AN EMPIRICAL DETERMINATION OF LABOUR OUTPUT FOR PAINTING IN THE NIGERIAN CONSTRUCTION INDUSTRY (A CASE STUDY OF SOME CONSTRUCTION SITES IN LOKOJA)

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DECLARATION

I declare that the work in this dissertation entitled "Empirical Determination of Labour Output for Painting in Nigerian Construction Industry (A Case Study of Some Construction Sites in Lokoja) has been carried out by me in the Department of Quantity Surveying. T

information derived from the literature has been duly acknowledged in text and a list of references provided. No part of this dissertation was previously presented for another degree or diploma in any other Institution.

Omowumi Tinuola AINA	_____	___ _____
Name	Signature	Date

CERTIFICATION

This dissertation entitled **"AN EMPIRICAL DETERMINATION OF LABOUR OUTPUTS FOR PAINTING IN THE NIGERIAN CONSTRUCTION INDUSTRY (A CASE STUDY OF SOME CONSTRUCTION SITE IN LOKOJA)** by Omowumi Tinuola AINA meets the regulations governing the award of the degree of M.Sc Quantity Surveying in the Ahmadu Bello University, and is approved for its contribution to knowledge and literary presentation.

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ABSTRACT

Research has shown that construction labour output is crucial to the success of construction projects. However, existing labour output used for the preparation of construction estimates in Nigeria are outputs derived from untested experiences. The focus of this study is to use the work study approach to empirically establish labour output for painting activities for the Nigeria construction industry using the classification in the BESMM3 as a guide. The procedure adopted field survey involving work measurement to observe and measure operatives output. Data were collected from on-going construction works and analysed using descriptive and regression analysis. The analysis carried out established general average output value per day as follows; painting of general surfaces of walls, girth greater than 300mm with (textured paint, 128.53m^2; emulsion paint, 81.07m^2; gloss paint, 72.58m^2). Painting of general surfaces of walls, girth less than or equal to 300mm with (gloss paint 211.10m, emulsion paint 277.59m); Painting of general surfaces of ceiling soffit, girth greater than 300mm (emulsion paint 85.31m^2).The findings in this study revealed a higher output per day for painting of general surfaces of walls, girth greater than 300mm using (textured paint, 128m^2). This study shows that different items of work in painting trade have various measuring units and also various labour outputs. The results of the analysis suggested that mode of employment, qualification of workers, temperature of the work environment, period of observation and experience of the operatives affect output of workers to varying degrees based on the location of application of the paint and the unit of measurement of the work items. This 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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ABBREVIATION

BESMM 3	Building and Engineering Standard Method of Measurement, Third Edition
BOQ	Bill of Quantities
B.S	British Standard
NABTEB	National Business and Technical Examination Board
N.D	National Diploma
SSCE	Senior Secondary Certificate Examination
GDP	Gross domestic product
SPSS	Statistical Package for Social Science
NIQS	Nigeria institute of Quantity Surveyors
MCAA	Mechanical Contractors Association of America

CHAPTER ONE

INTRODUCTION

1.1 Background of the Study

Estimating is one of the key fundamental functions of the Quantity Surveyor and accurate estimates are very vital to clients when making decisions therefore, clients expect useful and objective information from estimators. Cost estimates provide a useful basis for budgetary planning and cost control for construction projects. Garret (2006) reported that the sustainability and success of the construction industry depends greatly on the level of accuracy in project cost estimates.

Estimating the costs of construction works involves the multiplication of unit rates and the measured quantities in the Bill of Quantities. The calculation of the unit rates for the individual measured items in the Bill of Quantities requires the collation of current cost information for materials, labour, plants, profit and overhead (Ashworth, 2002). The estimation of the cost of materials, plant, overhead and profit has never been a point of contention because they involve the quantitative estimation of the cost values for plants, profit and overheads while market survey are carryout for materials prices and are the basis for the material cost estimation (Ashworth, 2002). Labour pricing is usually done on the basis of output constants collected on each trade (Ayeni, 1999). It is important that cost estimates have clear indications of the level of information reliability.

The inaccuracy found in estimates is mostly attributed to labour and there is no known standard theoretical yardstick to determine the financial value of the daily output (Udegbe, 2007), as the sustainability and success of the construction industry depends greatly on the level of accuracy in project estimates and the consequences of adopting inaccurate estimates are extremely large (Udegbe, 2007). Improvement in productivity may also increase the supply of more affordable housing in the country.

Yates and Swagata (1993) assert that the productivity of workers is also being influenced by factors which vary according to geographical locations. Therefore, if these factors vary actually with location then the output derived from experience or the British originated outputs which are being used within the Nigerian context cannot be realistic and accurate, so also, methods of construction differs.

Udegbe (2007) opines that cost reduction in building construction must take cognizance of factors like labour relationship with subordinates; skills acquired coupled with educational qualification and the overall importance of labour force in construction. The researcher also stated that different workers have different variables affecting their levels of productivity such as: level of education or training, method of work to be done, personal health and hygiene, motivational factors, type of tools to be used, machine, equipment and materials employed, character traits and inter-personal skills, work-load to be executed, expected quality of work to be done, weather conditions and location of the projects.

Akeredolu (2014); Onyeagam (2014); Adegboyega (2014) reported that Quantity Surveyors solely rely on labour outputs derived from experience or the British originated outputs. Most of these outputs were generated intuitively not based on any empirical study; in order to address this issue, several studies have been carried out to empirically determine labour outputs for different trades such as plastering (Udegbe, 2007); block laying, rendering and excavation works (Mohammed, 2009);floor screeding and terrazzo tiling (Gide, 2011); glazing works and electrical cabling (Sani, 2010); sanitary fittings, plaster of Paris and PVC ceiling (Sambo, 2009); door and window glazing (Sani, 2011); laying interlocking tiles (Ibrahim, 2011); concrete work, form work and reinforcement (Abba, 2010); tilling work (Aliyu, 2010) and Labour Output on Roof caccasing, roof covering and Painting by Shuaibu (2010) etc. However, these researchers presented reports without taking cognizance of Building and Engineering Standard Method of Measurement (BESMM) as a guide which provide a uniform basis for measuring construction works and embodies the essentials of good practice, in order to take care of the peculiarities in the Nigerian construction industry until 2014 when some other researchers used the BESMM as a guide to establish the labour output for some trade; such as wall tiling (Akeredolu, 2014), block laying (Onyeagam, 2014) and rendering and plastering (Adegboye, 2014) but there are other construction activities that is needed to be done using the BESMM as a guide to improve the accuracy of construction cost estimates.

Hence, this research work intends to establish labour outputs of painting according to the specifications in the BESMM3 with the view to improve the accuracy of construction cost estimates in the Nigerian Construction Industry.

1.2 Statement of the research problem

The inaccuracy of the project cost estimates as pointed out by Udegbe (2007); Adegboye (2014); Onyeagam (2014) and many more have negative effects on construction projects, such as cost overrun and time over run. Udegbe (2007) attributed these inaccuracies to the inaccurate building up of unit rates. Studies reported that Quantity Surveyors in Nigeria solely rely on labour outputs derived from experience or the British originated outputs (Mohammed, 2009). Most of these outputs were generated intuitively not based on any empirical study especially in Nigeria. In order to address this issue, several studies were carried out to empirically determine labour outputs for different trades, painting inclusive.

Udegbe (2007) conducted a similar study in Edo state and concluded that a painter should cover a minimum surface area of $76m^2$ daily while Shuaibu (2010) conducted a similasr study in Kaduna and concluded that painters should cover $73m^2$ per day which was generalized for all the work items on painting trade and not as specified in the BESMM, which have various measuring units and as a result have various labour outputs.

1.3 Significance of the Study

Since there are no reliable reference hand books and manuals of output constants specifically in use by Nigerian building industry there is need to establish a reliable labour output constants in the building industry to improve the accuracy of project cost estimates for various trades for different geographical locations on construction sites base on the specifications in the BESMM. In this research, the labour output for painting has been investigated this will help in evaluating the time and equivalent cost of projects.

1.4 Aim

The aim of this work is to empirically establish the labour outputs for painting trade in the Nigerian construction industry in accordance with the provisions in the BESMM3.

1.5 Objectives

i. To identify factors affecting the productivity of construction workers involved in painting works from literature.

ii. To identify the various measurement rules for painting activities as contained in the BESMM3

iii. To empirically determine the labour output of the selected painting activities identified

iv. To examine the effects of the productivity factors on the labour outputs determined.

1.6 Research Hypotheses

To determine the effect of the labour productivity factors on the outputs established, both null and alternative hypothesis were formulated in order to conduct inferential analysis. They are as follows:

i. Alternative Hypothesis (H1): There is output difference in all the different periods of observations.

ii. Null Hypothesis (H1o): There is no output difference in all the different periods of observations.

iii. Alternative Hypothesis (H2): The level of outputs of workers depends on their mode of employment.

iv. Null Hypothesis (H2o): The level of outputs of workers does not depend on their mode of employment.

v. Alternative Hypothesis (H3): There is output difference between the highly experience

groups of workers and workers with lower experience.

vi. **Null Hypothesis (H3o)**: There is no output difference between the highly experience groups of workers and workers with lower experience.

vii. **Alternative Hypothesis (H4)**: There is output difference between the well-educated group of workers and workers with lower qualification.

viii. **Null Hypothesis (H4o**): There is no output difference between the well-educated group of workers and workers with lower qualification.

ix. **Alternative Hypothesis (H5)**: There is output difference with the change in temperature of the work environment.

x. **Null Hypothesis (H5o**): There is no output difference with the change in temperature of the work environment.

xi. **Alternative Hypothesis (H6)**: There is output difference with the change in weather condition of the work environment.

xii. **Null Hypothesis (H6o)**: There is no output difference with the change in the weather condition of the work environment.

1.7 Scope and Limitation

1.7.1 Scope of the Study

The scope of this work is restricted to painting and only considered some areas of the painting activities that were applicable on site in accordance with the specifications in the BESMM3. This includes:

I. Painting of general surface of walls, girth greater than 300mm (M60.1.1.1) with:
    i. Texture paint
    ii. Emulsion paint and
    iii. Gloss paint on regular surfaces measured in m^2, because of the peculiarity in the usage of different types of paints.

II. Painting of general surface, girth less than or equal to 300mm (M60.1.2.1) with :
    i. Gloss paint and
    ii. Emulsion paint on regular surfaces measured in m.

III. Painting of general surfaces of ceiling soffit, girth greater than 300mm (M.60.1.1.1) with emulsion paint measured in m^2

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

V. The survey was carried out within Lokoja metropolis in Kogi State due to the fact that the nature of the research requires physical study of the natural phenomena of productivity level of construction operatives on site and it availability and permission granted by the site managers to have access to their sites for their workers to be observed.

1.7.2 Limitations

The following are the limitations of the study, which may affect the accuracy of the results:

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

ii. The difficulty in assessing whether workers tend to improve upon their natural productivity level when being directly observed.(Hawthorne effect)

iii. Since productivity factors vary with location then the output derived from this research may not be applicable and accurate in other locations due to difference in method of application, culture and the geographical location.

iv. A situation whereby operatives gives false information about themselves.

1.7.3 Basic Assumptions

i. The background information of the surfaces to be painted where these results would be applied is the same as the one used in this research.

ii. The methods of application or operation are the same as the one used in this research.

CHAPTER TWO

LITERATURE REVIEW

2.1 Construction Industry

Construction industry is important to any country from a wide range of reasons associated with certain peculiar features of the industry such as its products being investment-goods (Kazaz and Ulubeyli, 2004). The construction industry is very important to the economy of every nation. It covers half of the whole field of fixed capital accumulation (Fagbenle, 2011) therefore; it constitutes the most single sector of capital formulation in any national economy (Fagbenle, 2011).

Construction is a term that covers a wide range of activities in civil engineering and building which includes both new works, repairs and maintenance (Fagbenle, 2011). Fagbenle (2011) also said that the construction industry could be divided into two main branches, namely building and civil engineering. He went further to say that though a close structural relationship exists between the two branches, they are so sufficiently distinguished that the building component can be successfully and usefully studied independently of civil engineering branch of the industry.

Building and civil engineering vary in many other respects. Building project covers residential house, office complexes like secretariat, bank house and other commercial units like market stalls. They vary in size ranging from single room accommodation to bungalows and to high-rise buildings. Civil engineering work encompasses a wide range of different projects and constructed with different materials, *e.g.* roads, bridges, sewers, reservoirs, water towers and swimming pools

2.2 Nigerian Construction Industry

The construction industry in Nigeria is labour intensive; and it is the highest employer of the nation's workforce. The industry also accounts for over 50% of the country's gross capital formation. Unfortunately most empirical studies have revealed that the output of the industry is quite low when compared with many developed countries. Workers' productivity on construction sites has been shown to be very poor and this has been the trend for a long time (Fagbenle, 2011). The industry is also seen as the barometer for the performance of the economy in most developing countries (Kazaz *et al*, 2004).

2.3 Labour

Labour is defined as a task that requires the exertion of body or mind or both. Labour is also regarded as an important resource in construction because it is the one that combines all the other resources namely materials, plant equipment and finance in order to produce the various construction products as expressed by (Fagbenle, 2011) consultants via specification, controls materials, plant costs, profit and overheads by the competition. This then leaves labour as the major resource opened to improvement.

In a simple form, labour productivity could be defined as the hours of work divided by the units of work accomplished (Thomas, 1994) i.e $\frac{\text{Work Hour.}}{\text{Units}}$

However, in reality, labour productivity is a much more complex phenomenon which largely depends on quite diverse factors such as site conditions, workers' competence, materials availability, weather, motivation, supervision etc. Management also affects labour productivity, for example, the incompetent management of the industry and its construction agencies, whether these are public or private, is a prime cause of low productivity. Often, labour

productivity is a key factor contributing to the inability of many contracting organizations to achieve their project goals, which include, most importantly, the profit margin. Therefore, it is paramount to understand the main determinants of labour productivity, and to keep and compare accurate records of productivity levels across projects.

Labour productivity in generally speaking is the same as the "average product of labour" (average output per worker or per worker-hour, an output which could be measured in physical terms or in price terms). It is the ratio of a volume measure of output to a volume measure of input. The three most commonly used measures of input are: hours worked; workforce jobs; and number of people in employment. Measured labour productivity will vary as a function of both other input factors and the efficiency with which the factors of production are used (total factor productivity). So two firms may have equal total factor productivity (productive technologies) but because one has more capital to use, labour productivity will be higher

$$= \frac{\text{Output}}{\text{Input.}}$$

2.4 Productivity

Productivity is a general indicator to measure performance taking into account efficiency (Fagbenle, 2011). Productivity generally takes the form of output divided by input. Output may be any indicator of what a business is trying to produce, such as revenue, profit, units produced, etc. Common input measures are time, labour, and other resources used in the production of goods or services. Productivity measures are also part of the balanced score card system and generally relies on some indicators of output per employee (Fagbenle, 2011). He also stated that productivity involves reaching the highest level of performance with the least expenditure of resources.

Lawal (2008) reported that construction workers in the Nigerian public service have almost zero productivity. Therefore, poor productivity of craftsmen has been identified as one of the most difficult problems that construction industries especially those in developing countries face. In view of this, there is a growing and continuous interest in productivity studies all over the world because of its importance in the management and control of project cost.

A good project management in construction must vigorously pursue the efficient utilization of labour, material and equipment and that improvement of labour productivity should be a major and continuous concern of those who are responsible for cost control of construction project (Lawal, 2008).

Shuaibu (2010) observed that despite the intensive investigations made into the factors affecting labour productivity, researchers have not agreed on a universal set of factors with significant influence on productivity; or any agreement reached on the classification of these factors. He however, grouped factors affecting construction labour productivity under ten headings, namely:

i. Manpower
ii. Leadership
iii. Motivation
iv. Time
v. Materials/tools
vi. Supervision
vii. Project
viii. Safety
ix. Quality and

x. External.

Kazaz *et al*. (2006) considered productivity factors under four groups namely;

i. Organisational factors,

ii. Economic factors,

iii. Physical factors and

iv. Socio-psychological factors based on the theory of motivation.

Durdyev *et al* (2011) considered key constraints and improvement measures for on-site labour productivity using 56 sub-factors. The factors were identified under eight broad categories of internal and external constraints namely:

i. Project management/project team characteristics,

ii. Project finance,

iii. Workforce,

iv. Project-related factors,

v. Unforeseen events,

vi. Technology/process,

vii. Statutory compliance and

viii. Other external factors.

Odesola (2012) identified 75 factors affecting construction labour productivity from literature and focus group discussions with masonry artisans and project supervisors/engineers. These factors were classified into five groups namely:

i. Management related factors,

ii. Labour-related factors,

iii. Environmental factors,

iv. Project-related factors and

v. Natural factors.

Construction labour productivity is mostly affected by the management of the labour directly involved with on-site activities. In view of this, Udegbe (2007) remarked that craft workers as the major player executing construction processes and activities, have a significant influence on construction labour productivity. In the same vein, Dai *et al*. (2009) consider craft workers to be in the ideal position to know where and how much of site's productivity is lost or could be gained.

Since labour productivity involved the management of labour, project supervisors/engineers often regarded as middle level managers are responsible for the coordination of the instructions from upper level managers for implementation by the craftsmen. These instructions equally affect construction labour productivity.

2.5 Factors Affecting Productivity of Construction Workers

Fagbenle (2011) identified three main factors that are affecting site performance as: shortcomings in labour management (unfair wages, lack of motivation etc.); extraneous reasons (harsh weather, breakdown of law and order etc.); and labour's shortcoming (lateness, idleness, poor workmanship etc.)

Fagbenle (2011) grouped the factors affecting the environment of construction projects under cultural, economic, political, social, physical, aesthetic, financial, legal, institutional, technological and policy. Other influencing factors identified include traditional measures such as health, safety, material, size and scope (Fagbenle, 2011). Fagbenle (2011) identified seven dimensions of organizational performance namely: effectiveness; efficiency; quality;

productivity; quality of work; innovation and profitability. The importance of manpower training and management to the construction industry was studied by (Fagbenle, 2011) and concluded that manpower enables the effective use of construction resources.

Fagbenle (2011) researched into the training needs of staff in the construction industry. The authour asserted that training programmes are designed to achieve increase in performance, improvements in quality, achievement of lower unit cost, betterment of individual worker and cultivation of workers' motivation. Fagbenle (2011) noted that inadequate utilization of labour force has led to the increase in crime rate in the country.

Also, (Fagbenle, 2011) studied the perceptions on measures of contractors' performance by taking a case study of Lagos State indigenous contractors. His result indicated that there are no significant differences in the assessments and ratings of the identified measures of contractors' performance. All the research efforts provided good information on the several factors affecting construction projects on sites. However, they did not touch the aspects of construction labour performances and their influencing factors. Further to the literature conducted through related researches, referred journals and books, the following factors were concluded that can be utilized in order to make major influence on construction worker productivity:

i. Motivation

Human potential is boundless but it requires motivation in order to excel (Fagbenle *et al* 2011). He said it is the responsibility of the contractor to quickly identify the most demanding motivators for his operatives and make use of it. Litschka *et al* (2006) proposed that it seems obvious for managers that; job satisfaction, commitment and motivation are extremely important factors for productivity. There seems to be awareness that organizations have to

actively promote their human and organizational assets – like investing in training and other employee- orientated activities, because these activities are perceived as beneficial for productivity and efficiency.

Ian (2006), states that in broad terms motivation can be considered to comprise an individual's effort, persistence and the direction of that effort. In simpler terms, motivation is the will to perform. It is, perhaps, of more value to identify the characteristics frequently associated with will-motivated individuals. Such people are commonly thought to consistently achieve at work to exhibit energy and enthusiasm in the process. They often work with people to overcome organizational problems, or obstacles to progress, and frequently demand and accept additional responsibilities. They may also be more willing to accept organizational change. Historically there have been two major approaches to solving the motivation puzzle. Management can motivate people to work by fear and being tough. Or it can motivate people by understanding and being good.

According to Eguchi (2008), one of the best ways to improve employee productivity is to create a direct link between output and pay by implementing a piecework compensation plan. In a piecework compensation plan, there are no hourly wages. Instead, employees get paid according to how many parts they assemble, how many sales they make, how many hours they bill, etc. In addition to financial incentives, many employees are motivated by the need for social recognition, that's why giving achievement awards to outstanding employees is a good way to improve productivity, also achievement awards typically take the form of plaques, jackets, certificates, prizes, and are handed out to employees who meet certain performance standards (Eguchi, 2008). Furthermore, providing employees with adequate breaks is essential

for improving overall productivity, however, break time not only gives employees something to look forward to, but also gives them a chance to recharge their batteries and they'll come back refreshed and ready to focus for another couple of hours until the next break (Eguchi, 2008).

ii. Communication

For construction workers to be effective, they must clearly understand what is required to be done on site (Fagbenle *et al* 2011). Communication within organizations is a vital ingredient of motivation. For example, employees are likely to be motivated by recognition and constructive feedback by their line manager. It is not enough for employees to be doing a good job; more often than not, some recognition of that is important. Communication needs to be two-way. Expectancy motivation theory suggests that people are motivated by attempts to achieve desired outcomes to their manager. Similarly, mis-communication, sending out inaccurate or misleading information, can cause motivational problems (Ian, 2006). The leader is responsible for creating a common goal, which they communicate and share. Furthermore, the leader should continually monitor that their subordinates feel empowered. The leader may also play a part in recognizing the contributions made by employees by emphasizing efforts of an employee as important (Fagbenle, 2011).

iii. Planning

According to Thomas *et al*. (2001), project and site managers need to have complete job histories, educational records and other information relating to employees in order to make realistic decisions concerning the utilization of the workers under their control. Job-site managers and construction managers also need to have access to information and underlying

work processes and functions controlled by Human Resource department. Such information includes:

i. Data pertaining to each person in the project or at the work, employment history, qualifications, career plans and training/development completed/required.
ii. Data relating to contractor, consultants, part-timers and temporary workers
iii. Information concerning peoples' time-off patterns/ preferences and desired work/location preferences.
iv. Information concerning the availability of others in the organization for job reassignment or redeployment.
v. Operational data concerning the workforce itself such as workforce size, productivity ratios, resource allocation, both for site managers' organizational units and similar work organization-wide.
vi. Information such as time and attendance data, payroll, applicant data from an applicant tracking system, training records from the career development system, cost data from accounting.
vii. Information relating to wages, working hours, holidays, allowances, safety, disputes and for the proper management of industrial relations.
viii. Environmental data that impacts on the HRs managed by the site manager, supervisor, or team leaders such as salary surveys, skill shortages, new employment legislation, retirement trends, and changing attitudes and values of workers.

The impact of on-site availability of operational Human Resource data helps managers to know their people better and can help them find answers to such questions as: Can two tasks be handled by the same individual. And will that result in lower costs and provide similar or better

results. And finally what skills are required for the tasks, and who has the skills to take both tasks in this organization or in other locations.

iv. Specialization

Projects in construction most time are never designed or built exactly in the same manner as previous projects. (Thomas *et al*., 2001) asserts that environmental factors such as the landscape, weather and physical location force every project to be unique from its predecessors. According to Thomas *et al*. (2001), there are also aesthetic factors that create uniqueness from project to project. Such factors have a significant impact upon major project characteristics. While most construction personnel find this uniqueness to be an attractive element for a career in construction, it can have an adverse effect upon construction productivity. Project uniqueness requires modifications in the construction processes. These modifications require workers to go through a learning curve at the beginning stages of each project activity. As organizations get bigger and as the nature of the work done diversifies, then it is more likely that employees start to specialize in the type of work that they do.

Specialization is the extent to which there are different specialist roles in an organization: the higher the number of specialist roles the higher the degree of specialization. Specialization also refers to the extent to which employees engaged in similar or closely related tasks and grouped together. This according to Thomas *et al*. (2001) is called routine specialization and occurs when jobs are split down such that employees only do one or a few parts of a job but not the whole job. This makes employee reach high levels of efficiency, and control is simplified as jobs are tightly defined.

v. Training

There is currently a lack of formal training in construction work. It is the lowest of any major sector of the economy. This lack of training is due to practical concerns such as employers completing the increased percentage of non-union work (Arabian Business, 2008). In general, the workforce of contractors is highly mobile.

According to Kenyon (2005), said productivity tends to be higher compared to other employees fas they undergo formalized training from the start of their apprenticeship, and this ensures the right expectations are set out and reinforced regularly. The benefit of training is measurable almost immediately, that is, the employee is more productive as soon as he has mastered new skills. Supervisors should explain what productivity means to all employees and show them how increased productivity leads to fewer hassles and greater profits. Once they have identified new, more productive ways of doing something, he should make sure everyone involved understands the change and why it is being implemented.

Sharon *et al*. (2004) stated that training is essentially an investment in human capital, the economic benefits of which can be thought of as being shared between:

i. The individual trainee, through higher wages.
ii. The firm, through enhanced profitability.
iii. Society as a whole, through "externalities" (returns over and above the private returns to the individual trainee or firm who pays for the training).

vi. Health & Safety

An improved productivity of the workforce translates into a more productive firm. While various motivational factors have traditionally been applied to stimulate motivation of people in order to improve their productivity, the potential of improved productivity through health promotion has only recently become the subject of investigation. It has long been recognized that good health is an important factor in employee efficiency and productivity (Fielding, 1990), and can lead to a better performance, both physically and mentally. Healthy people are less likely to be absent from work through illness, are more likely to cope better with stress, and less likely to suffer from musculoskeletal injuries sustained in the workplace, and generally display more evidence of job satisfaction. It therefore makes good sense to explore avenues for improving employee health in order to reap the benefit of improved productivity.

vii. Technology & Innovation

Project manages role is to encourage innovation and try to find creative ideas to do the job in better ways that save efforts and time and increase production, furthermore, to ensure that the workers have good equipment. In many instances, labour productivity is limited by the equipment they are forced to use. If your plant is filled with 20-year-old machinery that constantly needs attention from the maintenance crew, or if your tools are slow or out dated, then you are not giving your workers a fair opportunity to be productive.

Technology has had a tremendous effect on overall productivity. All but the most basic of tasks on a site have seen changes due to advances in technology over recent years. Tools and machinery have increased both in power and complexity. These advances in technology can significantly modify skill requirements.

Introducing new technology can be more difficult in the construction industry than in other industries because there is less motivation to automate a task when the labour associated with the task is not expensive. Due to such impediments, firms are naturally reluctant to try a new technology, especially if it amounts to putting the entire company on the line. Should the new technology prove effective, the firm gains only a temporary strategic advantage. Once it is proven, other bidders can quickly begin to adopt the technology. A construction company should therefore enlist all of its workers in the search for greater productivity, the company should communicate explicitly that suggestions are welcomed and should consider some type of reward system for suggestions that increase productivity. He added that one effect of involving the workers in improving productivity is that they will come to look on the goal as making progress, not finding blame.

The construction company should take a gradualist approach, introducing first the new equipment that will have the most immediate positive impact and to make sure the training that to be provided in new technologies not only details how to use the technology, but also how the company and the workers will benefit from it.

viii. Monitoring & Control

Careful monitoring of the implementation process is crucial to ensuring its sustained effectiveness. This should include activities such as obtaining measurable outcomes in order to provide a clear focus for monitoring and following through the process. Essential elements of this should include control and feedback in the form of both formal and informal mechanisms that allow the process of implementation to be monitored (Cheng *et al,* 2007).

ix. Unfair wages

Fagbenle *et al,* (2011) stated that there is no hard and fast rule relating to the minimum wage for the construction workers in Nigeria, as different wages are being paid in different sites across the country. This normally prompts the construction workers to migrate to where they will be better remunerated.

x. Negative influencing factors

Included in this instance are delays in the delivery of materials and equipment as well as poor welfare facilities. These negative factors reduce the performance and effectiveness of the workers in this regard. Also, mechanical plants that are delivered to the sites hours behind schedule or equipment brought to the site and find out to be faulty at the point of use, will definitely affect worker's output in a negative manner (Fagbenle *et al,* 2011).

xi. Inclement Weather

Inclement weather such as extremely hot sun, heavy rain and harsh weather can negatively contribute to labour performance on construction sites. In some cases, work has to be stopped as a result of heavy downpour/serious rainstorm. Harsh weather (e.g. sun) can also drop the output of average construction workers especially the new ones whom might not be used to working under such weather. Provision of adequate working tools and protective elements will go a long way in reducing this negative influencing factor (Fagbenle *et al,* 2011

xii. Dearth of Investment in Research and Development

Research and development has been stressed by Fagbenle *et al,* (2011) as an important one in order to devise new and more effective and efficient working methods.

There are manuals made available through associations like the Mechanical Contractors Association of America (MCAA) whom has a list called Impacting Factors on Construction Crew Productivity, and this list highlights 33 factors affecting labour productivity which are as follows:

i. Overtime

Scheduling of extended work days or weeks exceeding a standard eight-hour work day or 40 - hour work week lowers work output and efficiency through physical fatigue and poor mental attitude.

ii. Morale and Attitude

Spirit of workers based on willingness, confidence, discipline, and cheerfulness to perform work or tasks can be lowered due to a variety of issues, including increased conflicts, disputes, excessive hazards, overtime, over-inspection, multiple contract changes, disruption of work rhythm, poor site conditions, absenteeism, unkept workspace, and so on.

iii. Fatigue

Fatigue can be caused by prolonged or unusual physical exertion.

iv. Stacking of Trades

This occurs when operations take place within physically limited space with other contractors, resulting in congestion of personnel, inability to use or locate tools conveniently, increased loss of tools, additional safety hazards, increase visitors, and prevention of crew size optimum.

v. Joint Occupancy

This occurs when work is scheduled utilizing the same facility or work area that must be shared or occupied by more than one craft, and not anticipated in the original bid or plan.

vi. Beneficial Occupancy

This is a result of working over, around, or in close proximity to other crafts, owner's personnel, or production equipment, which may cause noise limitations, dust, or other hazardous risk. This may also prevent or cause access restrictions.

vii. Concurrent Operations

This is the effect of adding operations to any sequence of operations that has already been planned, without a gradual and controlled implementation of additional operations.

viii. Absenteeism and Turnover

There is a great deal of time and money lost associated with high turnover and absenteeism on projects. Construction projects in certain areas with low manpower and high demand for labor will usually be more impacted than others. Extreme weather conditions (such as extreme heat or cold) will also increase absenteeism and turnover. Replacement workers are usually not familiar with the work or area, and require experienced workers to stop work and show them what to do.

ix. Mobilize/Demobilize

This relates to moving resources on and moving off to projects as a result from changes or delays, causing work disruptions. Productivity may drop during these periods as time is lost when crews move from one area or work assignment to another.

x. Errors and Omissions

Increases in errors and omissions impact on labor productivity because changes are then usually performed on a crash basis, out of sequence, cause dilution of supervision, or any other negative impacts.

xi. Start/Stop

This results from a work stoppage or suspension of work, which may cause a break in the schedule, usually triggering a start/stop of work activity. Stop-starts can have an impact on productivity and cost of a project. Work scheduled or reassigned during holidays such as thanksgiving, Christmas, New Year's, and so on are often impacted with stop-starts. Workers tend to discuss the time off and lose previous momentum with a drop in productivity before they get back in routine.

xii. Reassignment of Manpower

When workers are reassigned, they experience unexpected or excessive changes, losses caused by move-on or move-off, reorientation, and other issues that result in a loss of productivity.

xiii. Late Crew Build-up

This is caused when the planned project manpower loading is altered and causes manpower loading to build up slower than planned due to availability, shortage of resources, or competition from resources. Impacts can be in excess of 10 percent.

xiv. Crew Size Inefficiency

This is when the optimal crew size is altered by adding or removing crew members. When workers are added or removal from a crew, it breaks up the original team effort and rhythm of the crew and results in loss of productivity.

xv. Site Access

This is a result of interferences to the convenient or planned access to work areas. This can be due to blocked stairways, roads, walkways, insufficient man-lifts, or congested work sites.

xvi. Logistics

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

xvii. Security Check

This could be caused by workers entering or leaving the area, or from an important people in the industry moving in and out, tool box checks, transport of labor to secure area, and so on.

xviii. Learning Curve

When crew turnover causes new workers to be added to a crew or additional manpower is needed within a crew, a period of orientation occurs in order to become familiar with changed conditions. They must then learn work scope, tool locations, work procedures, and so on.

xix. Ripple Effect

This is caused when changes in other trades' work then affects other work, such as the alteration of schedule.

xx. Confined Space

When work is in a confined space with limited ventilation, this can result in nonproductive labour to provide whole watch, along with other issues. Time is also lost when getting to and from the work area.

xxi. Hazardous Work Area

This is caused when working in an area that is classified as hazardous, requiring special safety equipment and clothing. Restrictions may limit time and exposure of workers to the area, resulting in less time on tools in the area.

xxii. Dilution of Supervision

This occurs when supervision is diverted from productive, planned, and scheduled work to analyze and plan contract changes, expedite delayed material, manage added crews, or other changes not in the original work scope and schedule. Dilution is also caused by an increase in manpower, work areas, or project size without an increase in supervision.

xxiii. Holidays

If workers work on holidays, there is not only a cost factor for holiday pay, but there is usually a loss of productivity as well. It may be addressed as a morale factor since workers are away from families and working instead of enjoying the holidays, or it can also be factored separately. Either way, there is usually a productivity loss to consider.

xxiv. Shorter Daylight Hours

Delays can cause work to be deferred from one time period to the next, which may involve seasonal changes. Different regions and locations around the world also have different amounts of daylight hours, depending on the season.

xxv. Weather and Season Changes

Performing work in a change of season, temperate zone, or climate change resulting in work performed in either very hot or very cold weather, rain or snow, or other changes in temperature or climate can impact workers beyond normal conditions.

xxvi. Rain

Most crafts do not work in the rain, but many do, especially those who live in wet regions of the country and must work or risk losing too much in wages. Work can, and does occur in the rain, but not without inefficiencies due to rain gear, visibility, safety, morale, discomfort, hazards, and other issues.

xxvii. Shift Work

This is when work is performed at any time other than the first shift or the morning shift of a work day. Work on second and third shifts are less efficient and may even be based on a shorter work period. The reduced daylight hours and problems trying to pick up where the last shift left off results in less productivity.

xxviii. Working in Operating Area

Inefficiencies can result when work is in close proximity to operating units such as heat from boilers, smoke from emissions, explosion zones, and so on. This can cause work stoppages, need for protective clothing, work permits, or other requirements.

xxix. Over-manning

This is caused when work planners hire too many workers for the estimated work scope and duration. Sometimes, when labor in certain areas or regions is scarce or hard to get, work planners may overcompensate for potential absenteeism and turnover, which creates overstaffing. Another cause is the false assumption that increased manning will always result in increased work productivity.

xxx. Tool and Equipment Shortage

This is caused when there is insufficient quantity or quality of tools and equipment to meet the needs of the project.

xxxi. Area Practices

This can be the result of added or extended coffee breaks, unique observance or custom, or other practices unique to the craft, owner, country, project location, or other customary practices in the area.

xxxii. Proximity of Work

This is caused by working in a remote area, proximity of tools, break area; material lay down yard, or other resources causing a loss of time for access.

xxxiii. Alternating, Staggered, or Rotating Work Schedules

This usually results in unusual or unique scheduled work periods designed to optimize craft hours worked, attract labor to remote sites, compete for labor resources, and minimize fatigue.

2.6 Work Study

2.6.1 Definition of work study

Cole (1996), defined work study as a generic terms 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 received in order to affect improvement. The British Standards Institute Glossary of terms used in Management Services (BS3138, 1969) defines 'Work Study' as systematic examination of activities in order to make improvement.

2.6.2 Aim of work study

According to Barnes (1980), a good work study programme should achieve the following:

i. Increased in productivity of workmen
ii. Reduction in cost of labour
iii. Increased in profit margin
iv. Makes task easier
v. Ensure security of operation
vi. Lay down standards and verifies estimates against actual cost
vii. Reduce wastage of materials and time.
viii. Produce more efficient organization workforce.

2.6.3 Objectives of work study

The main objective of work study is to obtain optimum use of human and material resources, which are available to it (Barnes, 1980). The objectives of every work study as pointed out by Barnes (1980) are as follows:

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

2.6.4 Benefit of work study

Barnes (1980) enumerated the following as the 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

2.6.5 Work study Techniques

The predominating techniques in the Work Study Practitioner's portfolio are

i. Method Study

ii. Work Measurement

These two basic techniques are complimentary to each other, and are rarely utilized in isolation from each other, 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).

2.6.6 Method study

According to the British Standards Institute (BS3138, 1969) method study is “The systematic recording and critical examination of ways of doing things in order to make improvements. The aim of method study is to analyze a situation, examine the objectives of the situation with a view to provide an improved, more efficient and effective method or system.

2.6.7 Method study procedure

The basic procedure of method study is as follows:

i. Select the work or area to be studied.
ii. Record all appropriate and relevant data about the current situation.
iii. Examine critically, the recorded data.
iv. Develop alternative approaches to making improvements and choose the most appropriate.
v. Install the new method, to make the required changes to the situation.
vi. Maintain that new situation.

2.6.8 Work measurement

Work measurement is a collection of techniques, particularly time study, aimed at establishing the time taken by a qualified worker to complete a specified job at a defined level of performance (BS3135, 1969). The work units usually are given in standard minutes or standard hours.

2.6.9 Purpose of work measurement

The purpose of work measurement according to Cole (1996) is as follows:

i. planning the work of a workforce,

ii. manning jobs, to decide how many workers it would need to complete certain jobs,

iii. scheduling the tasks allocated to people

iv. costing the work for estimating contract prices and costing the labour content in general

v. calculating the efficiency or productivity of workers - and from this:

vi. Providing fair returns on possible incentive bonus payment schemes

2.6.10 Procedure for work measurement

Culvert (1981) in Ajia (2002) outlined five (5) steps as the general procedure of work measurement;

a. Select the work to be measured

b. Define the method being used and the job elements

c. Measure the quantity of work and assess the rating

d. Calculate the standard time including allowances

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

2.6.11 Uses of work measurement

University of Leeds (1983) stated the following as uses of work measurement:

i. To establish the most effective way of carrying out a particular operation.
ii. To be able to determine the relative efficiency and timing of alternative methods.
iii. It an aid to standardization of methods.
iv. To be able to set equitable standards of performance for labour and plant; also to provide information on which to base fair and realistic incentive schemes.
v. To investigate, reduce and ultimately eliminate effective time.
vi. To provide elemental data for training local operatives.
vii. To provide data for job departmental estimates and a basis for budgeting control.
viii. To provide reliable data for preparing schedules and programmes of operations for maintenance works.
ix. To determine gang size, type of plants and material testing.

2.6.12 Work measurement Techniques

Several techniques are available for Work Measurement according to previous researchers, these include the followings:

i. Synthesis

Synthesis is described as making use of previously collected elemental data available for each element involved. This technique is very useful especially when building up the time for a new activity (Shuaibu, 2011).

ii. Estimating

According to (Smith, 1970) cited in (Shuaibu, 2011), estimating can exist in the following forms:

a. Analytical estimating
b. Category estimating and
c. Comparative estimating

a. Analytical estimating:

This relies on the experience and judgment of the estimator. It is a development of estimating, in which the job is broken down into elements whose times are estimated partly from experience and partly from using element time already known. These are totaled to give the standard time for the job.

b. Category estimating:

This is a form of range estimating which requires knowledge of the work. Estimators often prefer giving a range estimate; this provides a safety net should things go wrong. Such ranges are not just picked upon at random but are statistically calculated and based on probability theory.

c. Comparative estimating:

In this method estimators rely on experience of the work in order to produce estimates. This experience can be augmented by the provision of each time-range with a few typical, descriptive, jobs that would guide estimators to the most appropriate range. The estimator would compare the work to be estimated with those in the various ranges until the most appropriate fit is found.

iii. Rating:

BS 3138 (1969), defines rating as the assessment of worker's rate of working relative to the observer's concept of rate corresponding to standard rating. This method is based on the observer making snap observations at random or systematic sample times, observing what the operators are doing at the times of those observations and some believes that rating is not a fair and proper way for work measurement (Shuaib, 2011).

iv. Models:

A most useful method for standard or synthetic data-banks of job or element times is using computer models of the jobs. These are generated as mathematical formulae in which the observed data are inserted to compile a time for completion of the task or project. It is a useful method for recycling time standards for elements of basic work over and over again, only changing the values of the variables to suit each project.

2.7 Time study

Time study is a tried and tested method of work measurement for setting basic times and standard time for carrying out specified work (Akeredolu, 2014). It is a principle technique of Work Measurement even today (Gide, 2011). The term "Time Study" as a work measurement technique is one of the ways to study the time required to perform a job. 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. 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 (Ajia, 2002). The procedure for time study involves the following stages:

i. Timing

ii. Rating

iii. Normalizing

iv. Allowances

i. Timing

This is the actual recording of the time to complete an operation by a qualified operative. It is done on the field using a watch. A good wrist watch can be used for this purpose, but a more convenient tool is a stop watch. The recording is done on prepared time study sheets. The most common methods of time as stated by (Lawrence, 1993) cited in (Mohammed, 2011) are;

a. The continuous or cumulative timing

b. 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 the time at end of each work element then reset (snap back) the watch to zero.

ii. Rating

This involves the observer making an assessment of the workers rate of working, that is, the tempo of work of the worker relative to the observer's concepts of the rate corresponding to standard rating after appropriate training.

iii. Normalizing

The normal time is the basic time which is the actual time according to the observer taken to finish a task (Cole, 1996).

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

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

iv. Allowances

Workers usually suffer from fatigue imposed both by the work undertaken and the working conditions. The normal practice according to Foster *et al* (1991) is to make an addition to the basic time commonly referred to as "allowance". It allows the worker to recover from the effects of fatigue and attend to personal needs. It is given as a percentage of the basic time. It is expected that allowances should not be more than 30% Foster *et al* (1991). In addition to the relaxation allowances a further amount is added to cover contingencies. Therefore, to produce a realistic standard time for the proper performance of the work, the idle time (used for personal needs, change of posture, motion, visual fatigue etc.) and relaxation periods observed during the study excluded is added back as allowances to give the standard time.

2.7.1 Aims of time study

The aim of time study is to establish a time for a qualified worker to perform specified work under stated conditions and at a defined rate of working. This is achieved by a qualified practitioner observing the work, recording what is done and then using a time measuring device for the timing and simultaneously assessing the pace of working.

Different researchers had conducted different work on the determination of labour output for different trades at different locations but some were not in compliances with the BESMM. Some of those that were not in compliances with the BESMM are: Shuaibu (2010) conducted a research appraiser on labour outputs and workers' productivity on site within Kaduna metropolis. The operations observed were roof caccassing, roof covering and painting. Work measurement technique was used for the physical observations carried out. Standard time study sheets were prepared and used to collecting relevant data. The data were subjected to statistical analysis and the results obtained from the analysis gave a general output values per day of 80.99m for a gang of four to five labourer, 302.23m^2 and 73.04m^2 for a gang of two labourer for roof carpentry, roof sheeting and painting respectively. These output values were established with consideration to the effect of factors affecting productivity on site that include gender, age, qualification, work experience, payment method. This implies that the outputs can only be realized with the maximization of the above conditions. Udegbe (2007) discussed on the output of painting, where he said that no matter the output of the painters', since there is no standard of payment, the client pays how much he feels should be paid. Udegbe (2007) as well talked of the factors that affect labour output. Udegbe (2007) asserts that leadership affects both the productivity and quality of work and concludes that painters should cover a minimum surface area of 76m^2 per unit rate daily.

Gide (2011) conducted a quantitative research on the trends and patterns of the productivity level of terrazzo and cement and sand screed. Gide (2011) stated that the consequences of adopting inaccurate estimates are enormous and overwhelming. The research empirically established labour outputs for sceeded bed and Terrazoo Tile for the Nigerian construction industry. The results of the analysis carried out established general average output values per day of; 33.38m^2 and 30.45m^2 for cement sand screeding, and terrazzo flooring, respectively. Udegbe (2005) 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 result of the research on plastering was an average output per day of 37.01m^2 and recommended a minimum of 36m^2 of wall surface a day. Udegbe (2005) further ascertained that if a labourer is trained and employed to serve a bricklayer on a site, the master servant inter-play would highly be boasted leading to high productivity value of about 76%.

Mohammed (2009) stated that the high degree of inaccuracy in the bill of quantities produced by Quantity Surveyors in Nigeria is attributed to the uncertainty of the labour constants used in pricing labour costs which are mostly British-based. Mohammed (2009) stated that the geographical factors do affect productivity of workers hence the accuracy of cost estimates produced by Quantity Surveyors in Nigeria is questioned. Mohammed (2009) carried out a research work to determine workers outputs on: door and window glazing, Samples of construction sites within the Kano state were considered for the study. The results of the data analysis established outputs per day per gang of 58.49m^2 for door glazing and window glazing. In addition, productivity factors were considered in relation to the outputs. The result of the data analysis revealed a positive relationship between all the productivity factors and the workers outputs indicating that any change in the factors affects the output level of workers

under observation. That is to say as factors are improved, the productivity level of workers is also improved in that location. Abba (2010) also carried out a similar research on concrete work, form work and reinforcement within Zaria and Kaduna town. Data collected were subjected to statistical analysis. The results of the analysis carried out established general average output values per day of; 153.97m, 30.91m and 2,446.96kg for Formwork to sides of slabs and beams and to columns and also reinforcement work. However, the analysis of variance test conducted in order to analyze and investigate the extent of influence of the productivity factors revealed that, in all the trade considered in this research age as significant difference on the output of workers on site and experience plays a significant role in the output of workers on site too in all the trades except for concreting where it does not play any significant role. The method and level of payment according to the research was not a determinant factor of workers output on site. The group of highly qualified workers has higher outputs than those with little or no qualification. Therefore, it can be concluded that qualification of workers do not have a significant difference on their output on site.

Saheed (2010), state that the financial implications of using any of the labour force in the construction industry accounts for a significant proportion of the cost of building Using work study approach to empirically establish labour outputs on glazing activity and electrical wiring for Nigeria construction industry. Saheed (2010) also looked at the factors that affect the output of the workers he concluded that average glazier should fix a minimum of 13 (900 x 900) size windows, 12 (1200 x 1200) size windows daily and an average electrician should lay a minimum of 223 meters of cable daily.

Aliyu (2010) established the labour output for tiling trade for the Nigerian construction industry in his research. The research was carried out within Zaria, Jaji, and Kaduna metropolitan city. The general average output of a gange per day was obtained from the analyses as: 18.55m^2, 12.60m^2 and 133.11m in floor tiling, wall tiling and skirting length respectively. The negotiation level of payment was observed throughout the study. Working period as well as tools availability and functionality were found to have influence on the workers' output.

Abdulrazaq *et al* (2010) established quantitative labour output constants for trades such as block work, plaster work, trench excavation, tiling work, plaster of Paris (POP) ceiling finishes, concrete work among others. It clearly showed that the labour output in practice are at sharp variance with the empirical outputs established and strongly demands similar studies in all the building trades. Hence, this paper reports the results of a similar empirical investigation based on work study techniques, to determine workers outputs on formwork to sides of columns and slabs, and formwork to soffits of slabs and beams within Zaria and the Kaduna metropolitan city. The results of the data analysis established outputs per gang of: 153.97m for formwork to sides of columns and slabs and 30.91m^2 for formwork to soffits of slabs and beams.

2.8 Paint

The dictionary of architecture and construction cited in (Shuaibu, 2011) defines paint as a liquid solution of pigment in a suitable vehicle of oil, organic solvent, or water; liquid when applied but dries to form an adherent, protective, and decorative coating. Different types of paint are usually identified by the medium that the pigment is suspended or embedded in,

which determines the general working characteristics of the paint. Some paints are fast drying paint containing pigment suspension in acrylic polymer emulsion. Some paint like acrylic paints can be diluted with water, but become water-resistant when dry.

2.8.1. Tools used for painting.

i. Hand Brushes

ii. Rollers and

iii. Scrapers.

iv. Mopping stick or a long straight stick.

2.9 Extracted items on painting from the BESMM3

Some selected items from the extracted items gotten from the BESMM3 as the possible and work related items of painting work is in Table 2.1

Table 2.1: M60 Painting / clear finishing according to BESMM3

Location	Classification (References)	UNIT
General surfaces	Girth > 300mm, multi-coloured work (M60.1.0.1.1)	M^2
	Isolated surfaces, girth $\leq$ 300mm, multi-coloured work (60.1.0.2.1)	M
Railing	multi-coloured work (M60.7.1.1.1)	M^2

Source: BESMM3

These can be further broken down into:

a. Painting of general surfaces of walls, girth greater than 300mm (M60.1.1.1) with: Texture paint, emulsion paint and gloss paint on regular surfaces measured in m^2 because of the peculiarity in the usage of different types of paints.

b. Painting of general surface, isolated surfaces, girth less than or equal to 300mm (M60.1.2.1) with: gloss paint and emulsion paint on regular surfaces measured in m.

c. Painting of general surfaces of ceiling soffit, girth greater than 300mm (M.60.1.1.1) with emulsion paint measured in m^2

d. Painting of railing in m^2.

CHAPTER THREE

RESEARCH METHODOLOGY

3.1. Introduction:

Fellows and Liu (1999) described research as a "voyage of discovery" which makes contribution to the body of knowledge. However, every successful research work must evolve out of a well-organised route or strategy. This strategy according to literature is known as research methodology. This is the way a researcher goes about carrying out the research. Hence, this chapter focuses on the way this research was carried out which includes; Research design, Area of study, Study population, Sample and sampling techniques, data collection, and Statistical analysis of the data.

3.2 Research design

The research design for this study is inferential form of research design aimed at collecting data for the purpose of describing and interpreting the existing conditions regarding the productivity of workers on site. This research design is being adopted for this study due to the nature of the research being purely "quantitative" developed to study the natural phenomena of the productivity level of construction laborers and tradesmen. It involves the survey of some construction sites with various tradesmen with focus on painting trade.

3.3 Area of study

This research was carried out within Lokoja; the state capital of Kogi State. Lokoja is the capital and one of the Local Government Area in Kogi State with an area of 3180 km² and a population of 195,261 at the 2006 census. This area was chosen based on availability and permission granted by the site managers to have access to their sites for their workers to be observed due to the fact that the nature of the research requires physical study of the natural phenomena of productivity level of construction operatives on site. Therefore numerical quantitative data were collected through site observation using a structured time study sheet for the purpose of the study. Data were collected only from on-going construction projects in Lokoja.

3.4 Study population

Sani (2011) described research population as all conceivable elements subjects or observations relating to a particular phenomenon of interest to the research, that 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. The population considered for this research study is the "*construction sites*" engaged in painting within the scope and area of study earlier described for the research. These construction sites where mostly residential and commercial buildings, for both public and private owners in Lokoja. The research also captured the age distribution, gender, educational background, and all other relevant information of the population of interest.

3.5 Sampling technique

Since it is not economical to consider the entire population due to time and other logistic reasons, a sample size of 34 construction sites were considered for observation, all in Lokoja environs. A non-probability sampling method known as *purposive sampling* was employed in selecting all the construction sites of the study because of the activities required to be studied. All the sites were selected on the basis of availability and permission granted by the site managers to have access to their sites for their workers to be observed. From each construction site, the sample characteristics were fully captured as the true representation of the study population. Painting activities in progress were observed and studied accordingly.

3.6 Data collection

Data were collected for the purpose of this research work through field survey using a well-structured time study sheet prepared for data gathering.The study sheet was divided into three sections; section A, section B and section C. Data was collected by measuring the work output executed using measuring tapes. The observed output and time were all recorded on the site in the study sheet.

3.6.1 Field Survey

A well-structured time study sheet was prepared for data gathering for the purpose of this study. The time study sheet was divided into three different sections:

Section A: compiled data on the general information of the project under observation.

Section B: consists of a structured closed ended questionnaire designed to capture all relevant background information relating to the workers. This background information was

designed to accommodate the factors that affect labour productivity of the respective workers under observation and to determine how such factors influence the output of tradesmen under observation. The influencing factors as observed by previous researchers like Mohammed (2009) were; Age, sex, Mode of employment, Experience, Qualification, Working condition. Section C is the work measurement aspect of the data collection process. It recorded the starting, finishing, and the actual time expended in the delivery of an operation. The total outputs per unit time observed were also collected at the different periods of the study. Data were collected personally and also assisted, from the construction sites sampled. The assistants employed were Quantity Surveyors and some serving National youth service corps members that were Quantity surveyors. These assistants were well oriented and trained on the research and data collection procedures before we all proceeded to collect the measurements.

The measurement of the work output executed was carried out using measuring tapes. The observed output and time were all recorded. The output/unit time is then converted to output per day which was taken as an actual time required by operative to deliver a given output according to the specifications in the BESMM3.

3.7 Data analysis

The data collected was subjected to descriptive and regression analysis using SPSS version 18.0. The quantitative output values were converted into output/day and then average outputs/day which was further converted to output/hour.

3.7.1 Test for effect of productivity factors on Labour Outputs

The analysis of the effect of productivity factors on labour output was established using regression analysis. The regression analysis is used to measure causal effect and the effect relationship among the productivity factors and the outputs.

The regression model employs ordinary least square method

$Y = \overline{b0 +} b1$ (Qualification) + b2 (Experience) + b3 (Type of contract) + b4 (weather condition) + b5 (Degree of temperature) + b6 (Morning period) + b7 (Afternoon period) + e

Where bo = intercept, when other factors are assumed constant and b1, b2, b3, b4, b5, b6, and b7 represent the predictor coefficients (effect estimate).

e = error term or residual variable unknown.

The level of significance for acceptance and rejection of Hypothesis is 5% (0.05alpha level). It rejects the null hypothesis and accepts the alternative hypothesis and t. score is a standard estimate of difference within the observed productivity factor selected while p value shows the level of significance of the productivity factors selected.

3.7.2. Measurement of outputs

The quantitative output values gathered on the painting trade category were converted from output/period to output/day units. The measures of central tendency particularly the mean is used to calculate the average outputs/unit time, that is, average output/day.

CHAPTER FOUR

DATA PRESENTATION, ANALYSIS AND DISCUSSION OF RESULTS

4.1 Introduction

This chapter reviewed the strategies employed in the presentation and analysis of the data collected for this study and evaluates the output value of workers on general basis setting down the major parameters of the factors influencing productivity of workers on site operations based on data collected, and also presents the analysis and findings of the productivity level in terms of output per unit measurement of tradesmen in site operations.

4.2. Descriptive analysis

4.2.2. Labour output for Painting of general surface of walls, girth greater than 300mm

4.2.3. Background Information for the painting activities collected

Background Information for the painting activities collected for general surface of walls, girth greater than 300mm in m^2 and girth less than or eqaual to 300mm in m which are provisions in the BESMM3 that were applicable to the site visited, they are:

i. Include internal and external walls
ii. Paints are done on cement, sand rendered surfaces
iii. On regular surfaces
iv. Two coats of paint were applied
v. Three different type of paint were studied; Gloss, Emulsion and Texture
vi. Paints were applied with roller and touch brush
vii. The activity includes preparatory work done on the sub base before the actual painting activities to painting.

Table 4.1 shows the output values for painting of walls of girth greater than 300mm with gloss paint. The full tables can be seen in the appendices 2.

Table 4.1: Labour output values for Painting of general surfaces of walls, girth greater than 300mm with gloss paints measured in 'm^2'

Observation no. of construction sites	First period output (m^2/day)	Second period output (m^2/day)	Total output(m^2/day)
1	26	11.5	37.5
2	34.5	15.5	50
3	57.3	16	73.3
4	54	25	79
5	56	14	70
6	72	21	93
7	36	18	54
8	61.5	21.50	83
9	66.5	26	92.5
10	48	20	68
11	55	20	75
12	58.5	21	79.5
13	26.5	11.50	38
14	25	11.50	36.5
-	-	-	-
20	54	13	67
21	33	14	47
29	80	26	106
30	82	24	106
31	84	21	105
32	48	24	72
33	74	16	90
34	108	36	144
Total	1824.3	643.5	2467.8
Average/ Day	53.66	18.93	72.58
Average/ hour	6.71	2.37	9.07

Source: Researcher's field survey (2015).

Table 4.2 shows the output values for painting of walls of girth greater than 300mm with emulsion paint. The full tables can be seen in the appendices 2.

Table 4.2: Labour output values for Painting of general surfaces of walls, girth greater than 300mm (M60.1.1.1) with emulsion paints measured in 'm^2

Observation no. of construction sites.	First periods (m^2/day)	Second periods (m^2/day)	Total output (m^2/day)
1	72.5	16.0	88.5
2	49.0	14.0	63.0
3	85.0	41.2	126.2
4	82.0	20.0	102.0
5	72.0	37.0	109.0
6	87.0	23.0	110.0
7	42.5	14.0	56.5
8	91.0	15.0	106.0
9	49.0	19.0	68.0
10	36.0	16.0	52.0
11	56.5	14.5	71.0
12	56.0	15.0	71.0
13	56.0	12.0	68.0
14	48.0	22.9	70.9
15	11.2	16.3	27.5
16	57.5	24.0	81.5
17	55.0	10.5	65.5
18	26.0	27.0	53.0
-	-	-	-
44	11.2	14.0	25.2
45	84.0	26.0	110.0
46	57.0	18.0	75.0
47	59.0	11.0	70.0
48	55.0	14.0	69.0
Total	2825.72	1065.8	3891.5
Average	58.87	22.20	81.07
Average/ hour	7.35	2.78	10.13

Source: Researcher's field survey (2015).

Table 4.3 shows the output values for painting of walls of girth greater than 300mm with textured paint. The full tables can be seen in the appendices.

Table 4.3: Labour output values for Painting of general surfaces of walls, girth greater than 300mm (M60.1.1.1) with textured paints measured in 'm^2'

Observation no. of construction sites	First periods (m^2/day)	Second periods (m^2/day)	Total output (m^2/day)
1	32	10.5	42.5
2	111	49.5	160.5
3	115	42.5	157.5
4	110.5	51	161.5
5	95	41	136
6	44	40.6	84.6
7	132	25	157
8	77.5	37	114.5
9	116.5	45	161.5
10	85	56	141
11	116	54	170
12	92.25	8	100.25
13	65	14	79
-	-	-	-
46	96.5	47	143.5
47	84.5	17.5	102
48	110	28.5	138.5
49	67.5	20.5	88
50	108	44	152
51	108.5	8	116.5
52	112	36.5	148.5
53	133	27.5	160.5
54	89	11.5	100.5
Total	5137	1805.76	6940
Average/ day	95.13	33.44	128.52
Average/ hour	11.89	4.18	16.07

Source: Researcher's field survey (2015).

Table 4.4 shows the output values for painting of walls of girth less than 300mm with gloss paint. The full tables can be seen in the appendices.

4.2.4. Labour output for general surfaces of wall, girth less than 300mm in 'm'.

Table 4.4: Labour output values for Painting of general surfaces of walls, girth less than 300mm (M60.1.1.1) with gloss paints measured in 'm'

Observation no. of construction sites.	First periods (m^2/day)	Second periods (m^2/day)	Total output (m^2/day)
1	100.70	25.00	125.70
2	179.58	72.00	251.58
3	105.00	25.20	130.20
4	108.15	43.18	151.33
5	128.00	155.00	283.00
6	182.00	123.00	305.00
7	105.00	40.52	145.52
8	201.00	42.00	243.00
9	104.18	52.00	156.18
10	186.20	18.00	204.20
-	-	-	-
17	202.00	21.00	223.00
18	214.00	65.00	279.00
19	218.00	26.00	244.00
Total	3250.68	971.40	4222.08
Average/ day	162.53	48.57	211.10
Average/hour	20.32	6.07	26.39

Source: Researcher's field survey (2015).

Table 4.5 shows the output values for painting of walls of girth less than 300mm with emulsion paint. The full tables can be seen in the appendices.

Table 4.5: Labour output values for Painting of general surfaces of walls, girth less than 300mm (M60.1.1.1) with emulsion paints measured in 'm'

Observation no. of construction sites.	First periods (m^2/day)	Second periods (m^2/day)	Total output (m^2/day)
1	360.00	99.20	459.20
2	210.00	33.60	243.60
3	105.00	51.33	156.33
4	319.00	44.00	363.00
5	180.00	92.00	272.00
6	125.00	60.52	185.52
7	210.00	45.00	255.00
8	354.00	22.00	376.00
9	372.00	21.00	393.00
10	340.00	26.00	366.00
11	215.00	47.00	262.00
12	153.00	31.00	184.00
13	152.00	33.60	185.60
14	294.00	42.00	336.00
15	320.00	22.00	342.00
16	366.65	21.00	387.65
17	226.80	27.00	253.80
18	180.00	24.00	204.00
19	126.00	52.70	178.70
20	205.00	78.00	283.00
21	163.63	47.00	210.63
22	182.00	62.00	244.00
23	210.00	33.60	243.60
Total	5430.28	1206.31	6384.63
Average/ day	236.10	52.45	277.59
Average/ hour	29.51	6.56	34.70

Source: Researcher's field survey (2015).

Table 4.6 showed the results of the descriptive analysis of the labour output for painting of walls with different type of paints. It was observed from the Table 4.6 that there were differences in the output per day for painting of general surfaces of walls, girth greater than 300mm with different types of paint; gloss having 72.58m^2/day; emulsion having 81.07m^2/day and textured with 128.53m^2/day. This is as a result of the nature of the paints used in term of adhesive and drying, handling and experience of the painters. Painting of general surfaces of walls, girth less than 300mm shows the value of outputs using gloss and emulsion paint as 211.10m/day and 277.59m/day which the differences in the output is also as a result of the difference in the nature of the paint used in term of adhesive and drying, handling and experience.

Table 4.6: Descriptive analysis for Labour output for Painting of general surfaces of walls, girth greater than 300mm (M60.1.1.1) with different types of paints

Description of work item	Type of paint	Output/ day (two coats)	Output/hour (two coats)
Walls of girth greater than 300mm	Gloss	72.58m^2	9.07 m^2
	Emulsion	81.07 m^2	10.13 m^2
	Textured	128.53m^2	16.07 m^2
Walls of girth less than 300mm	Gloss	211.10m	26.39m
	Emulsion	277.59m	34.70m

Source: Researcher's field survey (2015) Average/Day

4.2.5. Labour output for painting of general surfaces of ceiling soffit, girth greater than or equal to 300mm in m^2.

The following were the background Information considered for painting of general surfaces of ceiling soffit, girth greater than or equal to 300mm:

i. Include internal and external ceiling soffits

ii. Paints are done on asbestos ceiling boards

iii. On regular surfaces

iv. Two coats of paint were done

v. By a painter

vi. Applied with roller and touch brush and

vii. The activity also includes preparatory work done on the sub base before the actual painting activities.

Table 4.7 shows the output values for painting of ceiling soffit of girth greater than 300mm with emulsion paint. The full tables can be seen in the appendices.

Table 4.7: Labour outputs for painting of general surfaces of ceiling soffits, girth greater than or equal to 300mm measured in m^2 with emulsion paint

Observation no.	First periods (m^2/day)	Second periods (m^2/day)	Total output (m^2/day)
1	70.0	32.0	102.0
2	66.0	16.0	82.0
3	51.0	45.0	96.0
4	87.0	18.5	105.5
5	41.0	36.0	77.0
6	70.5	23.5	94.0
7	55.0	48.0	103.0
8	52.0	22.0	74.0
9	72.0	63.0	135.0
10	81.0	54.5	135.5
11	54.6	60.0	114.6
12	27.5	23.5	51.0
13	52.5	21.0	73.5
14	114.0	70.5	184.5
15	84.0	28.0	112.0
-	-	-	-
29	72.0	12.0	84.0
30	41.0	23.0	64.0
31	48.0	16.0	64.0
32	71.0	10.0	81.0
33	51.0	8.0	59.0
34	39.0	19.0	58.0
Total	1994.7	905.9	2900.6
Average/ day	58.67	26.64	85.31
Average/ hour	7.33	3.33	10.66

Source: Researcher's field survey (2015).

Table 4.8 shows the results of the descriptive analysis of workers outputs for painting of general surfaces of ceiling soffits, girth greater than 300mm with emulsion paint. The result shows the output of 85.31m^2/day by a painter and 10.66m^2/hour using two coats.

Table 4.8: Descriptive Analysis of Labour output for painting of ceiling soffits, girth greater than or equal to 300mm measured in with emulsion paint.

Description of work item	Type of paint	Output/day (two coats)	Output/hour (two coats)
Ceiling soffit, girth greater than 300mm	Emulsion	85.31m^2	10.66m^2

Source: Researcher's field survey (2015) Average/Day

4.2.6. Labour output for painting of Railings, with gloss paint in m^2.

The following background information for painting on railings, girth greater than 300mm with gloss paint in m^2 was considered;

i. Include hand rails for houses, shops and landscaping of road sides

ii. Paints are done on the general surfaces of the iron/steel rails

iii. One coat of paint were been done

iv. By one painter

v. Paint were applied with small size roller and touch brush and

vi. The activity includes preparatory work done on the sub base before the actual painting activities.

Table 4.9 shows the output values for painting of railings with gloss paint. The full tables can be seen in the appendices.

Table 4.9: Labour output values for Painting of railings, using gloss paint in m^2

Observation no.	First periods (m^2/day)	Second periods (m^2/day)	Total output (m^2/day)
1	37.0	11.4	48.4
2	27.5	11.5	39.0
3	13.5	12.0	25.5
4	17.0	15.0	32.0
5	23.0	10.0	33.0
6	37.0	15.0	52.0
7	35.5	12.0	47.5
8	47.0	20.0	67.0
9	7.1	10.0	17.1
10	25.6	8.4	34.0
11	22.6	9.0	31.6
-	-	-	-
37	28.0	21.5	49.5
38	80.0	28.0	108.0
39	21.0	14.0	35.0
40	29.5	22.0	51.5
Total	1363.0	623.3	1986.3
Average/ day	34.08	15.58	49.66
Average/ hour	4.26	1.95	6.21

Source: Researcher's field survey (2015).

Table 4.10 shows the results of the descriptive analysis of the workers outputs for painting of railings, with one coat of gloss paint and the determined output which is 49.66m^2 per day as determined.

Table 4.10: Descriptive Analysis of Labour outputs for painting of railings with gloss paint in m^2

Description of work item	Type of paint	Output/day (one coats)	Output/hour (one coats)
Railings	Gloss	49.66m^2	6.21m^2

Source: Researcher's field survey (2015) Average/Day

The Summary of the descriptive analysis of Labour outputs observed on painting activities per painter as shown in Table 4.11 shows that:

First Period: It was observed that the mean output of the painters with gloss, emulsion and textured paint in Table 4.1, Table 4.2, Table 4.3 and the summary Table 4.11 irrespective of the influencing factors was 53.66m^2, 58.98m^2 and 95.13 m^2 respectively for walls of girth greater than 300mm with the standard deviation of 23.56, 22.11 and 21.12 respectively. It was observed that walls of girth less than 300mm had the mean output of the painters with gloss paint, emulsion paint to be 161.46m and 226.97m irrespective of the influencing factors with a standard deviation of 82.90 and 105.80. It was also observed that the average output of the workers irrespective of the influencing factors was 58.67m^2 with a high standard deviation of 22.13 which shows that the individual outputs were scattered and not clustered around the mean value.

Second period: The mean output recorded during the second period for the general surfaces of walls of girth greater than 300mm was 18.93m^2, 22.08m^2, 33.40m^2 per day as shown in Table 4.10 The Table shows a reduction in the productivity level of the painters which might be due to the duration of the time used during the second period and their working capacity. The standard deviations were 14.93, 12.18 and 6.15 respectively for walls of girth greater than 300mm with gloss, emulsion and texture paint. The average output recorded during the second period for painting of walls girth less than 300mm was 49.46m and 50.62m which show a reduction in the productivity level of the painters which might be due to the duration of the time used during the second period and their working capacity. The standard deviations were 27.25 and 25.83 respectively. The average output recorded during the afternoon period for ceiling soffits, girth greater than 300mm was 26.64m^2 and the standard deviation was 16.52. The average output recorded during the second period for railings was 15.58m^2. This also shows a reduction in the productivity level of the painters .The standard deviation was 22.65 m^2.

Table 4.11: Summary of the Descriptive Analysis of Labour outputs observed on painting activities per painter

Description of work items	Period of observation	No of observations	Minimum	Maximum	Mean	Std. Deviation
Ceiling soffit, girth greater than 300mm with Emulsion paint	Labour Outputs/ Person/day	34	37.00	184.50	85.3103	31.33452
	Morning Work	34	22.00	115.00	58.6676	22.12520
	Afternoon Work	34	8.00	70.50	26.6441	16.52006
Railing, girth greater than 300mm with Gloss paint	Labour Outputs/ Person/day	40	17.10	127.50	49.6575	22.65294
	Morning Work	40	7.10	102.00	34.0750	18.74758
	Afternoon Work	40	5.00	28.00	15.5825	6.15650
Walls girth <300mm with Emulsion paint	Labour Outputs/ Person/day	23	145.52	459.20	277.5909	109.89777
	Morning Work	23	105.00	360.00	226.9687	105.79931
	Afternoon Work	23	22.00	99.20	52.4522	25.82513
Walls, girth < 300mm with Gloss paint	Labour Outputs/ Person/day	16	88.50	420.90	211.0984	100.05494
	Morning Work	16	72.50	348.90	161.4569	82.89818
	Afternoon Work	16	16.00	123.75	48.5660	27.25327
Walls, girth > 300mm with Emulsion	Labour Outputs/ Person/day	48	23.10	134.60	81.0667	28.06758
	Morning Work	48	11.20	98.60	58.9833	22.10669
	Afternoon Work	48	6.00	68.00	22.2033	12.17784
Walls, girth > 300mm with Gloss paint	Labour Outputs/ Person/day	34	36.50	144.00	72.5824	25.96350
	Morning Work	34	25.00	108.00	53.6559	21.12113
	Afternoon Work	34	11.50	36.00	18.9265	6.14612
Walls, girth > 300mm with Texture paint	Labour Outputs/ Person/day	54	42.50	188.00	128.5250	30.27764
	Morning Work	54	32.00	161.00	95.1287	23.56138
	Afternoon Work	54	8.00	73.50	33.4430	14.93307

Source: Researcher's field survey (2015) Descriptive Analysis

4.3 The inferential statistics analysis

Regression Analysis was used to determine the effect of the productivity factors on the outputs obtained. The following labour productivity factors were considered for the tests. These factors were reported to be common and highly ranked factors of productivity affecting labour output of workers in Nigreian construction sites (Mohammed, 2009; Adegboyega, 2014; Akeredolu, 2014 and Onyeagam, 2014). These factors are:

i. Period of observation

ii. Mode of Employment

iii. Qualification

iv. Experience

v. Gender

vi. Age

vii. Temperature of the work environment and

viii. Weather condition

From the data collected, all the workers falls under the same option for some of the productivity factors such as Age and gender because all falls under 19 to 35 from the different ranked range such as below 19years, 19 to 35years, above 36years and all the workers were male which implies that 100% of the observed workers were male and thus indicates the discriminatory nature of the painting activities in the construction market. Perhaps location, culture and the nature of the work item in question were the basis for this. Females were not involved in painting activities in that locality as such there were no variable to be compared. The temperature of the work environment was ranked, which ranges from 25^{o}c to 30^{o}c, 31^{o}c to 35^{o}c and 36^{o}c to 40^{o}c. Apart from the ordinary

apprenticeship training of the workers observed, additional training in respect of educational qualification was taken into cognizance.

Ameh *et al.*, (2002) attributed high labour output to the quality of operatives. Different workers had different educational background ranging from primary certificate, SSCE, NABTEB, ND and others as grouped from the data gathered which confirms that the sample observed was a sample of qualified workers. The mode of employment ranging from contract employed workers, negotiated worker and Daily paid workers were also determined as stated in the study sheet. The weather conditions were also categorized into sunny, windy, and rainy as the case applied also the type of paints used.

4.3.1. Period of Observation

Null hypothesis ($H0_1$): There is no output difference in all the different periods of observations. The Tables 4.12, Table 4.13, Table 4.14 and Table 4.15 shows the regression analysis of the first and second periods for: Painting of general surfaces of walls with different paints, girth greater than 300mm; Painting of general surfaces of walls with different paints, girth less than 300mm; painting of general surfaces of ceiling soffit, girth greater than 300mm with emulsion paint and painting of railings, with gloss paint.

The result of the analysis revealed that there were differences between the period of observation which lead to a decrease in the output but the decrease were not significant because all the calculated significant p value were greater than the (0.05) alpha level of significance. This means that there were differences but the difference between the productivity of painters in the first and second period were not significant except for painting of general surfaces of ceiling soffit, girth greater than 300mm with emulsion paint where there exist a

positive change which is significant because the calculated P value 0.001 is lower than 0.05 alpha level of significant. Hence the null hypothesis is rejected for the periods of observations except for painting of general surfaces of ceiling soffit, girth greater than 300mm with emulsion paint where the first period support acceptance of the null hypothesis. This simply means that the level of output per productivity does not dependent on the period of work for these painting activities except for painting of general surfaces of wall with gloss paint and ceiling soffits with emulsion which is probably because of fatigue, location and the rate of dryness of the paint.

The unstandardized coefficients B in the analysis Tables are the actual rate of change that determines the true effect of the independent variable. The standard error examines the risk of using the unstandardized coefficient B without evaluating the un-equal sample associated with the independent variable. The standardized coefficients (Beta) help to remove and check the unreliable nature of the unstandardized coefficient B. Estimate for difference (t value) determine the significance of the value in relation to the tabulated casual value in statistical error measurement, that is, a positive value greater than or equal to zero shows that effect of standardized coefficient is attributed to chance while when t value is less than zero shows that the standardized coefficient is more likely to impact the dependent variable, that is, the output.

Table 4.12: Painting of general surfaces of walls with different paints, girth greater than or equal to 300mm in m^2 equal to 300mm in m^2

Variable	Type of paint	Observed No	Mean	Unstandardized Coefficient B	Std.Error	Std. coefficient (Beta)	Estimate for diff. (t value)	Sig. P value
First period	Gloss	34	53.656	-3.168	10.612	-0.054	-0.299	0.768
	Emulsion	48	58.983	-4.925	7.752	-0.149	-0.635	0.529
	Texture	54	95.129	-6.668	7.455	-0.136	-0.895	0.376
Second period	Gloss	34	18.927	-42.854	21.838	-0.329	-1.962	0.061
	Emulsion	48	22.083	-5.654	7.398	-0.764	-0.764	0.449
	Texture	54	33.396	1.813	4.618	0.63	0.393	0.696

Source: Researcher's field survey (2015) Regression Analysis

The result of the analysis revealed that there were differences between the periods of observation which lead to a decrease in the output but the decrease were not significant in Table 4.12.

Table 4.13: Painting of general surfaces of walls with different paints, girth less than or equal to 300mm in m.

Variable	Type of paint	Observed No	Mean	Unstandardized Coefficient B	Std.Error	Std. coefficient (Beta)	Estimate for diff. (t value)	Sig. P value
First period	Gloss	16	161.457	49.761	29.900	0.444	1.664	0.130
	Emulsion	23	226.97	38.765	26.394	0.341	1.469	0.161
Second period	Gloss	16	49.644	41.319	29.169	0.409	1.417	0.190
	Emulsion	23	50.622	10.708	65.217	0.37	0.164	0.872

Source: Researcher's field survey (2015) Regression Analysis

The result of the analysis revealed that there were differences between the periods of observation which lead to a decrease in the output but the decrease were not significant in Table 4.13.

Table 4.14: Painting of railings, girth greater than 300mm

Variable	Type of paint	Observed No	Mean	Unstandardized Coefficient B	Std.Error	Std. coefficient (Beta)	Estimate for diff. (t value)	Sig. P value
First period	Gloss	40	34.075	4.238	3.464	0.244	1.223	0.230
Second period	Gloss	40	15.583	-4.945	3.202	-0.275	-1.544	0.132

Source: Researcher's field survey (2015) Regression Analysis

The result of the analysis revealed that there were differences between the periods of observation which lead to a decrease in the output but the decrease were not significant in Table 4.14.

Table 4.15: Painting of general surfaces of ceiling soffit, girth greater than 300mm

Variable	Type of paint	Observed No	Mean	Unstandardized Coefficient B	Std.Error	Std. coefficient (Beta)	Estimate for diff. (t value)	Sig. P value
First period	Emulsion	34	58.668	18.688	5.212	0.723	3.586	0.001
Second period	Emulsion	34	26.644	20.628	9.557	0.478	2.158	0.40

Source: Researcher's field survey (2015) Regression Analysis

The result of the analysis revealed that there were differences between the periods of observation which lead to a decrease in the output but the decrease were not significant in Table 4.15 also.

4.3.2 Mode of Employment

Null Hypothesis (H2o): The level of outputs of workers does not depend on their mode of employment. Table 4.16 shows the result of the effect of productivity factors with the mode of employment for painting of general surfaces of walls with different paints, girth greater than 300mm; painting of general surfaces of walls with different paints, girth less than or equal to 300mm; painting of railings with gloss paint and painting of general surfaces of ceiling soffit, girth greater than 300mm with emulsion paint. The result of the regression analysis shows that there exist an effect on the productivity of painters and changes in the mode of employment but the differences were not significant because all the calculated significant p value for each is greater than the 0.05 alpha level of significance as shown in Table 4.16 as a result do not rejects the null hypothesis because the level of output of workers does not depend on the mode of employment except for painting of general surfaces of walls with gloss paints, girth greater than 300mm which had the calculated p value as 0.017 which is lower than 0.05 hence it rejects the null hypothesis and accepted the alternative Hypothesis.

This means that the level of output per painter does not dependent on the mode of employment of workers under observation for painting of general surfaces of walls, girth greater than 300mm with emulsion paint, gloss paint and painting of general surfaces of ceilings soffit with emulsion paint, railings with gloss paint and general surfaces of walls, girth less than 300mm using emulsion paints, hence the null hypothesis $H0_2$ was accepted all the work items but rejected for painting of walls, girth greater than 300mm with textured paint and for painting of general surface of wall, girth less than 300mm with gloss paint.

Table 4.16: Effect of Mode of Employment on painting outputs

Variable	Type of paint	Observed No	Mean	Unstandardized Coefficient B	Std.Error	Std. coefficient (Beta)	Estimate for diff. (t value)	Sig. P value
Wall, girth ≥300mm.	Gloss	34	72.582	19.484	7.804	-0.0383	-2.549	0.017
Wall, girth ≥ 300mm.	Emulsion	48	81.067	-8.872	8.768	-0.077	-0.452	0.654
Wall, girth≥ 300mm.	Texture	54	128.525	-2.230	8.998	-0.036	-0.248	0.805
Ceiling, girth ≥ 300mm.	Emulsion	34	85.310	-2.775	9.236	-0.166	-1.129	0.269
Wall, girth < 300mm.	Gloss	16	211.098	-19.891	7.804	-0.383	-2.549	0.017
Wall, girth < 300mm.	Emulsion	23	277.591	23.841	35.260	-0.140	-0.676	0.509
Railings.	Gloss	40	49.658	-8.211	8.871	-0.180	-0.926	0.362

Source: Researcher's field survey (2015) Regression Analysis

4.3.3 Experience of workers

Null hypothesis (H3o): There is no output difference between the highly experience groups of workers and workers with lower experience. Table 4.17 shows the effect of productivity factors on the experience of workers for painting of general surfaces of walls with different paints, girth greater than 300mm; painting of general surfaces of walls with different paints, girth less than or equal to 300mm; painting of railings with gloss paint and painting of general surfaces of ceiling soffit, girth greater than 300mm with emulsion paint. All the calculated significant p value for each is greater than 0.05 significant levels as shown in Table 4.17; as such, rejects the null hypothesis except for painting of general surfaces of walls with gloss paints, girth

greater than 300mm which had the calculated p value as 0.032 which is lower than 0.05 hence accepts the alternative hypothesis.

This implies that lengths of experience of workers does not dictate the level of outputs for painting of all the work items except for painting of general surface of wall, girth greater than 300mm using textured paint.

Table 4.17: Effect of Experience of workers on painting outputs

Variable	Type of paint	Observed No	Mean	Unstandardized Coefficient B	Std.Error	Std. coefficient (Beta)	Estimate for diff. (t value)	Sig. P value
Wall, girth ≥300mm	Gloss	34	72.582	19.484	8.614	0.356	2.262	0.032
Wall, girth ≥ 300mm	Emulsion	48	81.067	-2.680	5.930	-0.077	-.452	0.654
Wall, girth≥ 300mm	Texture	54	128.525	13.168	8.687	0.249	1.516	0.136
Ceiling, girth ≥ 300mm	Emulsion	34	85.310	11.439	6.911	0.284	1.655	0.110
Wall, girth < 300mm	Gloss	16	211.098	-78.590	65.415	-0.376	-1.201	0.260
Wall, girth < 300mm	Emulsion	23	277.591	85.037	59.127	0.326	1.438	0.170
Railings	Gloss	40	49.658	8.457	8.944	0.189	0.945	0.351

Source: Researcher's field survey (2015) Regression Analysis

4.3.4 Qualification of workers

Null hypothesis (H4o): There is no output difference between the well-educated group of workers and workers with lower qualification. Table 4.18 shows the effect of productivity factor; Qualification of workers, on their output for painting of general surfaces of walls with different paints, girth greater than 300mm; painting of general surfaces of walls with different paints, girth less than or equal to 300mm; painting of railings, girth greater than 300mm with gloss paint and painting of general surfaces of ceiling soffit, girth greater than 300mm with emulsion paint. It was observed from the result that there positive changes or increase in the outputs with the level of qualification attained but the increase were insignificant because all the calculated significant p value for each item of work 0.38, 0.78, 0.87, 0.97, 0.17 and 0.35 were greater than the 0.05 alpha level of significance except for painting of general surfaces of ceiling soffit, girth greater than 300mm with emulsion paint which had 0.04 as shown in Table 4.18; hence all other painting activities accepts the null hypothesis except painting of general surfaces of ceiling soffit, girth greater than 300mm with emulsion paint which rejects the null hypothesis.

This implies that output difference exists between the groups but does not have significant effect except for painting of general surfaces of walls, girth greater than 300mm with gloss paint and railings with gloss paint, where the results rejects the null hypothesis.

Table 4.18: Effect of Qualification of workers on painting outputs

Variable	Type of paint	Observed No	Mean	Unstandardized Coefficient B	Std.Error	Std. coefficient (Beta)	Estimate for diff. (t value)	Sig. P value
Wall, girth ≥ 300mm	Gloss	34	72.582	4.298	4.810	0.151	0.894	0.380
Wall, girth ≥ 300mm	Emulsion	48	81.067	1.129	4.042	0.043	0.279	0.782
Wall, girth≥ 300mm	Texture	54	128.525	0.651	3.922	0.029	0.166	0.869
Ceiling, girth ≥ 300mm	Emulsion	34	85.310	9.545	4.437	0.367	2.151	0.041
Wall, girth < 300mm	Gloss	16	211.098	2.092	59.523	0.009	0.035	0.973
Wall, girth < 300mm	Emulsion	23	277.591	85.037	59.127	0.326	1.438	0.170
Railings	Gloss	40	49.658	8.457	8.944	0.189	0.945	0.351

Source: Researcher's field survey (2015) Regression Analysis

4.3.5 Temperature of the work environment.

Null hypothesis (H5o): There is no output difference with the change in temperature of the work environment. Table 4.19 shows the effect of productivity factors on the temperature of work environment for painting of general surfaces of walls with different paints, girth greater than 300mm and girth less than 300mm, painting of railings, girth greater than 300mm with gloss paint and painting of general surfaces of ceiling soffit, girth greater than 300mm with emulsion paint. The result shows that there exists a positive and negative effect between the productivity of painters with change in temperature as shown in the B coefficient vales in Table 4.19 respectively which is due to the rate of drying as temperature changes. All the calculated significant p value for each is greater than the 0.05, these means that there are positive and

negative effects respectively but the effects is not significant except for painting of general surfaces of walls with gloss and emulsion paints, girth greater than 300mm where the calculated P value 0.015 and 0.036 is lower than 0.05 alpha level. Hence the null hypothesis is accepted for all the work items except for painting of walls, girth greater than 300mm with gloss and emulsion paints as shown in Table 4.19.

Table 4.19: Effect of Temperature of the work environment on painting outputs

Variable	Type of paint	Observed No	Mean	Unstandardized Coefficient B	Std.Error	Std. coefficient (Beta)	Estimate for diff. (t value)	Sig. P value
Wall, girth ≥300mm	Gloss	34	72.582	31.701	12.131	0.474	2.613	0.015
Wall, girth ≥ 300mm	Emulsion	48	81.067	1.265	12.578	0.019	0.101	0.920
Wall, girth ≥ 300 mm	Texture	54	128.525	30.329	14.061	0.391	2.157	0.036
Ceiling, girth ≥ 300mm	Emulsion	34	85.310	-0.593	10.026	-0.009	-0.59	0.953
Wall, girth < 300mm	Gloss	16	211.098	47.824	64.539	0.245	0.741	0.478
Wall, girth < 300mm	Emulsion	23	277.591	77.990	44.229	0.397	1.763	0.097
Railings	Gloss	40	49.658	-4.225	16.135	-0.072	-0.262	0.79

Source: Researcher's field survey (2015) Regression Analysis

4.3.6 Weather condition

Null hypothesis (H6o): There is no output difference with the change in weather condition of the work environment. The result of the analysis as shown in Table 4.20 shows the effect of productivity factors on the weather condition of the work environment for painting of general surfaces of walls with different paints, girth greater than 300mm, painting of railings with gloss paint and painting of general surfaces of ceiling soffit, girth greater than 300mm with emulsion paint. The result in Table 4.20 shows that there exist a positive and negative effect as shown in the B vales respectively but all the calculated significant p value for each cases is greater than the (0.05) alpha level of significance. This means that there were differences in the output of workers as the weather condition changes but the effects and differences were not significant hence accepts the null hypothesis. This implies that; though there were differences in the output, the difference for the labour output of the painters with the change in the weather condition of the work environment is insignificant.

The effect of weather condition on the painting of general surfaces of walls with different paints, girth less than or equal to 300mm could not be determined reason been that the data gathered for this work item all falls under sunny weather as a result there were no other weather condition to be compare with.

Table 4.20: Effect of Weather condition on painting outputs

Variable	Type of paint	Observed No	Mean	Unstandardized Coefficient B	Std.Error	Std. coefficient (Beta)	Estimate for diff. (t value)	Sig. P value
Wall, girth ≥300mm	Gloss	34	72.582	-31.257	26.114	-0.206	-1.197	0.242
Wall, girth ≥ 300mm	Emulsion	48	81.067	1.502	15.997	0.018	0.094	0.926
Wall, girth≥ 300mm	Texture	54	128.525	-11.220	12.317	-0.130	-0.911	0.367
Ceiling, girth ≥ 300mm	Emulsion	34	85.310	-21.824	19.336	-0.166	-1.129	0.269
Railings	Gloss	40	49.658	12.263	17.677	0.181	0.694	0.493

Source: Researcher's field survey (2015) Regression Analysis

It was observed that there were output difference from the resultant output gotten from this research with the different type of paint used; difference between labour output using textured, emulsion and gloss paint with textured paint having the highest output value per day followed by output for emulsion and then gloss paint for walls of girth greater than 300mm. There were no options to be compared with under age from the data collected because all falls under the same option which is age 19 to 35 years. This implies that painters in Lokoja are mostly vibrant youths since it was only the same option, there were no variable to be compared.

It was also observed that the workers were all male which implies that female worker are not usually involved in painting activities on construction sites because of the nature of painting trade as all painting and its associated works were done by the painters them self.

CHAPTER FIVE

SUMMARY CONCLUSION AND RECOMMENDATIONS

5.1. Introduction

This chapter entails the conclusion of the results based on the information obtained throughout the process of the research work and appropriate recommendations were made.

5.2 Summary of Findings

A review of literature revealed that there is no single and uniform collection of labour constants currently in use within the Nigerian construction industry as such; some contractors adopt the British originated outputs while others use the output which they establish based on their personal work experience.

The aim of the study was to empirically establish labour outputs for painting trade in Nigerian construction industry using Lokoja as the case study, with the view of increasing the accuracy of construction cost estimates. The results established general average output values per day of: 128.53m^2/day, 81.07m^2/day, 72.58m^2/day, 211.10m/day, 277.59m/day, 85.31m^2/day and 49.66m^2/day for painting of general surfaces of regular surfaces of walls of girth greater than 300mm with textured paint, emulsion paint and gloss paint; general surfaces of regular surfaces of walls with girth less than or equal to 300mm with gloss paint and emulsion paint; general surfaces of regular surfaces of ceiling soffit, girth greater than 300mm with emulsion paint and railings with gloss paint respectively by a painter with two coats each except railings that was one coat of paint. The implications of these results is that, the output values considered average situations and conditions based on the productivity factors of sex, age, mode of employment, qualification, work experience, temperature of the

work environment and the weather condition. These set of productivity factors are just as revealed by (Mohammed, 2009; Adegboyega, 2014; Akeredolu, 2014 and Onyeagam, 2014), therefore, these output values determined can only be attained when average conditions of these factors are prudently maximised. This research highlights the areas of contention especially as relate to BESMM compliance between the results obtained and those of previous research work and concluded by giving general recommendation as to how the findings of this research can help in the production of fair and accurate cost estimates.

5.3. Conclusion

The study concluded that different items of work in painting have various measuring units and also various labour outputs as shown in Table 5.1 and this study revealed that mode of employment, qualification of workers, temperature of the work environment, period of observation and experience of the operatives affect output of workers to varying degrees as shown in Table 5.2 based on the location of application of the paint and the unit of measurement of the work items.

Table 5.1 shows the summary of the output of painters for all the operation of the work items and their average outputs per unit.

Table 5.1: General Summary of Output of Painters

OPERATION	AVERAGE OUTPUT/ PAINTER/ DAY	AVERAGE OUTPUT/ PAINTER/ HOUR
General surface of regular surfaces of walls, girth greater than 300mm with textured paint	128.53m^2	16.07m^2
General surface of regular surfaces of walls, girth greater than 300mm with emulsion paint	81.07m^2	10.13 m^2
General surface of regular surfaces of walls, girth greater than 300mm with gloss paint	72.58m^2	9.07 m^2
General surface of regular surfaces of walls, girth less than 300mm with gloss paint	211.10m	26.39m
General surface of regular surfaces of walls, girth less than 300mm with emulsion paint	277.59m	34.70m
General surface of regular surfaces of ceiling soffit, girth greater than 300mm with emulsion paint	85.31m	10.66 m^2
Railings with gloss paint. (one coat)	49.66m^2	6.21 m^2

Source: Researcher's field survey (2015) Descriptive Analysis Mean

Table 5.2: General Summary of effect of productivity factors on output of painters

(Results of Hypotheses $H_1o - H_6o$)

Operation	Period of observation		Mode of Employment	Qualification	Experience	Temperature	Weather condition
	1st	2nd					
General surface of regular surfaces of walls, girth greater than 300mm textured paint	Accepted	Accepted	Rejected	Accepted	Rejected	Rejected	Accepted
General surface of regular surfaces of walls, girth greater than 300mm emulsion paint	Accepted	Accepted	Accepted	Accepted	Accepted	Accepted	Accepted
General surface of regular surfaces of walls, girth greater than 300mm gloss paint	Accepted	Rejected	Accepted	Rejected	Accepted	Rejected	Accepted
General surface of regular surfaces of walls, girth less than 300mm with gloss paint	Accepted	Accepted	Rejected	Accepted	Accepted	Accepted	Nil
General surface of regular surfaces of walls, girth less than 300mm with emulsion paint	Accepted	Accepted	Accepted	Accepted	Accepted	Accepted	Nil
General surface of regular surfaces of Ceiling soffit, girth greater than 300mm with emulsion paint	Rejected	Accepted	Accepted	Accepted	Accepted	Accepted	Accepted
Railings, with gloss paint. (one coat)	Accepted	Accepted	Accepted	Rejected	Accepted	Accepted	Accepted

Source: Researcher's field survey (2015) Summary of Regression Analysis

5.4 Recommendations

Based on the findings from this research effort, the under-listed recommendations are put forward to address the issue of the cost of painting trade by contractors.

i. Because painting is subjective (Udegbe, 2007), a painter should be able to cover a minimum of 70% of the resultant outputs per day as shown in Table 5.3:

Table 5.3: Recommended outputs

S/no	Description of work items	Numbers of coats	Determined output per day
i.	General surfaces of walls of girth greater than 300mm with regular surfaces using:		
	Textured paint	Two coats	128.53m^2
	Emulsion paint	Two coats	81.07m^2
	Gloss paint	Two coats	72.58m^2
ii.	General surfaces of walls, girth less than or equal to 300mm with regular surfaces using:		
	Gloss paint	Two coats	211.10m
	Emulsion paint	Two coats	277.59m
iii.	General surfaces of ceiling soffit, girth greater than 300mm using emulsion paint	Two coats	85.31m^2
iv.	General surfaces of railings using gloss paint	One coat	49.66m^2

Source: Researcher's field survey (2015) Descriptive Analysis Mean

ii. Contractors should exploit the output figures extracted according to productivity factors so as to optimize the productivity of their workers and profitability.

iii. In compliance to BESMM similar works should be conducted for different geographical area in Nigeria so as to validate the established output.

5.5 Contribution to knowledge

The outcome of this research is an improvement of existing knowledge based on the facts that BESMM was not used as a guide by previous researchers to determine the labour output for painting trade. It contributions are as follows:

i. The research was able to establish labour outputs for painting based on the specifications in the BESMM3 with two coats, which are:

Painting of general surfaces of walls, girth greater than 300mm with (textured paint, 128.53m^2; emulsion paint, 81.07m^2; gloss paint, 72.58m^2)

Painting of general surfaces of walls, girth less than or equal to 300mm with (gloss paint 211.10m, emulsion paint 277.59m)

Painting of general surfaces of ceiling soffit, girth greater than 300mm (emulsion paint 85.31m^2) and painting of railings with gloss paint 49.66m^2 (one coat).

ii. The research revealed a difference of 44% in the output of worker using different type of paints (textured, emulsion and gloss paint), due to the type of paint used which is as a result of experience, handling, the level of adhesive and drying of the paints etc.

iii. The research also revealed that work items such as: painting of general surface of walls and ceiling soffits, girth greater than 300mm are measured in m^2, painting of general

surface of walls and ceilings soffits, girth less than or equal to 300mm are measured in m and painting of railings measured in m^2 as specified in the BESMM3, have various measuring units and as a result have various labour outputs.

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APPENDIES 1

i. Instrument for data gathering:

DEPAARTMENT OF QUANTITY SURVEYING

FACULTY OF ENVIRONMENTAL DESIGN

AHMADU BELLO UNIVERSITY, ZARIA NIGERIA

TIME STUDY REPORT SHEET

(PAINTING WORKS)

SECTION A: BACKGROUND INFORMATION

1. Date: …… Sheet No: …….

2. Project: …….

3. Project Location: …….....

4. Operation Location: ……..

5. Work item description: …….....

SECTION B: OPERATIVE'S PERSONAL INFORMATION

6. Gender: a. Male ( ) b. Female ( )

7. Age: a. below 19 years ( ) b. 19-35 years ( ) c. above 36 years ( )

8. Mode of Employment: a. Contract employed worker ( ) b. Negotiated worker ( ) c. Daily Paid worker ( )

9. Weather condition: a. Sunny ( ) b. Windy ( ) c. Rainy ( ) others specify…….

10. Experience: a. below 1 year ( ) b. 2-5year ( ) c. 6-10years ( ) d. above 11years ( )

11. Qualification of worker: a. Primary Certificate ( ) b. SSCE ( ) C.NABTEB ( ) d. ND ( )

Others specify…….

12. Neatness of work done: a. poor ( ) b. fair ( ) c. Good ( )

13. Type of paint use …….

SECTION C: WORK MEASUREMENT

Gang size	Morning					Afternoon					Total Observed Time	Basic Time	Total output
	Start Time/ Temp	Stop Time/ Temp	Average Temp	Observed Time	Observed output	Start/ Temp	Stop/ Temp	Average Temp	Observed Time	Observed output			

Idle Time 1……. Idle Time 4……. …….. Idle Time 7…….

Idle Time 2……. Idle Time 5…… Idle Time 8…….

ii. Labour output values for Painting of general surfaces of wall, girth greater than 300mm (M60.1.1.1) with emusion paints measured in 'm^2

S/NO	FIRST PERIOD (M^2)	SECOND PERIOD (M^2)	TOTAL OUTPUT(M^2)	FIRST PERIOD TIME	SECOND PERIOD TIME	TOTAL TIME
1	72.5	16.0	88.5	6.49	1.27	7.76
2	49.0	14.0	63.0	4.55	1.45	6
3	85.0	41.2	126.2	4.10	3.10	7.2
4	82.0	20.0	102.0	5.00	2.00	7
5	72.0	37.0	109.0	4.50	2.35	6.85
6	87.0	23.0	110.0	5.30	1.25	6.55
7	42.5	14.0	56.5	5.20	1.05	6.25
8	91.0	15.0	106.0	5.00	1.00	6
9	49.0	19.0	68.0	5.35	1.15	6.5
10	36.0	16.0	52.0	4.40	2.15	6.55
11	56.5	14.5	71.0	5.00	2.15	7.15
12	56.0	15.0	71.0	5.00	3.00	8
13	56.0	12.0	68.0	5.25	1.23	6.48
14	48.0	22.9	70.9	4.03	4.50	8.53
15	11.2	16.3	27.5	3.50	3.05	6.55
16	57.5	24.0	81.5	5.10	2.15	7.25
17	55.0	10.5	65.5	5.15	2.00	7.15
18	26.0	27.0	53.0	3.45	4.10	7.55
19	49.0	18.0	67.0	4.10	2.30	6.4
20	85.0	12.0	97.0	6.50	0.55	7.05
21	62.0	18.5	80.5	5.00	1.50	6.5
22	93.0	31.0	124.0	4.45	2.27	6.72
23	62.0	33.5	95.5	5.05	3.00	8.05
24	56.5	27.0	83.5	4.15	2.00	6.15
25	84.0	36.0	120.0	4.00	3.00	7
26	36.5	16.0	52.5	4.45	2.30	6.75
27	90.0	44.4	134.4	5.15	2.05	7.2
28	87.5	12.0	99.5	5.00	1.00	6
29	84.0	33.0	117.0	5.40	2.20	7.6
30	69.0	50.0	119.0	4.10	3.00	7.1
31	39.0	6.0	45.0	5.30	0.40	5.7
32	98.6	20.6	119.2	6.18	1.32	7.5
33	47.5	68.0	115.5	2.51	3.05	5.56
34	51.0	41.0	92.0	2.51	3.00	5.51
35	56.0	14.0	70.0	4.10	2.05	6.15

36	43.0	13.0	56.0	5.00	1.50	6.5
37	38.0	20.0	58.0	5.00	2.15	7.15
38	21.2	11.9	33.1	3.50	2.55	6.05
39	51.5	22.5	74.0	5.00	2.15	7.15
40	55.0	25.0	80.0	5.15	2.00	7.15
41	56.5	15.0	71.5	5.10	1.35	6.45
42	68.5	29.5	98.0	6.00	1.02	7.02
43	43.0	7.5	50.5	5.45	0.50	5.95
44	11.2	14.0	25.2	3.50	3.00	6.5
45	84.0	26.0	110.0	5.10	2.55	7.65
46	57.0	18.0	75.0	5.30	1.10	6.4
47	59.0	11.0	70.0	5.00	1.30	6.3
48	55.0	14.0	69.0	5.15	2.10	7.25
TOTAL	2825.7	1065.8	3891.5	228.6	97.2	325.8
AVERAGE	58.86875	22.2041667	81.07292	4.155818	6.94357	4.72145

Labour output values for Painting of general surfaces of walls, girth greater than 300mm (M60.1.1.1) with texture paints measured in 'm^2

S/NO	FIRST PERIOD (M^2)	SECOND PERIOD (M^2)	TOTAL OUTPUT(M^2)	FIRST PERIOD TIME	SECOND PERIOD TIME	TOTAL TIME
1	32	10.5	42.5	5.00	2.00	7.00
2	111	49.5	160.5	5.24	3.50	8.74
3	115	42.5	157.5	5.30	3.15	8.45
4	110.5	51	161.5	5.02	3.22	8.24
5	95	41	136	4.10	3.00	7.10
6	44	40.6	84.6	6.03	5.08	11.11
7	132	25	157	6.00	1.15	7.15
8	77.5	37	114.5	5.00	3.50	8.50
9	116.5	45	161.5	5.42	3.17	8.59
10	85	56	141	5.00	3.50	8.50
11	116	54	170	5.00	3.50	8.50
12	92.25	8	100.25	6.15	0.55	6.70
13	65	14	79	6.15	1.32	7.47
14	68.5	37.50	106	5.05	3.00	8.05
15	82.5	38.5	121	5.00	3.50	8.50
16	91.2	46.5	137.7	4.45	2.00	6.45
17	105	35	140	5.10	2.55	7.65
18	79	39.5	118.5	5.10	2.55	7.65
19	80	36	116	5.10	2.00	7.10
20	106	21	127	4.05	1.19	5.24
21	106.5	14	120.5	5.03	3.01	8.04
22	111	20.3	131.3	4.55	1.45	6.00
23	87.5	12.5	100	6.49	1.27	7.76
24	72	28	100	5.00	2.15	7.15
25	122	24	146	4.55	1.45	6.00
26	108	31	139	5.00	2.15	7.15
27	105	35	140	5.00	2.00	7.00
28	100	18	118	5.30	1.30	6.60
29	120.5	16.5	137	6.35	1.31	7.66
30	53	24	77	5.10	2.00	7.10
31	84	52	136	4.30	4.00	8.30
32	87.5	12.5	100	6.49	1.27	7.76
33	99.5	44	143.5	5.24	3.50	8.74

34	85	41	126	4.10	3.00	7.10
35	85	42	127	4.10	3.00	7.10
36	112.5	47.5	160	5.24	3.50	8.74
37	53.5	9.5	63	6.11	1.01	7.12
38	107	47.5	154.5	5.24	3.50	8.74
39	113.5	73.5	187	5.00	3.50	8.50
40	70	35	105	4.40	2.15	6.55
41	87	42	129	5.55	1.20	6.75
42	125	55	180	5.55	2.20	7.75
43	78	40.5	118.5	5.01	2.25	7.26
44	161	27	188	5.15	1.01	6.16
45	90	42	132	5.00	3.50	8.50
46	96.5	47	143.5	5.02	3.22	8.24
47	84.5	17.5	102	5.30	1.10	6.40
48	110	28.5	138.5	5.00	1.30	6.30
49	67.5	20.5	88	5.30	2.00	7.30
50	108	44	152	5.15	2.10	7.25
51	108.5	8	116.5	5.30	0.44	5.74
52	112	36.5	148.5	5.48	1.08	6.56
53	133	27.5	160.5	6.35	1.03	7.38
54	89	11.5	100.5	6.35	1.31	7.66
TOTAL	5136.95	1803.4	6940.35	281.36	123.69	405.05
AVERAGE	95.1287037	33.3962963	128.525	5.2103704	2.290555556	7.50093

Labour output values for Painting of general surfaces of walls, girth greater than 300mm (M60.1.1.1) with gloss paints measured in 'm^2

S/NO	FIRST PERIOD (M^2)	SECOND PERIOD (M^2)	TOTAL OUTPUT(M^2)	FIRST PERIOD TIME	SECOND PERIOD TIME
1	26	11.5	37.5	5.30	2.30
2	34.5	15.5	50	5.15	2.30
3	57.3	16	73.3	5.30	2.30
4	54	25	79	5.30	2.30
5	56	14	70	5.15	2.30
6	72	21	93	6.00	2.30
7	36	18	54	5.00	2.30
8	61.5	21.50	83	5.30	2.30
9	66.5	26	92.5	5.30	2.30
10	48	20	68	5.15	2.10
11	55	20	75	5.00	2.00
12	58.5	21	79.5	5.30	2.30
13	26.5	11.50	38	5.30	2.30
14	25	11.50	36.5	5.30	2.30
15	32	12	44	5.30	2.00
16	28	12.50	40.5	5.15	2.30
17	27	12	39	5.16	2.30
18	33	14	47	5.30	2.30
19	60.5	15.5	76	4.30	2.00

20	54	13	67	5.30	2.30
21	33	14	47	5.30	2.30
22	37	19	56	5.30	2.30
23	32	12	44	4.30	2.00
24	81	27	108	5.00	2.00
25	84	21	105	5.30	2.10
26	64	16	80	5.15	2.20
27	52	27	79	5.30	2.00
28	54	29	83	5.30	2.30
29	80	26	106	4.45	1.30
30	82	24	106	5.30	2.30
31	84	21	105	3.30	2.30
32	48	24	72	5.15	2.30
33	74	16	90	5.16	2.30
34	108	36	144	5.15	2.30
TOTAL	1824.3	643.5	2467.8	173.82	74.90
AVERAGE	53.6558824	18.92647059	72.5824	5.11	2.20

Labour output values for Painting of general surfaces of walls, girth less than 300mm (M60.1.1.1) with gloss paints measured in 'm'

S/no	FIRST PERIOD period	SECOND PERIOD period	Total output (m)per day	FIRST PERIOD time	SECOND PERIOD time	Total time
1	100.70	25.00	125.70	2.24	0.57	2.81
2	179.58	72.00	251.58	4.10	2.08	6.18
3	105.00	25.20	130.20	4.00	1.05	5.05
4	108.15	43.18	151.33	5.06	1.17	6.23
5	128.00	155.00	283.00	3.15	4.05	7.20
6	182.00	123.00	305.00	3.20	3.08	6.28
7	105.00	40.52	145.52	2.45	1.50	3.95
8	201.00	42.00	243.00	4.10	1.05	5.15
9	104.18	52.00	156.18	3.45	2.05	5.50
10	186.20	18.00	204.20	3.15	0.45	3.60
11	348.88	62.00	410.88	5.00	1.35	6.35
12	138.00	23.00	161.00	2.55	1.20	3.75
13	248.00	92.00	340.00	4.35	2.22	6.57
14	142.00	29.50	171.50	2.35	0.56	2.91
15	215.00	27.00	242.00	4.05	0.45	4.50
16	125.00	30.00	155.00	3.25	1.58	4.83
17	202.00	21.00	223.00	4.15	1.05	5.20
18	214.00	65.00	279.00	4.22	2.30	6.52
19	218.00	26.00	244.00	4.30	1.22	5.52
TOTAL	3250.68	971.40	4222.08	69.12	28.98	98.10
AVERAGE	162.53375	48.57	211.10375	3.456	1.449	4.905

Labour output values for Painting of general surfaces of walls, girth less than 300mm (M60.1.1.1) with emulsion paints measured in 'm'

S/no	FIRST PERIOD	SECOND PERIOD period	Total output /day	FIRST PERIOD time	SECOND PERIOD time	Total time
1	360.00	99.20	459.20	5.00	1.37	6.37
2	210.00	33.60	243.60	3.08	0.45	3.53
3	105.00	51.33	156.33	2.44	1.18	3.62
4	319.00	44.00	363.00	4.20	1.15	5.35
5	180.00	92.00	272.00	4.09	1.45	5.54
6	125.00	60.52	185.52	2.40	1.05	3.45
7	210.00	45.00	255.00	3.23	1.05	4.28
8	354.00	22.00	376.00	4.35	0.35	4.70
9	372.00	21.00	393.00	5.02	0.30	5.32
10	340.00	26.00	366.00	4.55	1.05	5.60
11	215.00	47.00	262.00	3.46	1.20	4.66
12	153.00	31.00	184.00	2.47	1.07	3.54
13	152.00	33.60	185.60	2.35	0.45	2.80
14	294.00	42.00	336.00	4.08	0.58	4.66
15	320.00	22.00	342.00	4.30	0.45	4.75
16	366.65	21.00	387.65	5.30	0.51	5.81
17	226.80	27.00	253.80	3.23	0.40	3.63
18	180.00	24.00	204.00	2.57	0.47	3.04
19	126.00	52.70	178.70	2.01	0.82	2.83
20	205.00	78.00	283.00	3.30	1.33	4.63
21	163.63	47.00	210.63	2.52	1.00	3.52
22	182.00	62.00	244.00	3.33	1.05	4.38
23	210.00	33.60	243.60	3.38	0.45	3.83
TOTAL	5430.28	1206.31	6384.63	80.66	19.18	99.84
AVERAGE	226.261	50.26292	277.5924	3.507	0.8339	4.3409

Labour output values for Painting of general surfaces of ceiling soffit, girth greater than 300mm (M60.1.1.1) with emusion paints measured in 'm^2

S/NO	FIRST PERIOD (M^2)	SECOND PERIOD (M^2)	TOTAL OUTPUT(M^2)	FIRST PERIOD TIME	SECOND PERIOD TIME	TOTAL TIME
1	70.0	32.0	102.0	5.00	2.00	7.00
2	66.0	16.0	82.0	5.30	1.30	6.60
3	51.0	45.0	96.0	3.45	3.00	6.45
4	87.0	18.5	105.5	6.00	1.30	7.30
5	41.0	36.0	77.0	3.45	3.00	6.45
6	70.5	23.5	94.0	6.00	2.00	8.00
7	55.0	48.0	103.0	3.45	3.00	6.45
8	52.0	22.0	74.0	5.00	2.00	7.00
9	72.0	63.0	135.0	3.45	3.00	6.45
10	81.0	54.5	135.5	3.45	3.00	6.45
11	54.6	60.0	114.6	2.42	3.10	5.52
12	27.5	23.5	51.0	2.42	2.15	4.57
13	52.5	21.0	73.5	5.30	2.00	7.30
14	114.0	70.5	184.5	5.02	3.22	8.24
15	84.0	28.0	112.0	6.00	2.00	8.00
16	115.0	29.0	144.0	5.00	1.30	6.30
17	36.0	14.9	50.9	4.05	1.19	5.24
18	44.0	39.0	83.0	3.45	3.00	6.45
19	75.0	19.5	94.5	5.00	1.30	6.30
20	52.0	14.0	66.0	5.00	1.30	6.30
21	22.5	15.5	38.0	3.45	3.00	6.45
22	71.0	12.0	83.0	6.00	2.00	8.00
23	22.0	15.0	37.0	1.45	3.00	4.45
24	65.0	12.5	77.5	5.00	2.00	7.00
25	50.1	10.0	60.1	5.30	1.30	6.60
26	40.5	30.0	70.5	3.45	3.00	6.45
27	65.0	13.0	78.0	5.00	2.00	7.00
28	36.5	32.0	68.5	3.45	3.00	6.45
29	72.0	12.0	84.0	6.00	1.30	7.30
30	41.0	23.0	64.0	3.45	3.00	6.45
31	48.0	16.0	64.0	5.30	2.00	7.30
32	71.0	10.0	81.0	6.00	2.00	8.00
33	51.0	8.0	59.0	5.00	1.30	6.30
34	39.0	19.0	58.0	3.45	3.00	6.45

TOTAL	1994.7	905.9	2900.6	150.5	76.1	226.6
AVERAGE	58.7	26.6	85.3	4.4	2.2	6.7

The extracted items from the BESMM3 indicated below are possible and work related items of painting works in the BESMM.

TABLE 2.1: EXTRACTED ITEMS FROM THE BESMM3

M60 PAINTING / CLEAR FINISHING ACCORDING TO BESMM3

LOCATION	CLASSIFICATION (REFERENCES)	UNIT
General	Girth > 300mm, multi-coloured work (M60.1.0.1.1)	M^2
surfaces	Isolated surfaces, girth $\leq$ 300mm, multi-coloured work (60.1.0.2.1)	M
Railing	multi-coloured work (M60.7.1.1.1)	M^2