	Signature	Date
Dr. K. J. Adogbo Member, Supervisory Committee	Signature	Date
Dr. Y.M Ibrahim Head of Quantity Surveying Department	Signature	Date
Prof. A. Z Hassan Dean, School of Postgraduate Studies	Signature	Date

DEDICATION

This thesis is dedicated to my late father Mallam Alhassan Ibrahim and my mother Hajiya Hassana Alhassan for their contributions and advice.

ACKNOWLEDGMENT

My profound gratitude goes to Almighty ALLAH for keeping me in good health and making it possible for me to complete this research work.

I sincerely wish to express my deep appreciation, profound gratitude and unquantified thanks to Dr. A. D. Ibrahim for his invaluable assistance, guidance, close and meticulous supervision, constructive criticism, moderation, correction and patience which saw me through to the successful completion of this research. I am equally thankful to Dr. (Mrs) K.J Adogbo and Mall. M. Abdulrazaq for their guidance, comments and understanding throughout the research period.

My deep appreciation goes to my wife Hajija Madinatu and my children, for their prayers, patience, tolerance and endurance during the sleepless nights and my absence in the course of this study. In fact, their immeasurable understanding had seen me through to the completion of this research.

I cannot but thank Alhaji Ndanusa for his words of encouragement before, during and after the completion of this research. May ALLAH reward you abundantly (Amen).

I appreciate Mr Peter Onyeagam for his full contribution during the course of this research and my brother Ibrahim Alhassan I appreciate you all for your support and encouragement. May ALLAH bless you all (Ameen).

ABSTRACT

There is dearth of information on output level of building operatives in Nigeria, consequently, the output constants currently used for preparation of construction estimates are remnants of British colonial heritage or derived from untested experiences. Therefore this study aims at empirically determining output constants for floor finishes (screeds and tiles) for building project in Abuja. The objectives are to identify the productivity factors related to Building Engineering Standard Method of Measurement 3 (BESMM3) and evaluation of their impact on the outputs of five work items of floor finishes. The procedure adopted field survey involving work measurement to observe and measure operatives output. Data was collected from 80 on-going construction sites with an average of 50 gangs of workers for each work item to establish the following average outputs per day; 25mm thick cement and sand screed (23.70), 44mm thick cement and sand screed (19.31), 400 X 400mm ceramic floor tile (27.38), 300 X 600mm ceramic floor tile (30.18) and 300 X 300mm ceramic floor tile (23.61). The study also revealed a significant difference on mode of employment and period of observation on the outputs of the workers. The results suggest that experience and negotiation as mode of employment affect output of workers to varying degrees based on the thickness of floor screed and unit area of floor tile. The study has recommended that the established output should serve as an effective baseline for efficient estimating process and be in compliance with the BESMM requirements.

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LIST OF ABBREVIATIONS

ANOVA:	Analysis of Variances.
BESMM3:	Building and Engineering Standard Method of Measurement, Third Edition.
BOQ:	Bill of Quantities.
BS:	British Standard.
C & G:	City and Guides of London.
CESMM:	Civil Engineering Standard Methods of Measurement.
CP:	Code of Practice.
ICE:	Institute of Civil Engineers.
JCT:	Joint Contract Tribunal.
LSD:	Least Significance Different.
NABTEB:	National Business and Technical Examinations Board.
NAPTED:	National Apprentice Training and Entrepreneur Development
ND:	National Diploma.
NIQS:	Nigerian Institute of Quantity Surveyors.
NJIC:	National Joint Industrial Council
PWD	Public Works Department
RICS:	Royal Institution of Chartered Surveyors.
SFBCN:	Standard Form of Building Contract of Nigeria.
SFC:	Standard Form of Contract.
SMM:	Standard Method of Measurement.
SMMBWS:	Standard Methods of Measurement of Building Works and Services.
SMMIE:	Standard Method of Measurement of Industrial Engineering.
SON:	Standard Organization of Nigeria.
SPSS:	Statistical Package for Social Sciences.
SSCE:	Senior Secondary Certificate Examinations

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CHAPTER ONE

1.0 INTRODUCTION

1.1 Background of the Study

The source of labour output used for estimation of construction cost has been a point of discourse and contention. This is because this involves the quantitative estimation of the labour rates while market survey research for materials prices are the basis for the material cost estimation (Ashworth, 2002). The high degree of inaccuracy found in BOQ estimates is mostly attributed to the uncertainty of the accuracy of the labour constants used in pricing labour costs. Ajia (2002) concluded that while most of the outputs used by estimators are the British originated constants, some contractors adopt outputs gotten from their experience and hence non-uniform outputs are widely in use.

The common method of generating cost estimates for construction projects involves the multiplication of unit rate by the measured quantities in the bill of quantities (Ashworth, 2002). The unit rate is a component of labour rate (obtain from the multiplication of labour constant by all-in rate) plus cost of material and percentage allowance for profit and overhead, while the measured quantities are obtained from drawings and specifications for the works rules specified by Building and Engineering Standard Methods of Measurement (BESMM). The inconsistency in application of a defined output constant for construction estimates has posed a serious challenge to the accuracy of estimates computed by quantity surveyors.

Labour being one of the important components of the construction industry productivity represents a considerable proportion of the final cost usually accounting for between 40 to 60% of building cost (Abdullahi *et al*., 2010 and Butchan *et al.*, 1993). The assessment of

labour rate used for preparation of unit rate for Bill of Quantities requires high level of reliability and accuracy. Essentially, the preparation of Bill of Quantities requires collating cost information on materials, assessing labour and plant outputs and evaluating project overheads. It is important, that cost estimates have clear indications of the level of information reliability and not subsequent explanation of inaccuracy (Morledge, 2006).

According to Abdulrazaq *et al.* (2010) the output constants currently used for preparation of construction estimates are remnants of British colonial heritage or derived from experience of the estimators. Olomolaiye and Ogunlana (1989) reported that firms based their outputs for estimating and planning purposes on experience which at best are educated guesses. Without adequate knowledge of operatives output, it is impossible to draw a reliable construction programmes or make accurate cost estimates for tendering purposes. According to Talhouni (1990), the British Research Establishment (BRE) studies only reported the overall labour variability for house building, but no attempt was made to quantify or explain the performance variability with regard to possible causes or factors that will affect the output of labour on the site and therefore the database used in the previous studies are questionable and are primarily based on activities sampling or data reported by tradesmen.

However, Yates and Swagata (1993) argued that the productivity of workers is being influenced by factors which vary according to geographical locations. Therefore, if these factors vary acutely with location then how feasible, realistic and accurate are the currently adopted British originated outputs within the Nigerian context? Hence, this research work intends to employ work study approach to empirically establish labour outputs of some selected trades with the view of improving the accuracy of construction cost estimates.

1.2 Statement of the Problem

The Nigerian institute of Quantity Surveyors in an attempt to incorporate certain basic features apparent in designs, geographical location and various incursions in construction industry produced the Building and Engineering Standard Method of Measurement (BESMM) to be used for Nigerian construction industry. It is expected that outputs for trade in the Nigerian construction industry conform to work items of the BESMM. The output constants being used for preparation of construction work estimates in Nigeria are not in conformity with the work items in BESMM rather remnants of British colonial heritage or output derived from experience of the estimators are being used. Previous researches carried out on empirical determination of labour output for surface finishes (floor and tiles) did not consider the work items as outlined in the BESMM3

1.3 Justification of the Study

The floor and tile finishes are of various forms, components and thicknesses which influence distinct work items as stated in BESMM and operational in construction site. It also implies that the outputs of the operatives relate to the work items and there are no reliable reference handbooks and manuals of output constants specifically to Nigerian building industry to estimate the required resources and time to control projects. It is also emphasized that an estimator will price work quicker if constant labour rates are used for several months (Brook, 2010). In this research, due to the importance of determining a reliable labour output constants in building industry, labour productivity for floor and tile finishes and factors influencing their reliability in the building construction in Nigeria has to be investigated. The operative output constants can be used by construction estimators

and planners for planning, estimating, and controlling the project activities and also be used for management functions (Yates and Swagata, 1993)

1.4 Aim and Objectives

1.4.1 Aims

The aim of this study is to empirically determine the output for floor screed and tile finishes in the Nigerian construction industry with a view to improving the accuracy of the construction cost estimates.

1.4.2 Objectives

The specific objectives were:

i. To identify factors and operations affecting floor and tile finishes

ii. To analyze the effect of productivity factors on labour output.

iii. To empirically determine the labour outputs of five selected floor and tile finishes work items.

1.5 Research Hypotheses

In order to achieve some of the objectives of this research, inferential test was conducted to determine the influence of the labour productivity factors on the labour outputs established. Hence, the following null hypotheses are posited in terms of workers output and productivity factors:

H_0 1: There is no difference in outputs among the various age groups of workers observed on site.

H_0 2: Levels of education does not have impact on outputs of workers observed on site.

H_0 3: The mode of employment has no impact on outputs of workers observed on site.

H_0 4: There is no difference in outputs among years of experience groups of workers observed on site.

H_0 5: There is no significant difference in outputs between changes in period of observation on site.

1.6 Scope and Limitation

i. This research focused on empirical determination of labour output for floor and tile finishes.

ii. The study focused on the following work items; 44mm and 25mm thick floor screed finishes and 600 x 300mm, 400 x 400mm and 300 x 300mm size floor tile finishes as identified in the BESMM.

iii. The study focused on time study aimed at establishing the time for a qualified worker/operative to carry out a task.

1.6.1 Limitation of the Study

i. The difficulty in assessing whether a worker is operating in full and natural capacity or not during the period of observations might affect the outcome of the findings

ii. The thicknesses of floor screed are not uniformly conformed to the studied thickness which might affect the outcome of the findings.

1.7 Basic Assumptions

i. The backgrounds of floor finishes are the same.

ii. The different mixes have no effect on the outcome.

CHAPTER TWO

2.0 LITERATURE REVIEW

2.1 Construction Industry in Nigeria

The construction industry structured in Nigeria evolved from the Public Works Department (PWD) which metamorphosed into the Federal Ministry of Housing and Urban Development. The major client of the industry is the Federal, State and Local government awarding 70 percent of construction work. The remaining 30 percent of construction works is awarded by private sector (Seeley, 1996). Accordingly, the economy of any nation depends on the quantities of construction that is going on. Over the years, government has a crucial role in determining demand for the construction for the construction industry output and its growth prospect, because public authorities buy about one-half of its output and because general economic measures have a powerful influence on the demand for private housing and industrial and commercial building. A steading, rather than widely fluctuating growth of demand is particularly important for the industry if it is to plan its work ahead, make sure of adequate supplies and deploy its resources efficiently.

In Nigeria, like most developing countries, the construction industry plays a dominant role in the economic activities of the country. According to CBN (2009) cited in Abdullahi et.al, (2010) the construction industry still accounts for about 70 percent of the fixed capital investment; its contribution to the national economy in recent years has reduced to just about 3 percent of the GDP. Furthermore, Husseini (1991) stated that the construction industry contributed about half of the stock of fixed capital investment opportunities which place it second to the government in the employment of labour.

All over the world and most especially in developing countries such as Nigeria, the construction industry is characterized by reported delays and cost overruns due to lack of adequate and accurate cost information. It has been bedeviled by myriad of problems ranging from prohibitive cost of construction and actual construction period and leading to outright abandonment of projects (Olatunji *et. al.,* 2000). Productivity is one of the most important factors affecting the overall performance of any organization whether large or small. The construction sector has a strategic role in developed and developing countries. Productivity improvement in the construction industry may have a significant impact on improving GDP. Since economic progress depends upon the investment of the capital for the future production, the rate of construction activity has a significant effect upon the economic health of the nation and its future growth. This implies that when the economy booms the construction industry also flourishes (Enshassi *et al.*, 2007).

2.2 Selected Standards Used in Nigerian Construction Industry

It is worthy of note that the influence of the colonization still has impact on the national activities both in the construction industry. This inferred that virtually all standards used in Nigerian construction industry are of British adopted standard;

The Standard Form of Contract (SFC): JCT (1963; 1967; 1980; 1984; 2005 and 2007) are used for building procurement and administration in building industry while ICE (1973) is used for civil engineering works. However, Nigeria published contract Standard to be used for contract procurement and administration for construction works. The Standard Form of Building Contract in Nigeria (SFBCN1990).

The Standard Method of Measurement (SMM): This is used for both buildings works and civil engineering works. These are measurement standards to provide the uniform basis for

measurement and evaluation of construction works and associated trades. There are several editions for both building and civil engineering measurement published by the Royal Institution of Chartered Surveyors (RICS) and the Institution of Civil Engineers (ICE) respectively. These documents have been British Standards until in 1988, Nigerian Institution of Quantity Surveyor (NIQS) published an adopted standard from the British based-standard, the first edition of SMM was published in 1996, this edition was reproduced to suit Nigerian culture and method of construction and then later metamorphosed into Building and Engineering Standard Method of Measurement (BESMM) in 2003 and reproduced 2008 to be using for both building and civil engineering works. The standard has become universally accepted in the tertiary institutions of higher learning and practicing Quantity Surveyors for preparation of BOQ for construction works.

British Standard (BS): There are publications issued by British Standard Institutions. BS set out minimum performance standards which goods and services must conform to. These recommendations are not legally enforceable, but the building regulations referred to some and accept them as deemed to satisfy minimum provision (Bamisile, 2004). The requirements and expectations of this standard are covered in the Standard Organization of Nigeria (SON).

Building Codes of Practice (CP): As relate to building, CP as it is called in the UK, gives recommendation for good practice in relation to design, manufacture, construction installation and maintenance of buildings and building material. This recommendation for good practice is also aimed to be covered in the proposed Draft National Building Code. The aim is to provide the minimum standards to safeguard life and property effectively,

regulating the process of design, approval, construction, use, occupancy location and maintenance of all buildings, structures taking into consideration the tradition and culture, as well as the technological and economical circumstance in Nigeria (Bamisile, 2004).

2.3 Development of Labour Productivity Standard

There are essentially two alternative means of developing work standards. A productivity work standard can be established by using historical accounting data or by analyzing a work process and then developing a scientific standard engineering standard. More often then not, the construction firm and the estimator have utilized accounting based standards. The process of developing an accounting standard is relatively simple. The estimator merely collects labour time card data regarding labour hours expended in a given time period and measures the work put in place during the same time period. The theory behind the structuring and use of historical accounting based data for estimating future projects is based on mathematics, the science of members. In particular, with the mathematical discipline referred to as statistics, it can be proved that the more data one collects regarding the occurrence of an event such as the productivity of a work process, the more reliable the cumulative data is in regard to predicting a future event. Obviously this statement is only true if in fact the observed events or work processes are similar to future events or work process (Adrian 1982).The critic of labour productivity work standards structured from past accounting data draws attention to four potential weaknesses underlying these standards.

First, it might be argued that a construction contractor never builds the exact construction work process under the exact working conditions more than once due to some attributed reasons; labour crew may change; nature planning work in progress, degree of supervision,

variation in weather such as rain, temperature etc. The difficulty of an accounting standard being or not being indicative of a future event is related to the details used to define the cost object or work item that is being measured. Therefore, the degree of details in defining productivity standards dictates to same degree their reliability in predicting future events.

Secondly, the data and resulting standards may not be current. The very time that it takes to collect, process and structure job-site accounting data may sometimes result in the data being outdated before it is available for estimating future work. In effect, as the industry now operates, labour productivity timeliness problem with data is lessened for construction estimating. Third, standard based on accounting data are only as good as the accuracy of the data itself. The construction process is decentralized from the comparing headquarters. While the construction firm may be headquartered in one city, it may construct project within a large geographic area including several cities and towns. The natural difficulties encountered when production personal have to collect accurate job site data can be lessened by development of a reliable and mandatory job – site cost system that includes data collection procedures. Fourth, for the fact that productivity by inefficiencies have become the 'norm' or accepted standard, it has been indicated that as much as 45% of total time for a construction work process is non – productive. This is because accounting based standards in effect use averages of non – productive and productive time to establish the standard, they do not indicate the potential, a contractor might achieve in terms of productivity instead, and they represent what has been achieved, including historical productivity inefficiencies. In effect on efficiencies inevitably become the standard for future estimating. Given the fact that there is evidence that the above is true that a firm's ability to increase productivity depends to some degree on the ability to set an attainable

standard – unrealistically low standard setting might be the most valid criticism of accounting – based standards for construction productivity. Nevertheless, too much realism may be one of the significant reasons for the low productivity that is characteristic of the construction industry.

An alternative to an accounting – based productivity standard is a scientific or engineering – based standard (work study). Such a standard is developed by "modeling" the work process and analyzing the potential output as a function of the work input of the resources that contribute to the work process (Adrian, 1982)

2.4 Finishing Construction

Finishing works is a fine job in building construction process where it forms the beauty of a building. Several types of finishes can be used based on the materials used, environmental conditions and costs. Finishing of a building can be divided into several sections:

Floor finishing;

Wall finishing;

Ceiling finishing;

2.4.1 Floor Finishing

Screeding a floor is the simple act of applying a well-blended mixture of Ordinary Portland Cement with graded aggregates and water to a floor base, in order to form a sturdy sub-floor that is capable of taking on the final floor finish or act as a final wearing surface. Nonetheless, as simple as this process might sound, there is a lot more to screeding than

trowelling on the cement sand mixture. It is one of the most vital steps in flooring that plays a major role in ensuring the quality, finish and durability of the entire flooring.

Traditional floor screed basically consists of sand and cement mixed at a ratio of between 3 to 5 parts sand and1 part cement. In the majority of cases 4 to 1 is quite sufficient. In the past reinforcement was achieved by using Hex wire (chicken wire) or D49 mesh. In the early 90's Polypropylene Fibres (PPF) started to become very popular, and today PPF is the most common used reinforcement for traditional floor screed. Traditional screed drying times vary according to the weather conditions, depth and manufacturers admixtures used.

Laying: Traditional floor screed is applied with a straight-edge, wooden / plastic float and finished with a trowel or power float. The basics are to find four level points, level between two with the straight-edge, level between the opposite two, and pull off between the 'screeds' with the straight-edge, to find a flat area. There are three main systems for traditional floor screeding, fully bonded, partially bonded, floating.

Plate 1: Fully bonded Screed

Fully bonded screeds: It need to be laid on a shot-blasted / scabbed concrete base, and be bonded using an adhesive such as PVA, SBR, epoxy resin or good old fashioned cement.

Cement makes a reasonable bonding agent if there is reasonable depth of at least 50mm. A good slurry must be formed using water, and must be brushed in thoroughly and any drying spots must be kept damp as screed is applied. It is always a good idea to damp the concrete slab the day before.

2.4.2 Plastering

Plastering is one of the finishing of the walls. It functions as a: Protect / cover the basic work. Produce a flat surface and neatly. Protect the basic work of the climate action. A cushion to the finishing paint work and laying of tiles. Provide facilities for cleaning. Increase durability to the work of the foundation. Provide comfort and safety to the residents who live in it.

2.4.3 Wall Tile

According to Obande (1985) tile is manufactured piece of hard wearing material such as ceramic , stone, metal or even glass generally used for covering roofs, floors, walls, showers, or other objects such as table tops. Alternatively, tiles can sometimes refer to similar units made from lightweight materials such perlite, wood, and mineral wool, typically used for wall and ceiling application. Tiles are often used to form wall and floor covering and can range from simple square tile to complex mosaics. Tile are most often made of ceramic, typically glazed for internal uses and unglazed for roofing, but other materials are also commonly used such as glass , cork, concrete and other composite material and stone. Ceramic is a mixture of clays that are pressed into shape and fired at high temperature which gives the tile its hardness the bisque or ceramic tiles may be painted and glazed. Small mosaic tiles may be lay to various patterns. Floor tiles are typically set into mortar consisting of sand, cement and often latex additives for extra adhesion. The spaces between the tiles are nowadays traditionally filled with mortar.

2.5 Overview of Surface Finishes Measurement as Relate to Besmm3

BESMM3 under general rules 1.1 states that SMM provides a basis for measuring construction works and embodies the essential of good practices. Bill of quantities shall fully describe and accurately represent the quantity of the works to be carried out. More detailed information than required by these rules shall be given where necessary in order to define the precise nature and extent of the work required. Cement: sand/concrete screeds work is measured under section M 'Surface finishes' as M.10 'Cement: sand/concrete screeds' of BESMM.

The measurement of surface finishes (M) as stated in BESMM involves six different components namely M10 (Cement: sand/concrete screeds/toppings); M12 (Trowelled/bitumen/resin/rubber-latex flooring); M13 (Calcium surface based screeds); M20 (Plastered/Rendered/Roughcast coatings); M23 (Resin bound mineral coatings) and J10 (Specialist waterproof rendering) of the same measuring descriptive features while M40 (Stone/Concrete/Quarry/Ceramic tilling/ Mosaic) and the measuring descriptive features is different from the one stated above. However, the measurement procedures and construction techniques as regards to the quantity of work may be the same, and the construction intricacies are quite different especially as the component composition varies significantly. This also implies that the productivity requirement varies. For instance, the thickness of sand screed floor of 25mm and 44 mm of M10 is not the same, also the various sizes of tiles influences the output of the operatives It is imperatives that the estimators take cognizance of productivity consideration as they prepare their estimates. It also suffice to say in as much as the SMM/BESMM take cognizance of the intricacies, the construction cost implication should as well take cognizance of the effect too. The

following information provided for the measurement of M10 and M40 are relevant for mason and tillers productivity:

- The information that is shown either on location drawing under 'A' Preliminaries/ General/ Items or on further drawings which accompany the bills of quantities;
- Plans of each floor and principal sections showing the position of and the materials used in the walls.
- The description rules require the thickness of screed be stated and be measured in square meter

2.6 Productivity and Construction Estimating

An accurate evaluation of productivity is the intermediate step between establishing the work to be performed for a construction project and establishing the cost of performing that work. Three elements are vital to an accurate estimate (Adrian, 1982).

i. Determination of the quantity of work,

ii. Identification of productivity needed to perform the work,

iii. Calculation of the unit cost of the resources to be used for the work.

The second, productivity is the element most subject to uncertainty sources over a relatively short time period is ordinary stable. Nevertheless, given the wide variation in the productivity of the resources that are part of the construction production process, the forecasting or estimating of productivity is undoubtedly the leading risk factor in construction estimates.

Productivity of construction producing resources to include labour and equipment is dependent on numerous factors. It is the estimator's ability to identify the many factors that impact productivity that is great part dictates the accuracy of a construction estimate.

Clearly an understanding of productivity including its forecasting and measuring and the contractor's ability to improve productivity both affect the preparation of a construction estimate.

Knowledge of alternative production system and their related productivity also affect the preparation of a construction estimates and subsequently profit or (loss) the contractor obtains from performing the work. The recognition of alternative means and methods for performing specific types of construction work emphasized the need for a strong relationship and communication channel between estimating and the actual production process. An estimator cannot accurately prepare a cost estimate for work unless he understands the means and method utilized in the field for that work (Adrian, 1982)

2.7 Factors Affecting Construction Labour Productivity

The factors influencing construction productivity have been the subject of inquiry by many researchers. In order to improve productivity, a study of the factors affecting it, whether positive or negative is necessary. Making use of those factors that positively affect productivity and eliminating (or controlling) factors that have a negative effect will ultimately improve productivity (Adnan et al, 2007). If all factors influencing productivity are known, it will also be possible to forecast productivity (Lema, 1995; cited in Adnan et al, 2007). Several researchers have investigated the factors affecting labour productivity (Adnan *et al.,* 2007), but despite such intensive investigations, researchers have not agreed on a universal set of factors with significant influence on productivity; or any agreement has not been reached on the classification of these factors (Adnan *et al*, 2007)

Several approaches have been adopted in relation to this classification of factors affecting construction productivity. Ayandele (1999) stated that in ordinary situations two major sets

of factors affect the site labour productivity requirements; organizational continuity and execution continuity. Organizational continuity encompasses physical components of work, specification requirements, design details etc. Execution continuity relates to work environment and how effectively a job is organized and managed. Management aspects include weather material and equipment availability, congestion and out of sequence work. Adnan *et al.* (2007) classified factors affecting construction productivity into two main groups: technological factors and administrative factors. The technological factors encompass those related mostly to the design of the project; the administrative group factors relate to the management and construction of the project. The administrative factors compose sub-groups, such as construction methods and procedural factors, equipment, labour factors and social factors. Also, the technological factors comprise of sub-groups, such as design factors, material factors and location factors.

Lim and Alum, (1995) studied factors affecting productivity in construction industry in Singapore. Their findings indicated that the most important problem affecting productivity were: difficulty with recruitment of supervisors, difficulty with recruitment of workers; high rate of labour turnover; absenteeism from the work site, and communication problems with foreign worker. Olomolaiye *et al*. (1996) cited in Adnan *et al.* (2007) studied factors affecting productivity of craftsmen in Indonesia, with their findings indicating that craftsmen in Indonesia spent 75% of their time working productivity. Five specific productivity problems were identified; i.e. lack of materials, rework, absenteeism, lack of equipment and tools.

Heizer and Render (1999) classified factors influencing site productivity into 3 groups: labour characteristics factors, project work conditions factors; and nonproductive activities. Olomolaiye *et al.* (1998) in Adnan (2007) observed that factors affecting construction productivity are rarely constant and may vary from one country to another, from project to project, and even within the same project, depending on circumstances. The other set of principal elements or factors affecting the productive capacity of labour, according to Oloko (1983) in another research are the skill of the worker (technical and attitudinal) , his innate ability – his physical and mental energy and the intensity of the application of both, his skill and organic ability to the production process.

The above factors according to Oloko (1983) further stated that the American Studies of Labour productivity broadly categorized the factors into three (i) factors in the employment situation (ii) factors in the individual which are mostly concerned with his personality system and (iii) factors in life outside the employment situation. Also, Ayandele, (1999) articulates these productivity factors, relating to human factors (or production) as;

i. Labour management relations
ii. Social and Psychological conditions of work
iii. Wage incentives
iv. Acceptability to, and liking for the job

Shifts, preferences and biases to mention but a few

Thomas (1991) and Bain (1982) identified the following factors as having influence on productivity of construction workers and described them as principal elements:

i. Type, scope, layout and complexity
ii. Time frame (percentage complete)

iii. Construction methods

iv. Weather

v. Skill of workforce

vi. Work practices

vii. Length of work day

viii. Incentives

ix. Availability of materials

x. Degree of supervision

xi. Enabling environment

xii. Covering regulations

xiii. Organizational size and maturity

xiv. Physical fatique

xv. Composition (age, sex, skill and training) of the labour force

xvi. Organisation of the spirit and emulation in production

xvii. Trade union practices

Ameh and Odunsami (2002) viewed the primary factor determining labour's output as work rate delays and waiting caused by poor management. On the other hand, Odeyinka and Yusif (1997) reported that a significant relationship exists between productivity and construction planning on one hand and organizational structure of a building firm on the other hand. Koehn (1986) in Yates and Swagata (1993) observed that productivity is related in part to management (Proper planning, realistic scheduling, adequate coordinating and suitable control; labour (union agreement, restrictive work practices, absenteeism turnover, delays, availability level of skilled artisans, and use of equipment); government

(regulations, social characteristics, environmental roles, climate and political ramifications), contracts (fixed price, unit cost and cost plus fixed price), owner characteristic and financing. Hence to improve productivity these factors must be considered. Maloney (1983) believes that the level of labour productivity is as a result of the driving, induced and restraining forces acting upon the workers and that those factors act positively and negatively (e.g. ergonomics). Similarly, Thomas (1991) (cited in Ameh and Odusanmi, 2002) categorizes the major factors that affect both labour productivity and direct work percentages into two groups:

i. Project characteristics, which include weather, construction method, skill of the work force, work practice among others and
ii. Work sampling procedure such as site area.

2.8 Factors Affecting Labour Productivity

It is clear from the above that factors affecting construction productivity are both numerous and diverse. It is nevertheless not exhaustive. It would be unreasonable to assume that it is possible to quantify the effect of each on productivity in a predictable manner since what may be significant in one environment, may be insignificant in another situation. Nevertheless, the literature provides a pool of factors that may be considered for productivity studies. The following is a summary of factors that have been identified in literature;

i. Lack of materials in local market;
ii. Worker absenteeism at work site;
iii. Using motivation system;

iv. Lack of tools;

v. Delays in materials deliveries to working site;

vi. Labour skill;

vii. Area of work site;

viii. Gang size;

ix. Disruption of power/ water supplies;

x. Rework;

xi. Interference;

xii. Supervisors absenteeism;

xiii. Climate conditions;

xiv. Accidents;

xv. Management practices;

xvi. Labour age;

xvii. Safety; and

xviii. Job size and complexity.

2.9 Previously Related Works on Labour Outputs Determination

Even though extraneous and extensive search were made on previous work on this area, all efforts were almost fruitless because none found compliance to BESMM/SMM. The investigations are as follows:

Lawal (2012) carried out a study to determine the daily productivity of mason on interlocking tiling in building sites in Zaria and recommended A gang of 2 skilled and 1

unskilled labour should cover a minimum of 81.01m^2 of interlocking tiling per day. However, the thicknesses and sizes of the tiles are not distinctly specified. Gide (2011) conducted a study on empirically establish labour outputs of cement and sand screeding, and terrazzo floor finish for the Nigerian Construction Industry in Katsina State. Based on the findings of this research, a mason should cover a minimum of 34m^2 of cement and sand screed per day and 31$m^2$of terrazzo per day. Also, the thicknesses and sizes are not distinctly specified. Jamilu (2012) conducted research using work study approach to empirically establish labour outputs for fixing suspended gypsum acoustic ceiling and hard board ceiling for the Nigerian construction industry in Zaria of Kaduna state. The results established general average output values per day of; 118.5m^2 and 119 gypsum acoustic ceiling and hard board ceiling works respectively. Considerations were not given to the sizes, operative features, etc. which have impact on the outputs of the workers. Abdulrazaq *et al*. (2010) conducted research on determining labour output on form work for construction projects in Kaduna metropolitan town based on work study technique and the research revealed an output per gang at 153.97m for formwork to sides of column and slabs and 30.91m^2 to soffits of slab and beam. Abdullahi (2009) conducted a research on determination of labour outputs for the Nigeria construction industry (a case of Kaduna metropolitan city). The research aimed at using work study approach; to empirically establish labour output for trench excavation, 225 block work and plastering/rendering. Considering the construction productivity influencing factors the result of the analysis carried out, established general average output per day at 19m^3, 10m^3 and 30m^2 for excavation, block laying and plastering/rendering respectively.

Udegbe (2007) conducted research determining labour output on painting activity in the construction industry in Edo State, Nigeria. The study aimed at identifying factors that can affect painting activity output in building construction. The researcher concluded that painting should cover a minimum surface area of $76m^2$ per day. Udegbe (2007) conducted a 10 years extensive quantitative research on the trends and patterns of the productivity level of plasterers. The research covered all the 18 local governments of Edo State. Accurate work measurement technique method was used in establishing all the outputs used for the study. Udegbe (2007) observed a very significant decline in output over the years which the likely causes according to his research were attributed to labour tactics and economy. The results of the research revealed an average output/day of $37.01m^2$over the years and recommended a minimum of $36m^2$ of wall surface a day. Ajia (2002) conducted a research appraising labour outputs and workers' productivity on site. The research was a 2 fold type consisting of field surveys and physical observations in Zaria and Ilorin. The operations observed were concreting and blockwork. Similarly, work measurement technique was used for the physical observations carried out. Standard time study sheets were prepared and used to collecting relevant data. Work operations were broken into elements and each element was observed and time was recorded. The aggregate observed time was used to determine the basic and standard times of the operation. Ajia (2002) further concluded that gang formations were inadequate for all trades on all the sites investigated and that is likely to affect productivity. While Udegbe's work (2005) tried to capture some of the productivity influencing factors in establishing the output constants, Ajia (2002) did not consider any of the factors and in fact was too general and unspecific. However, Ameh and Odunsami (2004), Adnan et al (2002) in their productivity studies

concluded that every productivity value is hinged to surrounding circumstances and factors which is a subject of among other geographical locations. Both researches made use of similar methodologies using time study sheets for physical observations of workers as work progresses on the sites. However, Ajia (2002) subjected his work to so much level of subjectivity trying to accommodate contingency time in form of relaxation allowance into the standard time of an activity.

The established outputs of these researchers are at variance to currently use British based outputs and the measurement factor are not in compliance to BESMM, consequently this formed the basis to challenge the reliability, the accuracy and the application of the British labour output constant being used for preparation of cost estimates for construction projects in Nigeria (Ajia 2002; Udegbe, 2007; Abdullahi, 2009 and Abdulrazaq *et al.*, 2010).

2.9.1 Work Study

Work study has a very long and respectable history stretching back to the eighteenth century with a number of people associated with early management thought and studies – F.W. Taylor, Charles Bedaux, Frank and LilianGilbreth, for example – as pioneers in the field (Pilcher, 1997). More recently, management consultants in many fields have used work study as a basis for consulting studies in a production environment (Pilcher, 1997) and in recent years both its application and success have fluctuated (like many other of the newer techniques) pending on its proper understanding in the varied and diverse conditions under which construction is carried out (Foster *et al.,* 1991). Work study is a very important tool in productivity improvement in industrial organizations, especially if the company wants to survive and cope with the present day marked competitions and

inflations (Anyanwu, 1985). It is therefore being employed extensively as a management tool to achieve higher productivity in any organization whether manufacturing tangible products or offering services to customers. Therefore, Gregson (1993) asserted that work study contributes immeasurably to the search for better method and the effective utilization of this management tool helps in the accomplishment of higher productivity.

2.9.2 Definition of Work Study

Like many terms used in the construction industry, many meanings have been given to work study with a very large consensus between different authors. Cole (1996) defined work study as a generic term used for those techniques particularly method study and work measurement which are used in the examination of human work in all its contexts, and which systematically leads to the investigations of all the factors which affect the efficiency and economy of the situation being reviewed in order to effect improvement. Hartzell (2006) in the dictionary of management described work study as a set of techniques including work measurement which analyses a given area of work to see whether performance can be made more efficient and economical. And it is based on the scientific management approach to the study of the organization. Work study is defined in BS 3138 (1969) as a term describing several techniques for examining work in all its contexts, in particular those factors affecting economy and efficiency, with the view to making improvement. In addition, Barnes (1980) in Ajia (2002) described work study as a body of knowledge concerned with the analysis of work methods and the equipment used in performing a job, the design of an optimum work method and the standardization of proposed work methods. Therefore, the central objective of all the definitions and meanings given to work study is the central objective of improving productivity at reduced costs, as well as to determine the best or most effective method of accomplishing a necessary operation or function of the method.

2.9.3 Objectives of Work Study

The objectives of every work study as pointed out by Barnes (1980) in Ajia (2002) are as follows:

i. To analyze the present method of doing a job systematically in order to develop a new better method.

ii. To measure the work content of a job by measuring time required to do the job for a qualified worker and hence to establish standard time.

iii. To increase productivity by ensuring the best use of human, machine and material resources and to achieve best quality product services at minimum possible cost.

iv. To improve operational efficiency.

2.9.4 Benefits of Work Study

Barnes (1980) and Bulter (1988) enumerated the following as the derivable benefits of employing work study in productivity improvement.

i. Increased productivity and operational efficiency.

ii. Reduced manufacturing cost.

iii. Improved work place layout

iv. Better manpower planning and capacity planning

v. Fair wages to employees

vi. Better working conditions to employees

vii. Improved work flow

viii. Reduced material handling costs

ix. Provides standard of performance to measure labour efficiency

x. Better industrial relations and employee morale

xi. Provides basis for sound incentive schemes

xii. Better job satisfaction for employees

xiii. To increase profit margin

xiv. To ensure security for operative

xv. To reduce wastage

xvi. To cut out delays

xvii. To produce a more efficient organization

xviii. To lay down objective training

2.9.5 Work Study Techniques

The two most commonly work study techniques are (Cole, 1996);

i. Method study

ii. Work measurement

These two basic techniques are complimentary to each other (Cole, 1996; Pilcher, 1997) and are rarely utilized in isolation from each other. Cole (1996) further added that even though either of these techniques can be applied to problem solving without the other, best values and results are obtained by carefully combining the two together. Cole (1996) further argued that the usual and best practice is that a method study to precede a work measurement. The observer should critically select and examine methods first before studying their established time at defined level of performance.

2.9.6 Method Study

Method study is defined in BS3138 (1969) as; The systematic recording and critical examination of the factors and resources involved in existing and proposed ways of doing a work, as a means of developing and applying easier and more effective methods and reducing costs.

According to Cole (1996) method study is composed of the collection of techniques, all of which systematically examine and record all the methods utilized in an operation with a view to increasing efficiency. It attempts to answer the questions what? When? How? Who? and where?

The main objective of a method study technique is to see whether a job is being performed in the most efficient and economical manner (Cole, 1996, Pilcher, 1997; Barnes 1980, Foster *et al.,* 1991). Pilcher (1997) added that method study is objectively concerned with obtaining higher productivity by improving methods of production. And if properly used would result to higher productivity through an improved production facility layout, a better environment for work, reduction of danger for fatigue, improved quality of work and better plant and equipment design.

2.9.7 Work Measurement

This is another technique of work study which involves the application of a number of techniques to cover the time taken to carry out a task. B.S. 3135 (1969) defines, work measurement as the application of the techniques designed to establish the time for a qualified worker to carry out a task at a defined level of performance. However, Gagnon (2000) submitted that a qualified worker is one who is accepted as having the necessary physical attributes, possessing the required intelligence and education and having acquired the necessary skill and knowledge to carry out the work in hand to satisfying standards of safety, quantity and quality. Cole (1996) defined work measurement as the collection of techniques, particularly time study, aimed at establishing the time taken by a qualified worker to complete a specific job at a defined level of performance. Work Measurement program sets to answer the questions how long? and when? (Cole, 1999). Hartzell (2006)

in the dictionary of management described work measurement as an integral part of the work study process in which a variety of subjective methods like work sampling are used to fix a standard time for the acceptable performance of a given task by a trained worker. Therefore, based on the above definitions, work measurement generally entails the determination of standard job which is used as a vital input towards improving organizational productivity. Managers through work measurement techniques measure the times needed for specific tasks, essential information for planning and estimating, which helps in measuring performance at different times during construction (Ajia, 2002). The objectives of work measurement are summarized as follows (Dlakwa, 1985);

i. To assist in method study
ii. To assist in cost control
iii. To assist in implementing total quality management.
iv. To assist in planning and scheduling of labour, plant and materials.
v. To provide a basis for incentive schemes.
vi. To assist in measuring the performance of skilled labourers.
vii. To compare different methods of working.

Not all jobs could be measured or examined by work measurement; especially where value is put as the prime objective. Lawrence (1992) enumerated certain criteria which must be met for work to be measured by measurement;

i. The work must be such that, when carried out by different people or plant, it is performed in the same way and under similar conditions.
ii. The workers who carry out the work must have necessary skills and be experienced in the particular operations. As measuring the time it takes for an inexperienced

worker, albeit a skilled one to complete a task would be of little value as once the worker that becomes adapted to the work, it would be performed much more quickly.

iii. In work situations whereby overall performance is improved by teamwork (i.e. where individuals ability to perform a particular task to a specified standard is less important than the combined ability of the team). In this kind of situation work measures should not be used to compare the performance of individuals but still has a place in determining standard times for an operation.

2.9.8 Procedure of Work Measurement

The general purpose of a work measurement program is to collect real data about actual events (Cole, 1996) and such collection process undergoes a number of stages termed as work measurement procedure (Barnes, 1980). Even though, the major stages of work measurement differ depending on the nature and degree of analysis, nature and level of data collection and measurement, and the nature of the synthesis process, all work measurement systems are based on the same simple procedure (NIM, 2009);

i. Analysis
ii. Data collection and measurement
iii. Synthesis

Analysis Stage: Before the measurement begins the task to be measured is analyzed and broken down into convenient parts that are suitable for the chosen measurement techniques. The purpose of the measurement technique is to derive a “basic time” for each of these activities, elements or motions.

Measurement Stage: At the measurement stage it is necessary to collect descriptive or qualitative data on the nature of the task, the conditions under which it is performed and other factors which may have bearing on the time that the task takes to be completed. However, when repetitive jobs are measured data are collected over a number of representative cycles of a job to obtain a "mean" or "typical" value. Analysis of the result can be done using statistical techniques to determine the number of observations that must be made to provide a given level of confidence in the final results. According to Olomolaye (1990), with the knowledge of how workers spend their day and their actual production output, it become possible to have scientifically based measures of the rate of production, percentage productivity time, percentage unproductivity time, percentage auxiliary and percentage supervision time as shown in the figure chart below.

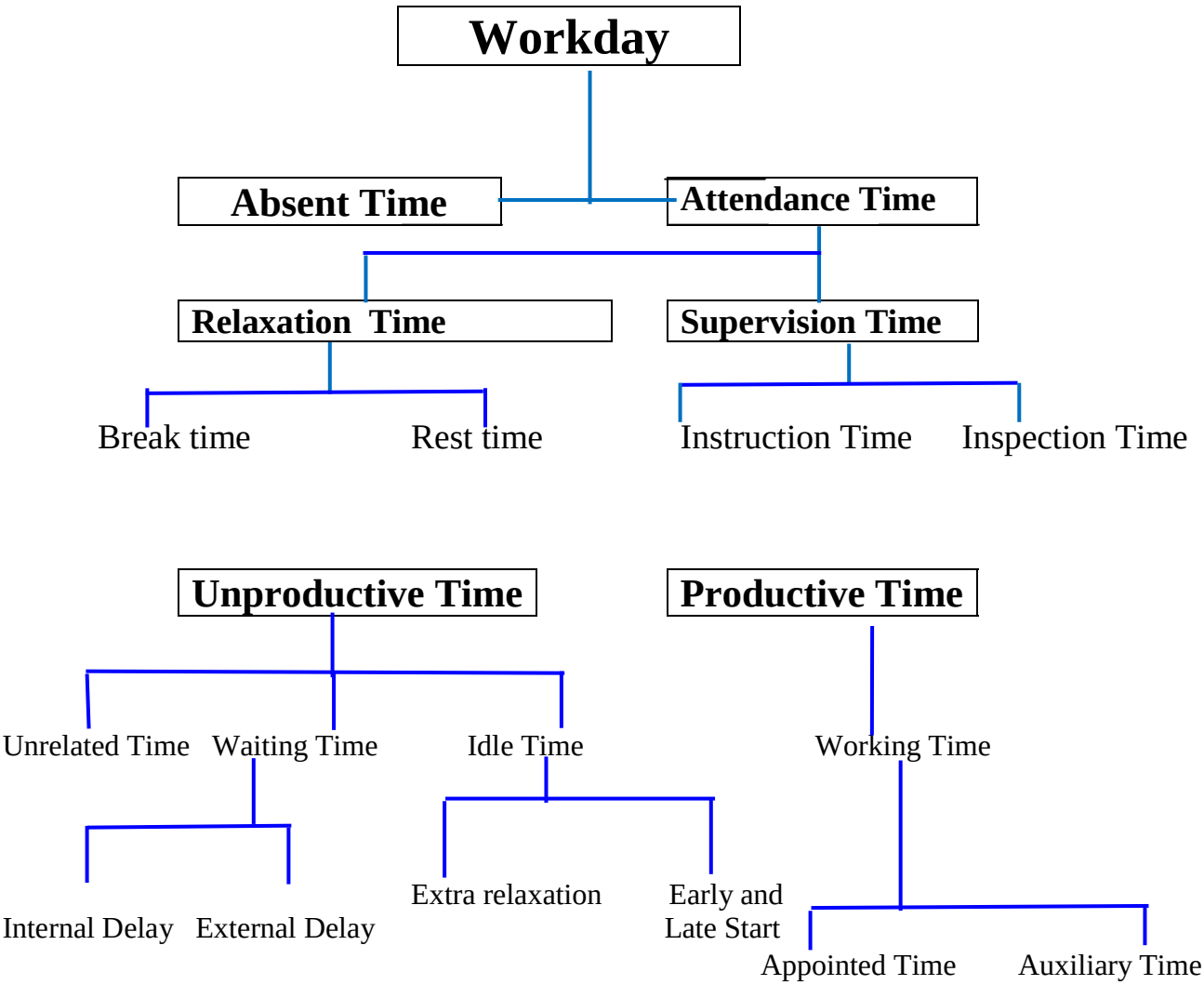

Figure 1: Classification of construction working day

Source: Field Survey, 2013

Synthesis Stage: At this stage the various parts of the task and their associated basic time are combined together in correct sequence and with correct frequency to produce time for a complete job. During this stage, the basic time will be adjusted for allowances to become the standard time for the task. However Cole (1996) in his book management theory described work measurement procedure using the model shown in fig. 2.2 below to measure and assesses the performance of people. The aim is to measure, or assesses, the performance of people.

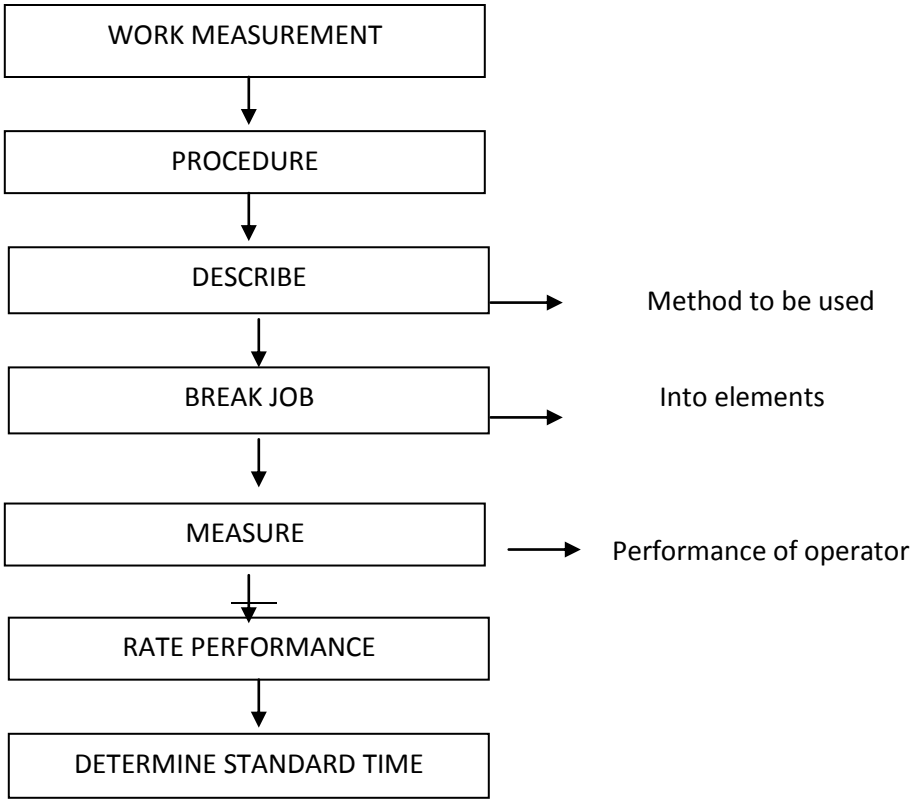

Figure 2: Work Measurement Outline

Source: Cole (1999)

Moreover, Culvert (1981) in Ajia (2003) outlined five (5) steps as the general procedure of work measurement;

i. Select the work to be measured

ii. Define the method being used and the job elements

iii. Measure the quantity of work and assess the rating

iv. Calculate the standard time including allowances

v. Compile and issue the allowed time with a job specification.

2.9.9 Work Measurement Techniques

There are various methods and variety of techniques for work measurement (NIM, 2009). Barnes (1980) argued in Ajia (2003) that the commonest work measurement techniques in the construction industry range from the simple timing of actual jobs to various forms of activity sampling synthesis. The most useful techniques of work measurement that have found increasing use in recent years are (Foster et al 1991; Gagnon, 2000, NIM, 2009; Barnes 1980);

i. Time study

ii. Activity sampling

iii. Analytical estimating

iv. Synthesis from standard and synthetic data.

v. History data method

However according to Cole (1996) and Lawrence (1992) work measurement could be classified into;

i. Those that rely on direct observation of the work (directly observation techniques).

ii. Indirect observation techniques i.e those which do not rely on direct time study.

According to Cole (1996) the direct time study involves the direct stop watch time study of the total time elapse of a given task, while the indirect time study is carried out where

times are worked out on paper without observing employees. And the most commonly employed techniques are the;

i. synthetic timing
ii. pre-determined motion time study, and
iii. the analytical estimating.

2.9.10 Time Study

The term "Time Study" as a work measurement technique is one of the ways to study the time required to perform a job. It is the most useful form of work measurement used in the building industry, for determining the standard time, since it embraces all other methods of work measurement (Dlakwa, 1985 cited in Ajia, 2002). Barnes (1980) defined "Time study" as a technique used for determining as accurately as possible from a limited number of observations, the time necessary to carry out a given activity at a defined standard of performance. This is done by using a stopwatch to record the actual time taken by the worker under observation to perform the elements of the work or task.

The working paper on work measurement of the University of Leeds (1983) in Ajia (2003) defined time study as a technique for recording the time and rates of working for the elements of a specified job carried out under specified conditions and, for analyzing the data so as to obtain the time necessary for carrying out all jobs at a defined level of performance. However, Ajia (2003) defined time study as the basic technique used in measuring work with the aid of a stop watch supplemented by a process of rating or assessing the performance of a person being studied. The procedure for time study involves the following stages (Barnes, 1980 in Ajia, 2002);

i. Timing

ii. Rating

iii. Normalizing

iv. Allowances

2.9.10.1 Timing

This is the actual recording of the time to complete an operation. It is done on the field using a watch. A good wrist watch with a second's hand can suffice for this purpose, but a better and more convenient tools is a stop watch. The operation as described earlier on is broken into elements and the time to do each separate element is recorded. The recording is done on prepared time study sheets.

The most common methods of time according to Lawrence (1993) are;

i. The continuous or cumulative timing

ii. Repetitive or fly back timing

Cumulative timing: Is the most common method used that requires only a wrist watch and time is recorded after each element. Fly back timing: is carried out with a fly back stop watch, with the observer recording the time for each element as work proceeds.

Time study uses continuous snapback approaches to record the elapsed time of a task. The snapback approach requires a stopwatch with reset button that allows the observer to read and record time at end of each work element then reset (snap back) the watch to zero (Lawrence, 1992). Although popular, the study method is subjective and relies heavily on the experience of the time study analyst (Pilcher, 1997) particularly the rating of the performance and the determination of standard time (Cole, 1999). However, Pilcher (1997) submitted that computerization data collection system will provide more accurate timing

than the stopwatch even though the conversion of the actual time to the expected or normal times remains a problem.

2.9.10.2 Rating

This involves the observer (after appropriate training) making an assessment of the workers rate of working relative to the observer's concepts of the rate corresponding to standard rating (Lawrence, 1993). It entails assessing the tempo of work of each operative working (Barnes, 1980) and requires the investigation to rate the employee by describing how quickly or slowly the employee is working compared to standard (Cole, 1996). Lawrence (1993) show that the assessment is based on the factors involved in the work such as effort, dexterity, speed movement and consistency.

Cole (1996) observed that the rating is usually done on the standard rating of 100 in the British Standard 3138 which is equivalent to the average rate at which qualified workers will naturally work at a job, provided they know and adhere to the specified method and provided they are motivated to apply themselves to their work. Thus, if an employee is rated to be working at a slower pace, he may be rated at say so, by comparison an employee adjudged to be working at a faster pace than average may be rated as 115 for example.

In the opinion of Barnes (1980) the weighing of these rating in comparison with the British Standard is given below;

a. 0 = Inactivity
b. 50 = very slow ineffective with no real interest
c. 75 = unhurriedly, but the operator is meaningful and producing a normal rate pay
d. 100 = Standard rate with the operative working at a speed Sufficient to earn up

to 33% bonus on top of normal earnings

e. 150 = exceptionally fast

2.9.10.3 Normalizing

The normal time is the basic time which is the actual time according to the observer taken to finish the job (task) (Cole, 1996) and it is seen by;

$$\text{Normal or Basic time} = \frac{\text{Observed time x observed rating}}{\text{Standard Rating}}$$

The formula above converts the observed time obtained from field work to the actual time taken by an operative working under normal rate.

2.9.10.4 Allowances

Workers carrying out work over a complete shift or working day obviously suffer from fatigue imposed both by the work undertaken and the working conditions. And the normal practice is to make an addition to the basic time (commonly referred to as "allowance") to allow the worker to recover from this fatigue and attend to personal needs (Lawrence, 1993).Therefore, to produce such a realistic standard time for the proper performance of the work, the idle time and relaxation periods observed during the study but excluded is added back as allowances to give the standard time.

Foster *et al*. (1991) and Barnes (1980) in Ajia (2003) showed that there are basically two types of such allowances';

i. Relaxation allowance and

ii. Contingency allowance

2.9.11 Relaxation allowance

Relaxation allowance according to Foster *et al.* (1991) is the time given to a worker to allow him to recover from the effects of fatigue and to attend to personal needs. It is given as a percentage of basic time and as a result of factors like;

i. Energy output
ii. Posture
iii. Motions
iv. Visual fatigue
v. Personal needs
vi. Thermal conditions
vii. Atmospheric conditions such as ventilation, toxic air etc.
viii. Other influences of environment such as dirt, noise, vibration of flows etc.

Foster et al (1991) indicated that relaxation allowances are not expected to be over 30% else, other mechanical aids would have been provided or alternative methods found. However, some exceptional types of works require between 150-200% due to high temperature, excessive humidity, the need for special clothing and respiration. Care should be taken in allocating the relaxation allowance, which is subject to judgments of the work study man.

2.9.12 Contingency Allowance

This is the time given to allow for unforeseen occurrences throughout the day, during this time the worker will not be doing a productive job but will be paying attention to his tools (e.g. a painter cleaning his brushes) (Foster *et al.*, 1991).

Foster *et al.* (1991) suggest that this allowance should not exceed 5% and must be applied only to justifiable case.

Therefore, the adjusted basic time is given as a standard time expressed in the formula below;

Standard time = $\frac{\text{Basic time x 100 x Total \% allowance}}{}$ Expressed in standard minutes

2.9.13 Time Study Equipment

Even though the result is less accurate, the simple equipment used for time study are mainly a stop watch or an electronic timer, or an ordinary watch (Lawrence, 1993). Others enumerated by Ajia (2002) are; time study sheets, a study board in place the sheets, pencil for recording, and calculator for later use in calculating the basic time. Other more complicated equipments given by Barnes (1980) in Ajia (2002) are motion picture cameras and video equipment, electronic data collector computer, mechanical and electrical time recorder.

2.9.14 Selection of Operator to be studied

Before one chooses the operative to be studied, one needs the consent of the foreman, both Barnes and Foster (1991) in Ajia (2002) agreed that anyone with a near normal working speed could be chosen. Ajia (2002) further argued that, although theoretically choosing the slowest or the fastest worker will not make much difference, but it will be more difficult to rate a slow worker. Ideally one should not choose a beginner, because the method or work will be different from when this person has attained greater efficiency through experience in the job.

2.9.15 Activity Sampling

This is another work measurement technique employed in the building industry to determine an estimated period of utilization of plants or operatives and/or the activity levels of the subject under study. Activity sampling as defined by Leeds University working paper (1983) in Ajia (2002) is the technique by which over a period of time, a large number of instantaneous observations are made of a group of machines, methods or operatives. Each observations records what is happening at that instance and the percentage of observations recorded and given by

$$\frac{\text{Number of occasions plant was working}}{\text{Total number of observations}} \times 100$$

According to Seeley (1976) in Ajia, (2002), the technique of activity sampling is based on a principle similar to statistical quality control, in which random samples of work are taken and analyzed to find the number of defectives in a batch. The method consists of selecting a sufficient number of samples from a large group and from making a prediction of the lende. On a site activity sampling can be used (Ajia, 2002);

i. To assess unoccupied time as a basis for analyzing the cause of the ineffective time.
ii. To find the percentage of time spent on each element of work in an operation by each operative and/or machine.
iii. To find the percentage utilization of machines or operatives as basis for cutting down unoccupied time.

Foster *et al.* (1991) further added that activity sampling can be used where difficulties and encountered in site operations, to check if productivity is falling and not going well. Therefore, the basic and main advantage of an activity sampling is the fact that it can be

used to study a larger number of machines or men in one situation than in a continuous time study (Foster *et al.,* 1991). This often results in a broader picture of the efficiency of a particular operation than that obtained from a more limited but continuous study on a smaller group.

CHAPTER THREE

3.0 RESEARCH METHODOLOGY

2.10 Introduction

Ibrahim and Abdullah (2008) referred to research methodology as the way a researcher goes about doing the research, unfolding a particular style and employing different techniques for collection. It therefore follows that research methodology is an expression of detailed research plan to provide an acceptable answers to questions in a logical design procedure and sequence. This chapter depicts every detail of how the research was conducted, that is research design, study population, research sample and sampling techniques, validation and reliability of the instruments used, pilot survey, procedure for data collection, instrument used for data collection, and instrument for data analysis**.**

2.11 Research Design

Research design is an action plan for getting from "here" to "there" where 'here' may be defined as the initial set of questions to answer and there is some set of conclusions (answers) about the questions (Mostafa, 2003). The research design is the logical sequence that connects the empirical data produced by researcher to the study initial research questions and ultimately to its conclusion (El Sawalhi, 2002). The research design for this study is a descriptive form of research design aimed at collecting data for the purpose of describing and interpreting the existing conditions regarding the productivity of workers on sites. It involved the survey of hundred construction sites to identify the operation of ten block work items. This research design method was adopted for this study due to the

nature of the research was purely "quantitative" developed to study the natural phenomena of the productivity level of construction operatives. Therefore, absolute numerical quantitative data were collected through site observation and structural questionnaire and statistically analyzed through deductive approaches to draw conclusions. Research sequence can be presented simply by the chart indicated below.

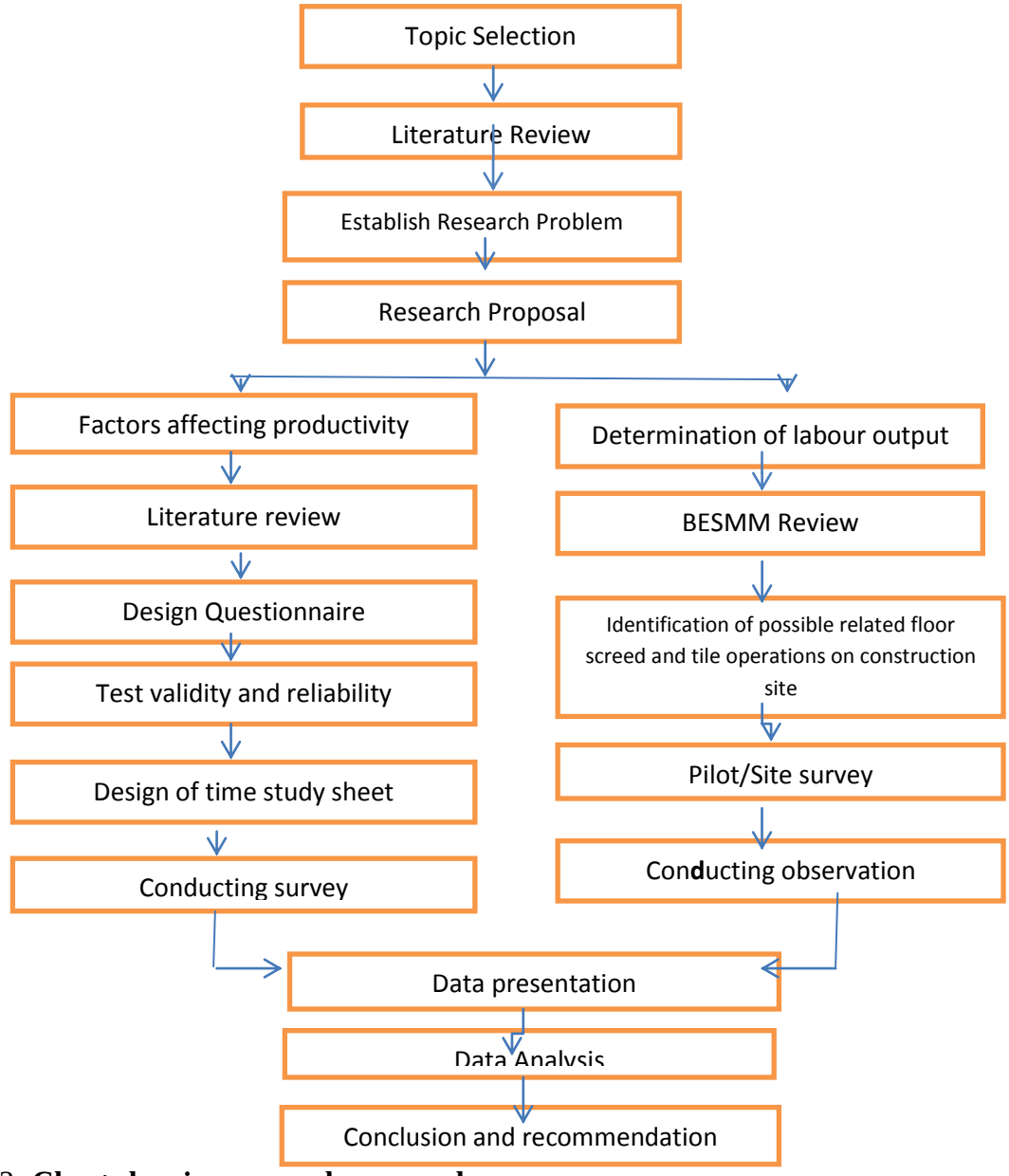

Figure 3**: Chart showing research approach**

2.12 Study Population

The research population is described as ‘all conceivable elements, subjects or observations relating to a particular phenomenon of interest to the research that is, it is a totality of items objects, persons issues or observations who share at least a common attributes or characteristics on which the research is centered (Abdul-Maliq, 2006). The main objective of a study population is to define the scope of the proposed study (Olufemi, 2007). The research population of interest considered in respect to this research study is the “*construction sites*” engaged in floor finishes. These construction sites ranging from small, medium to large constituted mostly of building projects such as residential, industrial and commercial for both public and private owners in Federal Capital Territory (FCT), Abuja. The research also captured the age distribution, gender, educational background, and all other relevant information of the population of interest.

2.13 Research Sample and Sampling Techniques

A sample is a small amount or proportion of total selected to represent the population hence it is impossible for researcher to reach and obtain information from each and every member either due to time or logistic reason. A non-probability sampling method known as *purposive sampling* was strategically adopted in selecting all the construction sites of the study. All the sites were selected on the basis of permission granted by the site managers to have access to their sites for their workers to be observed. The sample characteristics were fully captured as the true representation of the study population (construction sites) as indicated in the Table 3.1 below.

Table 3. 1:Sampling Size of the Study

S/No	Work Items	No of sites
1	25mm thick cement sand screed finishes level and to falls only ≤15 degree from the horizontal	50
2	44mm thick cement sand screed finishes level and to falls only ≤15 degree from the horizontal	50
3	Ceramic floor tile 400 x 400mm size to fall only ≤ 15 degree from horizontal plain	50
4	Ceramic floor tile 600 x 300mm size to fall only ≤ 15 degree from horizontal plain	50
5	Ceramic floor tile 300 x 300mm size to fall only ≤ 15 degree from horizontal plain	50
	TOTAL	250

2.14 Validation and Reliability of the Instrument

To establish quality of any research, the researcher must deal with the validity problem. The validity of an instrument is defined as an integrated evaluative judgment of the degree to which empirical evidence and theoretical rational support the adequacy of inferences and actions based on test scores or other models of measurement (Mostafa, 2003). To improve validity, question should be worded to increase the likelihood that they will mean the same thing to each respondent. Also, interviewing the respondents during the pilot studies enable to determine where questions were unclear or misleading. While reliability concerns the consistency of a measure (Fellow *et al.*, 1999). A question is reliable if it evokes consistent response, that is, a person would answer the questions the same way in the subsequent interviews (Mostafa, 2003). The validity and reliability of the instrument were determined through a pilot survey in some construction sites in FCT, Abuja.

2.15 Pilot Survey

Olufemi (2007) observed that every good research method should undertake a pilot survey which should enable the researcher to test and validate the entire data collection instrument to be used with the view to correcting any weakness, review the questionnaire or any other instrument used by various co-researchers or assistants. For the purpose of this research, it is relative important that the researcher anchored on the review of related trade to floor finishes in BESMM and also possible work items as relate to floor finishes in construction sites.

A list of work items extracted from BESMM as well as those possible work items in the construction site was prepared to survey for their frequencies in 80 construction sites in FCT, Abuja. Adopting a ranking procedure, the five work items occurred in more than 50 sites were chosen for this study

2.16 Procedure for Data Collection

For the purpose of this research work two different methods were adopted for data collections;

2.16.1 Literature review

Literature review assists in the synthesis of results into summary of what is known, and what is not known. It identifies areas of controversy in the literature as a basis for formulating questions for further research (Olufemi, 2007).In this regard, a thorough and extensive literature search of both primary (that is, the knowledge gained during field study, interview etc.) and secondary (journals, articles textbooks, magazine, standard operating document (BESMM), etc.) sources were reviewed purposely to collect relevant theory and information about labour output and productivity influencing factors on

construction sites, current outputs in use both the Nigerian and British originated constants. Similarly, details about work study particularly work measurement techniques were critically reviewed for the purpose of meeting the research.

2.16.2 Field Survey

The quantitative data used for this research work were collected personally from all the construction sites sampled except on a very few restricted and special sites where minimal assistance was obtained. The assistants employed were site foremen or consultants with considerably adequate training and experience. These assistants were well oriented and trained on the research objectives for data collection procedures before embarking for site measurement

2.17 Instrument for Data Collection

The research instrument is the means or item through which information or data was elucidated Depending on the data collection method selected for every research investigation, varieties of data collection instruments are available. According to Abdyl-Maliq, (2006) and Lawal and Adeyeye (2005), the common instruments available include; research questionnaires, interview sheets, observations (study sheets), audio player etc. For the purpose of this study, a well-structured "***Time study sheet***" was the major instrument for data collection. The time study sheet was divided into three different sections; **A, B, C.** Section A compiled data on the general information of the project, sheet No, operative work item location and work item description under observation. Section B encompasses the work measurement aspect of the outputs collection and records; the study No, gang size, starting, stopping, and actual time for morning and afternoon for execution of the work and also depicts morning output, afternoon output and total output while section C

consist of structured closed-ended questionnaire designed to capture all relevant productivity influencing factors as relating to screed and tiling works operatives outputs on site. The six different productivity influencing factors considered for this study as observed by Fagbenle *et al*. (2011); Ameh and Odunsami, (2002) cited in Abdullahi, (2009) and Adnan *et al.*(2007) were; gender, age, mode of employment weather condition, experience of workers.

2.18 Research Procedures

In order to attain the objectives set out for this research work the following steps were taken:

i. The operatives observed were taken unaware; a considerable distance was given from the operatives.

ii. The starting time and starting point of the operatives were noted

iii. A physical measurement of the work output executed was then carried out using simple tools such as tapes. The observed output and finishing time were both recorded.

iv. The actual time taken was calculated by taking the difference between the starting and the finishing time and thus the observed time was recorded. Starting being when the operatives started placing the tiles, starting does not include preparing bases.

v. The observed time was then taken as the basic time which was then transferred to the collation sheet where adjustments were made in the form of contingency allowances for delays and relaxation periods. This was then calculated as a standard time which was considered as the total time taken by an operative to deliver a given output.

vi. The output/unit time was then converted to an hour job and virtually to a day

vii. The quantitative output values were converted into output/day and output/hour. The measure of central tendency was adopted to calculate the average outputs/day.

2.19 Instrument for Data Analysis:

The data collected were subjected to the percentage, descriptive and inferential analysis tools as thus;

2.19.1 Descriptive Statistics

The quantitative output values were converted into output/day and output/hour. The measure of central tendency was adopted to calculate the average outputs/day. measures of dispersion; standard deviation, variance, standard error, and the confidence using SPSS version 21 to describe the extent of the validity and reliability of the descriptive output results.

2.19.2 Inferential analysis

The t-test and ANOVA are parametric instruments used for inferential analysis. The t-test is used to compare the mean of two samples while an analysis of variance (ANOVA) was used when there are more than two variances. A confirmatory test 'Post-hoc' was also run to conspicuously identify where the significance lies on the assessed group factors.

CHAPTER FOUR

3.0 DATA PRESENTATION, ANALYSIS AND DISCUSSION OF RESULTS

3.1 Introduction

The chapter evaluates the output value of workers on general basis setting down five (5) major parameters of the productivity influencing factors of workers on site operations. It is expected that data on the following productivity influencing factors; gender, age of workers, qualification of workers, mode of employment and experience of workers as relate to the operatives outputs were to be recorded. However, data were not recorded for gender of the workers. it was observed that no female operative was found in the 250 numbers of gangs observed as relate to floor and tile finishes .That submits that 100% of the observed workers were male, which indicates the discriminatory nature of the labour construction market. Perhaps location, cultural and religious backgrounds are the basis for that.

The data collected were quantitative records of observed time per day. These observations were done at two different periods; four hours in the morning and three hours in the afternoon. This strengthened the validity of the research results, since researchers have observed obvious deviations between outputs at different time period (Adnan *et al.,* 2002).

The productivity influencing factors recorded in the data presentation were;

Age of Workers: This was aimed at determining the impact of age group on the labour output. The three categories of age groups are age group below 20 years, age group, and range from 20 to 30 years and age group, 36 years and above

Qualification of Workers: the study meant to observe if educational qualification has significant impact on labour productivity apart from the ordinary apprenticeship training

acquired the six classes of educational qualification of workers observed are Primary certificate (FSLC), S.S.C.E, C&G/NABTEB, Diploma (ND) (that related to building construction), NAPTED and Others (workers with no qualifications)

Mode of Employment: The study meant to observe the influence of categories of engagement on productivity of workers. The three categories of workers considered were contract employed workers, negotiated workers and daily paid workers

Experience of Workers: the study also aimed at observing the influence of experience on productivity of workers. Four categories of years of experience were observed operatives below 2 year, Operatives, ranges from 2 to 5 years, Operatives, ranges from 6 to 10 years and Operatives, 11 years and above

3.2 Data Presentation

4.2.1 Observation of Frequencies of Group Productivity Workforce in Construction Site

A total number of two hundred and fifty (250) gang numbers were observed in Abuja for this study. The Table 4.1 presented below are the patterns of the operatives observed;

Table 4. 1:Percentage Distribution of Workforce for Age of Workers and Mode of Employment

	Below 20 years	20 - 35 years	36 years above	Contract employment	Nego workers	Daily paid
25mm thick cement sand screed finishes	10	29	11	11	24	15
44mm thick cement sand screed finishes	7	10	33	8	34	8
Ceramic floor tile 400 x 400mm size	3	14	33	10	10	30
Ceramic floor tile600 x 300mm size	9	27	14	16	14	20
Ceramic floor tile 300 x 300mm size	11	11	28	15	32	3
Total	40	91	119	60	114	76
Grand Total		250			250	
%	16	36.4	47.6	24	45.6	30.4

Table 4. 2:Percentage Distribution of Workforce for Qualification and experience of Workers

	Qualification of Workers					Experience of Workers			
Thickness/Size	PriSch cert	SSCE	C&G/ NABTEB	ND	Others	Below 1 year	2 - 5 years	6 - 10 years	11 years above
25mm thick cement sand screed finishes	9	7	11	16	7	8	27	8	7
44mm thick cement sand screed finishes	20	8	14	4	4	13	12	25	0
Ceramic floor tile 400 x 400mm size	12	8	19	8	3		7	22	21
Ceramic floor tile 600 x 300mm size	19	10	11	7	3	8	23	16	3
Ceramic floor tile 300 x 300mm size	8	5	19	11	7	3	11	29	7
Total	68	38	74	46	24	32	80	100	38
Grand Total			250					250	
%	27.2	15.2	29.6	18.4	9.6	12.8	32	40	15.2

3.3 Discussion

The result shows that 47.6% of the workers observed is predominantly tradesmen of 35 years and above, and 36.4% represents those age group of 25- 35 years. The aforementioned revelation indicated that the sample of workers observed were from strong and matured men of age above 20 years. However, Abdullahi (2009) and Ameh and Odunsami (2002) emphasized that the most productive workers are people within the age group of 20-35 years. It suffices to justify that the 35 years and above dominance could be attributed to highly technically experienced worker required for the finishes work. The Table 4.2 also indicates that 29.6% of the workers observed had C&G/NABTEB certificates and 27.2% had primary certificate showing that these were the predominant educational qualifications commonly found in floor finishes in addition to the apprenticeship training acquired. Therefore, it can be affirmed that the sample observed was a sample of qualified workers, because 90% of the sample had one qualification or the other.

Table 4.2 reveals that 45.6% of the workers observed were negotiated workers followed by 30.4% of daily paid workers indicating that workers prefer being engaged on negotiated to the other types because of self-motivation (Onyeagam, 2014). Also the Table 4.2 shows that 40% of the observed workers had 6-10 years of experience, followed by 32% of workers of 2-5years of experience. However, the table reveals that 87% of the workers observed were of high experience.

3.4 Data Analysis

The basic approaches to this quantitative research are; descriptive and inferential analysis testing as illustrated in this chapter. The data was extracted from the general collation sheet and presented as shown in the Tables below, thus;

i. Output 1: (Morning period of 4 hours duration)

ii. Output 2:(Afternoon period of 3 hours duration)

iii. Total output/day

Table 4.3 below shows different analysis of productivity factor: a one-way analysis of variance (ANOVA) and t-test for 25mm Thick Cement and Sand Screed

Age of Workers: This table shows a one-way analysis of variance for age of workers. It constructs various tests for the 3 different levels of the Group. Since the $P > 0.05$, there is not a statistically significant difference between the mean ages of workers from one level of the Group to another at the 95.0% confidence level. Hence the null hypothesis is accepted.

Mode of employment: the table shows various tests to compare the mean values of mode of employment for the 3 different levels of the group. Since the $P < 0.05$, there is a statistically significant difference between the mean of Contract employment worker and Negotiated worker, Negotiated worker and Daily paid workers at the 95.0% confidence level. Hence the null hypothesis is rejected.

4.3.1 25mm thick cement sand screed finishes level and to falls only ≤15 degree from the horizontal;Gang Size (1 Mason 1, Labourer)

Table 4. 3:Inferential Analysis of Productivity Factors for 25mm Thick Cement and Sand Screed

Productivity Factors	Mean ± SEM	Minimum	Maximum
Age of Workers			
Below 19 years	24.55 ± 1.63	18.00	35.00
19 – 35 years	21.18 ± 1.29	11.00	25.00
36 years and above	23.82 ± 1.11	15.00	41.00
Mode of Employment			
Contract employment worker	22.73 ± 1.09	15.00	31.00
Negotiated worker	27.53 ± 0.91*	19.00	41.00
Daily paid workers	16.67 ± 2.96	11.00	21.00
Qualification of Worker			
Primary sch. Cert	19.13 ± 1.63	11.00	24.00
SSCE	25.60 ± 2.06	21.00	31.00
C&G/NABTEB	24.26 ± 1.44	15.00	41.00
ND	24.55 ± 1.63	18.00	35.00
Others	21.14 ± 1.82	12.00	25.00
Experience of Worker			
≤ 1 year	22.00 ± 0.58	21.00	23.00
2 – 5 years	21.64 ± 1.66	11.00	31.00
6 – 10 years	28.62 ± 0.96	21.00	41.00
≥11 above	32.14 ± 0.86*	29.00	35.00
Output			
Morning(m^2)	14.48 ± 0.59		
Afternoon (m^2)	8.96 ± 0.41[a]		

N=50; *p< 0.05 (ANOVA); [a] p< 0.05 (t-test)

Qualification of Workers: This Table shows various statistics for qualification of worker for each of the 5 levels in the group. The one-way analysis of variance is primarily intended to compare the means of the different levels, listed here under the Mean ± SEM column. Since the $P > 0.05$, there is not a statistically significant difference between the mean qualifications from one level of group to another at the 95.0% confidence level.

Experience of workers: The Table shows various statistics for experience of workers for each of the 4 levels in the group. The one-way analysis of variance is primarily intended to compare the means of the different levels, listed here under the Mean ± SEM column. Since the $P < 0.05$, there is a statistically significant difference between the mean of ≤ 1 year and ≥11 above, 2 – 5 years and 6 – 10 years, 2 – 5 years and ≥11 above at the 95.0% confidence level.

Output: The Table shows summary statistics for Morning-afternoon. It includes measures of central tendency and measures of variability. The t-test tests the null hypothesis that the mean Morning-afternoon equals 0.0 versus the alternative hypothesis that the mean Morning-afternoon is not equal to 0.0. Since the $P < 0.05$, we can reject the null hypothesis at the 95.0% confidence level. Hence there is statistical significant decrease between morning and afternoon.

Table 4.4 below shows different analysis of productivity factor: a one-way analysis of variance (ANOVA) and t-test for 44 mm Thick Cement and Sand Screed

Age of Workers: This procedure performs a one-way analysis of variance for age of worker. It constructs various tests to compare the mean values of age of workers for the 3 different levels of the group. Since the $P < 0.05$, there is a statistically significant difference between Below 19 years and 19 – 35 years, 19 – 35 years and 36 years and above at the 95.0% confidence level (Table 4.4)

Mode of Employment: This table shows the mean mode of employment for each level of the group. It also shows the standard error of each mean, which is a measure of its sampling variability. This Table applies a multiple comparison procedure to determine which means are significantly different from which others. Since the $P < 0.05$, there is a statistically significant difference between Contract employment worker and Negotiated worker, Contract employment worker and Daily paid workers at the 95.0% confidence level.

Qualification of Workers: Table 4.4 also shows various statistics for qualification of workers for each of the 5 levels of the Group. The one-way analysis of variance is primarily intended to compare the means of the different levels, listed here under the Mean ± SEM column. Since the $P < 0.05$, there is a statistically significant difference between the mean of Primary sch. Cert and SSCE, Primary sch. Cert and C&G/NABTEB, SSCE and C&G/NABTEB , SSCE and ND, SSCE and Others, C&G/NABTEB and ND at the 95.0% confidence level. Hence the null hypothesis is rejected.

Experience of Workers: The table shows a one-way analysis of variance for experience of worker. It constructs various tests to compare the mean values of experience for the 4

different levels of the group. Since the P < 0.05, there is a statistically significant difference between ≤ 1 year and ≥11 above, 2 – 5 years and ≥11 above, 6 – 10 years and ≥11 above at the 95.0% confidence level.

Output: This procedure is designed to test for significant differences between two data samples where the data were collected as pairs. It calculates various statistics for the differences between the paired data. Also included in the procedure are tests designed to determine whether the mean difference is equal to zero. The table shows summary statistics for Morning-afternoon. The t-test tests the null hypothesis that the mean Morning-afternoon equals 0.0 versus the alternative hypothesis that the mean Morning-afternoon is not equal to 0.0. Since the P-value for this test is less than 0.05, we can reject the null hypothesis at the 95.0% confidence level.

Table 4. 4:Inferential Analysis of Productivity Factors for 44mm Thick Cement and Sand Screed.

Productivity Factors	Mean ± SEM	Minimum	Maximum
Age of Workers			
Below 19 years	17.11 ± 1.02	11.00	21.00
19 – 35 years	21.85 ± 1.08*	12.00	32.00
36 years and above	17.43 ± 1.08	11.00	25.00
Mode of Employment			
Contract employment worker	14.45 ± 0.77	11.00	18.00
Negotiated worker	20.80 ± 1.15*	16.00	28.00
Daily paid workers	18.23 ± 0.75*	12.00	22.00
Qualification of Worker			
Primary sch. Cert	16.74 ± 0.74	11.00	23.00
SSCE	24.60 ± 0.70*	20.00	28.00
C&G/NABTEB	20.82 ± 0.77*	17.00	25.00
ND	16.71 ± 1.54*	11.00	22.00
Others	19.00 ± 0.00*	19.00	19.00
Experience of Worker			
≤ 1 year	16.29 ± 1.11	11.00	19.00
2 – 5 years	18.76 ± 0.78	12.00	24.00
6 – 10 years	17.93 ± 1.12	11.00	25.00
≥11 above	29.67 ± 3.38*	23.00	34.00
Output			
Morning(m^2)	12.44 ± 0.32		
Afternoon (m^2)	10.32 ± 0.19[a]		

N=50; *p< 0.05 (ANOVA); [a] p< 0.05 (t-test)

Table 4.5 below shows different analysis of productivity factor: a one-way analysis of variance (ANOVA) and t-test for 400mm X 400mm x 5mm thick Floor Tile

Age of Workers: The Table above shows various statistics for age of workers for each of the 3 levels of Group. The one-way analysis of variance is primarily intended to compare the means of the different levels, listed here under the Mean ± SEM column. Since the $P < 0.05$, there is a statistically significant difference between Below 19 years and 19 – 35 years , 19 – 35 years and 36 years and above at the 95.0% confidence level. Hence the null hypothesis is rejected.

Mode of Employment: This procedure performs a one-way analysis of variance for mode of employment. It constructs various tests to compare the mean values of mode of employment for the 3 different levels of the group. Since the $P < 0.05$, there is a statistically significant difference between the mean of Contract employment worker and Negotiated worker, Negotiated worker and Daily paid workers at the 95.0% confidence level. Hence the null hypothesis is rejected.

Qualification of worker: This table shows various statistics for qualification of workers for each of the 5 levels of Group. The one-way analysis of variance is primarily intended to compare the means of the different levels, listed here under the Mean ± SEM column. Since the $P < 0.05$, there is a statistically significant difference between Primary sch. Cert and C&G/NABTEB, Primary sch. Cert and ND, Primary sch. Cert and Others at the 95.0% confidence level.

Table 4. 5:Inferential Analysis of Productivity Factors for 400mm X 400mm x 5mm thick Floor Tile

Productivity Factors	Mean ± SEM	Minimum	Maximum
Age of Workers			
Below 19 years	26.00 ± 1.35	22.00	28.00
19 – 35 years	31.50 ± 1.12*	26.00	38.00
36 years and above	25.97 ± 0.52*	21.00	34.00
Mode of Employment			
Contract employment worker	27.40 ± 0.61	25.50	30.00
Negotiated worker	30.90 ± 0.50*	29.00	34.00
Daily paid workers	26.47 ± 0.44*	22.00	33.00
Qualification of Worker			
Primary sch. Cert	30.08 ± 0.69	26.00	34.00
SSCE	27.69 ± 0.75	25.00	30.00
C&G/NABTEB	26.00 ± 0.39*	22.00	28.00
ND	26.38 ± 1.36*	21.00	32.00
Others	25.00 ± 0.00*	25.00	25.00
Experience of Worker			
≤ 1 year			
2 – 5 years	24.29 ± 0.52	23.00	26.00
6 – 10 years	26.59 ± 0.56	22.00	33.00
≥11 above	29.05 ± 0.70*	25.00	35.00
Output			
Morning(m^2)	12.44 ± 0.49		
Afternoon (m^2)	14.40 ± 0.21[a]		

N=50; *$p< 0.05$ (ANOVA); [a] $p< 0.05$ (t-test)

Experience of Workers: This table shows various statistics for experiences for each of the 3 levels of Group. The one-way analysis of variance is primarily intended to compare the means of the different levels, listed here under the Mean ± SEM column. Since the P < 0.05, there is a statistically significant difference between 2 – 5 years and ≥11 above, 6 – 10 years and ≥11 above at the 95.0% confidence level.

Output: Table 4.5 shows summary statistics for Morning-afternoon. This procedure is designed to test for significant differences between two data samples where the data were collected as pairs. It calculate various statistics for the differences between the paired data. Also included in the procedure are tests designed to determine whether the mean difference is equal to zero. The t-test tests the null hypothesis that the mean Morning-afternoon equals 0.0 versus the alternative hypothesis that the mean Morning1afternoo is not equal to 0.0. Since the P < 0.05, we can reject the null hypothesis at the 95.0% confidence level. Hence there is statistical significant increase between morning and afternoon output.

Table 4.6 shows different analysis of productivity factor: a one-way analysis of variance (ANOVA) and t-test for 600mm X 300mm x 5mm thick Floor Tile

Age of Workers: This procedure performs a one-way analysis of variance for age of workers. It constructs various tests to compare the mean values of age of workers for the 3 different levels of Below 19 years, 19 – 35 years and 36 years and above. The one-way analysis of variance is primarily intended to compare the means of the different levels, listed here under the Mean ±SEM column. Since the $P > 0.05$, there are no statistically significant differences between any pair of means at the 95.0% confidence level.

Mode of Employment: This procedure performs one-way analysis of variance for mode of Employment. It constructs various tests to compare the mean values of mode of for the 3 different levels of Contract employment worker, Negotiated worker and Daily paid workers. Since the $P < 0.05$, there is a statistically significant difference between the means of contract employment workers and negotiated workers, and negotiated workers and daily paid workers at the 95.0% confidence level.

Qualification of workers: The one-way analysis of variance is primarily intended to compare the means of the different levels, listed here under the Mean ±SEM column. Since the $P > 0.05$, there is no significant differences between any pair of means at the 95.0% confidence level. The method currently being used to discriminate among the means is Tukey's honestly significant difference (HSD) procedure.

Table 4. 6:Inferential Analysis of Productivity Factors for 600mm X 300mm x 5mm thick Floor Tile

Productivity Factors	Mean ± SEM	Minimum	Maximum
Age of Workers			
Below 19 years	26.79 ± 1.22	22.50	32.00
19 – 35 years	27.90 ± 1.06	23.00	33.00
36 years and above	27.94 ± 0.53	23.00	36.00
Mode of Employment			
Contract employment worker	26.30 ± 1.16	22.50	32.00
Negotiated worker	30.18 ± 0.59*	25.00	36.00
Daily paid workers	26.88 ± 0.74	23.00	30.00
Qualification of Worker			
Primary sch. Cert	27.65 ± 0.53	23.00	32.00
SSCE	26.89 ± 0.74	23.00	30.00
C&G/NABTEB	27.32 ± 0.94	22.50	33.00
ND	31.75 ± 2.36	25.00	36.00
Others	29.50 ± 0.55	27.00	34.00
Experience of Worker			
≤ 1 year	26.88 ± 0.90	22.50	33.00
2 – 5 years	27.50 ± 0.76	23.00	33.00
6 – 10 years	28.92 ± 0.65	23.00	36.00
Output			
Morning(m^2)	13.10 ± 2.11		
Afternoon (m^2)	14.79 ± 0.24[a]		

N=50; *p< 0.05 (ANOVA); [a] p< 0.05 (t-test)

Experience of workers: This procedure performs a one-way analysis of variance for experience of workers. It constructs various tests to compare the mean values of experience of workers for the ≤ 1 year, 2 – 5 years, 6 – 10 years and ≥11 above Group. The one-way analysis of variance is primarily intended to compare the means of the different levels, listed here under the Mean ±SEM column. Since the P > 0.05, there is not a statistically significant difference between the mean experiences of workers from one level of the Group to another at the 95.0% confidence level.

Output: The procedure is designed to test for significant differences between two data samples where the data were collected as pairs. It calculates various statistics for the differences between the Morning and Afternoon data. Also included in the procedure are tests designed to determine whether the mean difference is equal to zero. The t-test tests the null hypothesis that the mean Morning-afternoon equals 0.0 versus the alternative hypothesis that the mean Morning-afternoon is not equal to 0.0. Since the P > 0.05, we can reject the null hypothesis at the 95.0% confidence level. Hence there is significant increase between the Morning and Afternoon output.

Table 4.7 shows different analysis of productivity factor: a one-way analysis of variance (ANOVA) and t-test for 300mm X 300mm x 5mm thick Floor Tile

Age of workers: Various tests were carried out to compare the mean values of age of workers for the 3 different levels of below 19 years, 19-35 years and 36 years above with Mean ±SEM value of 22.80 ± 0.57, 22.59 ± 0.50 and 22.64 ± 0.28 respectively. Since the P > 0.05, there is not a statistically significant difference between the mean ages of workers from one level to another at the 95.0% confidence level.

Mode of Employment: the mean values of mode of employment was performed for the 3 different levels of Contract employment worker, Negotiated worker and Daily paid workers with Mean ±SEM value of 23.18 ± 0.63, 26.63 ± 1.09 and 22.80 ± 0.31 respectively. Since the $P < 0.05$, there is a statistically significant increase in mean negotiated workers when compared with contract employment worker and daily paid workers at the 95.0% confidence level.

Table 4. 7:Inferential Analysis of Productivity Factors for 300mm X 300mm x 5mm thick Floor Tile

Productivity Factors	Mean ± SEM	Minimum	Maximum
Age of Workers			
Below 19 years	22.80 ± 0.57	20.00	25.00
19 – 35 years	22.59 ± 0.50	17.00	28.00
36 years and above	22.64 ± 0.28	21.00	24.00
Mode of Employment			
Contract employment worker	23.18 ± 0.63	20.00	26.00
Negotiated worker	26.63 ± 1.09*	19.00	36.00
Daily paid workers	22.80 ± 0.31	21.00	26.00
Qualification of Worker			
Primary sch. Cert	22.67 ± 0.62	20.00	25.00
SSCE	22.57 ± 0.30	22.00	24.00
C&G/NABTEB	29.36 ± 1.83*	23.00	37.00
ND	22.75 ± 0.67	19.00	28.00
Others	21.29 ± 1.19	17.00	26.00
Experience of Worker			
≤ 1 year	22.63 ± 0.71	20.00	25.00
2 – 5 years	22.89 ± 0.49	17.00	28.00
6 – 10 years	22.63 ± 0.26	22.00	24.00

≥11 above	26.71 ± 1.51*	23.00	34.00
Output			
Morning(m^2)	12.46 ± 0.32		
Afternoon (m^2)	10.38 ± 0.20[a]		

N=50; *p< 0.05 (ANOVA); [a] p< 0.05 (t-test)

Qualification of workers: This procedure performs a one-way analysis of variance for qualification of workers. It constructs various tests to compare the mean values of qualification for the 5 different levels listed here under the Mean ± SEM column. Since the P < 0.05, there is a statistically significant difference between the following pairs of means workers qualification: Primary sch. Cert and NABTEB, SSCE and NABTEB, NABTEB and ND, and NABTEB and Others at the 95.0% confidence level.

Experience of Workers: This procedure performs a one-way analysis of variance for experience of workers. It constructs various tests to compare the mean values of experience of workers for the 4 different levels listed here under the Mean ± SEM column. Since the P < 0.05, there is a statistically significant difference between the following pairs of means of workers experience: ≤ 1 year and ≥11 above, 2 – 5 years and ≥11 above, 6 – 10 years and ≥11 above at the 95.0% confidence level.

Output: This procedure test for significant differences between two data samples where the data were collected as pairs. The t-test tests the null hypothesis that the mean Morning-afternoon equals 0.0 versus the alternative hypothesis that the mean Morning-afternoon is not equal to 0.0. Since the P < 0.05, we can reject the null hypothesis at the 95.0% confidence level.

3.5 Effect of Productivity Factors on Labour Outputs.

The effect of productivity factors are elucidated by the summary of results of the null hypothesis.

Table 4. 8:Summary of Results of Null Hypothesis

Work item	Age	Qualification	Mode of employment	Experience of workers	Period of work
	H_10	H_20	H_30	H_40	H_60
254mm thick floor screed finishes	Accepted	Accepted	Rejected	Rejected	Rejected
44mm thick floor screed finishes	Rejected	Rejected	Rejected	Rejected	Rejected
400 x 400mm size floor tile finishes	Accepted	Rejected	Rejected	Rejected	Rejected
600 x 300mm size floor tile finishes	Accepted	Accepted	Rejected	Accepted	Rejected
300 x 300mm size floor tile finishes	Rejected	Rejected	Rejected	Rejected	Rejected

3.6 Determination of Floor Screed and Tile Layers Outputs.

The outputs as relate to the observed productivity factors are summed up to obtain the average output per day as shown in the Table 4.11b below for the ten work items

The determined outputs per day were further divided by 7 hours (reference to table 4.3) to obtain output per hour as indicated in the table 4.12 below.

Table 4. 9:Determination of Output per Hour

S/No	Description of Work Items	Observed Time Per Day (h)	Determined Output Per Day(m^2)	Output Per Hour (m^2/h)
1	25mm thick floor screed finishes	7	23.70	3.39
2	44mm thick floor screed finishes	7	19.31	2.76
3	400 x 400mm size floor tile finishes	7	27.38	3.91
4	600 x 300mm size floor tile finishes	7	30.18	4.3
5	300 x 300mm size floor tile finishes	7	23.61	3.37

CHAPTER FIVE

4.0 SUMMARY CONCLUSION AND RECOMMENDATIONS

4.1 Summary of Major Findings

The study revealed significant effect on mode of employment, experience of workers and periods of observation for floor screed and only revealed significant different on mode of employment and period of observation for tile finishes. These are in agreement with Onyeagam (2014); Enshassi *et al.*, (2011); Abdullahi *et al.,* (2010); Abdullahi (2009) and Rojas *et al.,* (2003).

Work in compartment has not been distinctly specified in floor finishes of BESMM as observed its preponderance of 52 percent in the construction site and Onyeagam (2014) confirmed productivity impact as a result of work in compartment on the workers.

The study also revealed that there is output difference within the group factors. There are significant output differences between the classes of thickness for cement and sand floor screed finishes justifying the influence of thickness on the output of floor screed finishes. Also, there is influence on sizes of tiles on the outputs of the tillers

The output production of Ceramic floor tile finishes increases as the unit area (0.16m², 0.18m², and 0.09m ²) of floor tiles increases, however, the outputs increase is not directly proportional to the unit floor tile area.

The chapter concludes by giving general recommendation as to how the findings of the research can help in the production of fair and accurate Bills of Quantity which is non-

detrimental to either party. It also highlights the areas of contention especially as relate to BESMM compliance between the results obtained and those of previous work.

4.2 Conclusion

The study conclude that each specified work item has distinct productivity effect on the operative outputs and it professional important that to adhere and strictly comply with the work items specified in (M10) cement: sand screed finishes of the BESMM.

There is ardent need to distinctly categorize work in compartment in the floor finishes of BESMM because of its anticipated productivity impact on the workers.

The determined labour outputs are at variance with the currently used labour output in preparation of construction estimates.

The study also concludes that mode of employment and period of observation have significant impact on labour output for screed and tile floor finishes.

4.3 Recommendations

Based on the findings of the research, the following recommendations are put forward for implementation.

i. A mason should cover a minimum of the following work items

Table 5 1:Recommended Outputs

S/No	Description of Work Items	Gang size	Determined Output Per Day(m^2)	Output Per Hour (m^2/h)
1	25mm thick cement sand screed finishes level and to falls only ≤15 degree from the horizontal	1 mason and 1 labourer	22	3.14
2	44mm thick cement sand screed finishes level and to falls only ≤15 degree from the horizontal	1 mason and 1 labourer	18	2.57
3	Ceramic floor tile 400 x 400mm size to fall only ≤ 15 degree from horizontal plain	1 mason and 1 labourer	21	3.00
4	Ceramic floor tile 600 x 300mm size to fall only ≤ 15 degree from horizontal plain	1 mason and 1 labourer	28	4.00
5	Ceramic floor tile 300 x 300mm size to fall only ≤ 15 degree from horizontal plain	1 mason and 1 labourer	22	3.14

ii. The contractor should exploit the output figures extracted as relate to productivity factors so as to maximize the productivity of their workers.

iii. The output of workers on floor screed finishes of various thicknesses should use the determined output as a base to pro-rata the expected output.

iv. More study be conducted on output of floor tile finishes to validate the established output hence the finding is not at congruent to sizes.

v. For exigency reason, employer should employ workers on the term of negotiated agreement.

vi. Similarly output should be investigated on the basis of standard gang size formation using activity sampling techniques

vii. Study on comparison of categorized work in compartment be carried out to determine the productivity impact of operative of floor finishes.

viii. In compliance to BESMM, the NIQS in collaboration with NJIC should sponsor a research on determination of labour outputs in all trades as a way to ensure uniformity in estimating construction project.

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APPENDICES

Appendix 1:M-SURFACE FINSHES M10-CEMENT: SAND/CONCRETE SECREEDS/TOPPINGS

The extracted items indicated below are possible and work related items to cement: sand/ concrete screed/toppings

S/No	BESMM	Description of work item	Units	Frequency
1	5.1.1	25mm thick cement and sand level and to falls only ≤15 degree from the horizontal	M2	76
2		Floor: 44 thick ditto	M2	68
4	5.2.1	Floor; 25mm thick cement and sand to falls and cross falls and to slope 15 degree from the horizontal	M2	48
5		Floor,; 40mm thick ditto	M2	42
6		Floor; 44mm thick ditto	M2	38
7	5.1.1.2	Floor; 25mm thick cement and sand level and to falls only 15 degree from the horizontal laid in 1.2m average bays.	M2	54
8		600mm average bays ditto	M2	46
9		Floor; 40mm thick cement and sand level and to falls only 15 degree from the horizontal	M2	43
10		600mm ditto	M2	33
11		Floor 25mm thick ditto in one operation	M2	23
12		Floor; 40mm cement and sand level and to fall only 15 degree from the horizontal in one operation with base	M2	32
13		Floor; 40mm thick ditto in one operation 600m average bay	M2	37
14		25mm thick cement and sand screed finished smooth in one operation with their base	M2	25
15		40mm thick cement and sand ditto	M2	36
16		25mm thick cement and sand screed bed to	M2	45

		receive unglazed verified floor tiles		
17		40mm thick cement and sand screed bed ditto	M2	36
18	5.1.1.1	25mm thick cement and sand screed patterned	M2	54
19		40mm thick ditto	M2	44
20	No ref	25mm thick cement and sand floor area not exceeding 4m2	M2	53
21		25mm thick cement and sand laid in 1.2m average bay floor area not exceeding 4m2	M2	2
22		600mm ditto	M2	24
23		25mm thick cement and sand patterned floor area not exceeding 4m2	M2	53
24		40mm thick cement and sand screed not exceeding 4m2	M2	43
25		40mm ditto smooth	M2	43
26	5.1.1.1	Floor; 25mm cement and sand level and to falls only 15 degree from the horizontal patterned	M2	63
27		Floor; 40mm thick ditto	M2	
28		Floor; 44mm thick ditto	M2	43
29		Floor; 25mm thick cement and sand level and to fall only 15 degree from horizontal in 1.2m average patterned	M2	
30		Floor; 600mm thick ditto	M	22
31		Floor; f0mm thick cement and sand and to falls only 15 degree from the horizontal laid in 1.2m average bays patterned	M	27
32		Floor; 600mm ditto	M	12
33		Floor; 25mm thick fitto laid in one operation 1.2m average bay patterned with their base	M	17
34		Ditto 600mm thick	M	0
35		Treads; 225mm width, 25mm thick screeded bed	M	80
36		Tread; 250mm width, ditto	M	56

37		Treads; 275mm width, ditto	M	41
38		Tread; 300mm ditto	M	12
39		Tread; 225mm ditto smooth	M	20
40		Tread 250mm ditto smooth	M	25
41		Tread; 275mm ditto smooth	M	25
42		Tread; 300mm ditto smooth	M	15
43		Tread; 225mm width, 40mm thick screeded bed smooth	M	22
44		Treads; 250mm ditto	M	24
45		Treads; 275mm ditto	M	45
46		Treads; 300mm ditto	M	56
47		Treads; 225mm width, 25mm thick screeded patterned	M	35
48		Treads; 250mm ditt0	M	32
49		Treads; 275mm ditto	M	48
50		Treads; 300mm ditto	M	35
51		Treads; 225mm width, 40mm thick screeded patterned	M	41
52		Treads; 250mm ditto	M	0
53		Treads; 275mm ditto	M	32
54		Treads; 300mm ditto	M	23
55	10.0.2	Apron; 25mm thick cement and sand width screeded bed	M	23

Appendix 2:M40-STONE/CONCRETE/QUARRY/CERAMIC TILING/ MOSAIC

The extracted items indicated below are possible and work related items to ceramic tiling

Extract of ceramic tile work items

S/No	BESMM	Description of work item	Unit	Frequency
1	5.1.1	Ceramic floor tile 300 x 300mm size to fall only ≤ 15 degree from horizontal plain	M²	79
2		Ceramic floor tile 400 x 400mm size to fall only ≤ 15 degree from horizontal plain	M²	65
3		Ceramic floor tile 600 x 300mm size to fall only ≤ 15 degree from horizontal plain	M²	62
4		Ceramic floor tile 600 x 600mm size to fall only ≤ 15 degree from horizontal plain	M²	44
5		Ditto patterned	M²	46
6	5.2.1	Ceramic floor tile (size stated) to fall and cross fall and to slope ≤ 15 degree from horizontal plain	M²	45
7		Ditto patterned	M²	43
8	5.3.1	Ceramic floor tile (size stated) to slopes >15 degree from horizontal plain	M²	30
9		Ditto patterned	M²	25
10	6.0.1	Ceramic tile tread width stated	M	32
11		Ditto patterned	M	22
12	7.1.1	Ceramic floor sill width stated	M	38
13		Ditto patterned	M	25
14	8.1.1	Ceramic floor riser width stated	M	40
15		Ditto patterned	M	25
16	10.0.1	Ceramic tile apron width stated	M	16
17		Ditto patterned	M	12
18	12.1	Ceramic tile skirting height stated	M	48
19		Ditto patterned	M	23

Appendix 3:25 mm thick cement sand screed finishes level and to falls only ≤15 degree from the horizontal; Gang Size (1 Mason 1 Labourer)

Labour Outputs for 25mm Thick Cement and Sand Screed

	OUTPUT		
Gang No.	Morning (m^2)	Afternoon (m^2)	Total Output (m^2)/7Hrs
1	12	10	22
2	10	10	20
3	13	10	23
4	10	12	22
5	16	8	24
6	13	12	25
7	15	10	25
8	10	10	20
9	14	9	23
10	16	8	24
11	16	10	26
12	17	9	26
13	18	8	26
14	15	10	25
15	13	12	25
16	16	12	28
17	13	10	23
18	16	10	26
19	13	10	23
20	10	12	22
21	12	11	23
22	15	10	25
23	10	9	19
24	10	10	20
25	10	14	24
26	12	10	22
27	10	10	20
28	9	10	19
29	10	7	17
30	8	10	18
31	11	13	24
32	11	13	24
33	12	10	22
34	11	14	25
35	10	10	20
36	13	12	25
37	12	10	22
38	13	10	23
39	14	10	24

40	12	10	22
41	11	10	21
42	10	10	20
43	13	11	24
44	14	12	26
45	13	11	24
46	13	10	23
47	12	10	22
48	11	10	21
49	12	10	22
50	13	10	23
Total	614	519	1142
Average	**12.28**	**10.38**	**22.84**

Appendix 4:44mm thick cement sand screed finishes level and to falls only ≤15 degree from the horizontal; Gang Size (1 Mason 1 Labourer)

Labour Outputs for 44mm Thick Cement and Sand Screed

	OUTPUT		
Gang No	Morning (m^2)	Afternoon (m^2)	Total Output (m^2)/7Hrs
1	10	13	23
2	13	14	27
3	10	12.5	22.5
4	15	13	28
5	20	12	32
6	12	15	27
7	13	15	28
8	10	13	23
9	15	18	33
10	10	14	24
11	12	15	27
12	13	15	28
13	13	14	27
14	15	18	33
15	13	15	28
16	14	16	30
17	10	16	26
18	12	14	26
19	13	15	28
20	12	10	22
21	13	16	29
22	14	16	30
23	12	16	28
24	11	14	25
25	12	14	26
26	12	13	25
27	13	15	28
28	14	18	32
29	14	16	30
30	12	14	26
31	14	15	29
32	12	14	26
33	13	15	28
34	14	18	32
35	18	15	33
36	13	12	25
37	18	18	36

38	15	18	33
39	13	15	28
40	12	15	27
41	13	16	29
42	18	16	34
43	14	14	28
44	10	13	23
45	12	14	26
46	13	15	28
47	12	14	26
48	13	15	28
49	14	14	28
50	12	14	26
Total	647	739.5	1397.5
Average	**12.94**	**14.79**	**27.95**

Appendix 5:Ceramic floor tile 400 x 400mm size to fall only ≤ 15 degree from horizontal plain; Gang Size (1 Mason 1 Labourer)

Labour Outputs for Ceramic Floor Tile 400 x 400mm x 5mm thick

	OUTPUT		
Gang No	Morning (m^2)	Afternoon (m^2)	Total Output (m^2) per 7Hrs
1	12	14	26
2	10	12	22
3	12	13.5	25.5
4	10	14	24
5	12	14.5	26.5
6	10	15	25
7	13	14	27
8	12	15	27
9	13	11	24
10	10	10	20
11	15	10	25
12	18	15	33
13	10	18	28
14	15	15	30
15	13	15	28
16	12	15	27
17	9	15	24
18	12	14	26
19	10	15	25
20	12	14	26
21	13	15	28
22	13.5	14	27.5
23	8	14	22
24	13	15	28
25	14	13	27
26	13.5	14	27.5
27	12	14	26
28	12	13	25
29	11	15	26
30	12	15	27
31	20	15	35
32	18	16	34
33	15	14	29
34	16	16	32
35	13	16	29
36	14	16	30
37	18	14	32

38	14	16	30
39	15	15	30
40	14	16	30
41	12	14	26
42	12	14	26
43	0	13	13
44	13	14	27
45	0	14	14
46	12	14	26
47	13	14	27
48	14	16	30
49	13	16	29
50	14	16	30
Total	621	720	1342
Average	**12.42**	**14.4**	**26.84**

Appendix 6:Ceramic floor tile 600 x 300mm size to fall only ≤ 15 degree from horizontal plain; Gang Size (1 Tiler 1 Labourer)

Labour Outputs for Ceramic Floor Tile 600 X 300mm x 5mm thick

	OUTPUT		
Gang No	Morning (m^2)	Afternoon (m^2)	Total Output (m^2) per 7 Hrs
1	12	10	22
2	10	10	20
3	13	10	23
4	10	12	22
5	16	8	24
6	13	12	25
7	15	10	25
8	10	10	20
9	14	9	23
10	16	8	24
11	16	10	26
12	17	9	26
13	18	8	26
14	15	10	25
15	13	12	25
16	16	12	28
17	13	10	23
18	16	10	26
19	13	10	23
20	10	12	22
21	12	11	23
22	15	10	25
23	10	9	19
24	10	10	20
25	10	14	24
26	12	10	22
27	10	10	20
28	9	10	19
29	10	7	17
30	8	10	18
31	11	13	24
32	11	10	21
33	12	14	26
34	11	10	21
35	10	12	22
36	13	10	23
37	12	10	22
38	13	10	23
39	14	10	24

40	12	10	22
41	11	11	22
42	10	12	22
43	12	11	23
44	13	10	23
45	14	10	24
46	13	10	23
47	13	10	23
48	12	10	22
49	11	10	21
50	12	10	22
Total	610	519	1141
Average	12.2	10.38	22.32

Appendix 7:Ceramic floor tile 300 x 300mm size to fall only ≤ 15 degree from horizontal plain; Gang Size (1 Tiler 1 Labourer)

Labour Outputs for Ceramic Floor Tile 300 X 300mm x 5mm thick

	OUTPUT		
Gang No	Morning (m^2)	Afternoon (m^2)	Total Output (m^2) per 7 Hrs
1	20	10	30
2	20	6	26
3	22	9	31
4	12	9	21
5	13	10	23
6	23	7	30
7	25	16	41
8	16	6	22
9	20	7	27
10	20	8	28
11	19	10	29
12	10	6	16
13	12	7	19
14	13	8	21
15	15	6	21
16	14	4	18
17	10	5	15
18	15	6	21
19	12	11	23
20	14	6	20
21	16	15	31
22	19	16	35
23	18	13	31
24	12	11	23
25	10	12	22
26	12	9	21
27	9	9	18
28	11	10	21
29	14	10	24
30	15	9	24
31	10	8	18
32	13	11	24
33	6	5	11
34	11	10	21
35	14	11	25
36	14	11	25
37	13	12	25
38	10	10	20
39	13	11	24

40	9	9	18
41	14	9	23
42	10	5	15
43	18	13	31
44	16	6	22
45	13	8	21
46	23	7	30
47	14	10	24
48	16	6	22
49	14	4	18
50	12	11	23
Total	704	458	1162
Average	**14.08**	**9.16**	**23.24**

Appendix 8: Questionnaire on Floor Finishes (Screeds and Tiles) In Abuja

SECTION A: BACKGROUND INFORMATION

Date……. Sheet No……

Contract/Project…….

Project Location…….

Operation Location…….

Work item description for operative/study

1. ……..…….
2. ……..…….
3. ……..…….

SECTION B: WORK MEASUREMENT

Study No.	Gang size	Floor/Tile thickness	Morning			Afternoon			Total observed time	Basic time	Afternoon		Total output
			Start	Stop	Observed time	Start	Stop	Observed time			Morning	Afternoon	

SECTION C: OPERATIVES PERSONAL INFORMATION

1. Gender	St. No	Tick
Male	1	
	2	
	3	
Female	1	
	2	
	3	

2. Age	St. No	Tick
Below 20 years	1	
	2	
	3	
20 – 35 years	1	
	2	
	3	
Above 36 years	1	
	2	
	3	

2. Mode of employment		
	St. No	Tick
Contract employment	1	
	2	
	3	
Daily paid worker	1	
	2	
	3	

4. Weather condition		
	St. No	Tick
Sunny	1	
	2	
	3	
Windy	1	
	2	
	3	
Rainy	1	
	2	
	3	

5. Qualification of worker		
	St. No	Tick
S.S.C.E	1	
	2	
	3	
C & G/NABTED	1	
	2	
	3	
NAPTEB	1	
	2	
	3	
ND	1	
	2	
	3	
OTHERS	1	
	2	
	3	

6. Experience of worker		
	St. No	Tick
Below 1 year	1	
	2	
	3	
2 – 5 years	1	
	2	
	3	
6 – 10 years	1	
	2	
	3	
Above 11 years	1	
	2	
	3	