

# A LABOUR OUPUT MODEL FOR BLOCK WORK USING ACTIVITY SAMPLING TECHNIQUES IN GHANA

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## ABSTRACT

Labour output is an issue of a particular importance to some of the camping's in Ghana as it is considered a newly developed area and because of the huge amount of projects planned to be carried out in the near future. The purpose of this research is to determined labour output in the construction industry in Ghana. The main objectives of this study were to establish the labour output constants for block work; to find the factors affecting labour output in blockwork; and to compare the research findings to the labour output at the site for block work. Data will be collected using the Delphi and field questionnaire survey. The Structural Equation Modelling (SEM) and Nvivo will be used to analyse data from the field questionnaire survey and Delphi respectively.

*Keywords: Labour; Ouput; Model; Blockwork; Ghana*

## INTRODUCTION

### Background

As construction work becomes simpler in recent times, due to the increasing levels of technology and techniques that has introduced in to the industry, the general public continues to complain that the cost of putting up building or house is still high, which is believed depends principally on the cost of material and labour. According to (Bamfo-Agyei and Kotey, 2009) the cost of 'labour are normally be obtained from standard labour constants or from work study were time taken by operative to carry out a task is recorded.

Several construction companies are constantly searching for ways to improve labour output constants in the construction industry. This is because labour is one of the greatest risks in the building construction industry. This must be controlled and continuously improved. Because it is believed those constructions have a process of continuous improvement at site and it is necessary to evaluate this performance. Doing this only in terms of profits, which is the most common way, is not sufficient. Other ways of evaluating site performance is by studying labour output constants using scientific study.

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Although the construction industry is faced with a number of problems, several techniques can be put in place to improved labour output constant. Hence this study which is to present action for implementing a work sampling study on selecting job site to enhance work output on a building construction site. From Harris and McCaffer (2001); Since the primary task of construction is bringing favorable condition for management, workforce and resources to effectively and efficiently combine towards raising output constant and quality by achieving a given level of output with fewer inputs, while providing high rewards for those involved. Measuring productivity in the construction site is inherently difficulty due to the labour intensive divers' nature of the industry.

There is no doubt that construction industry is the key in any economic. Due to the increasing level of constructing a building the general public continues to complain that the average cost of designing and building a house is of high cost. Most Building construction companies are trying to generate ways which might improve labour output constants in the industry. It is because labour is one of the greatest risks in the construction sector or industry, which must be controlled and continues improvement of sites and it is necessary to determine this performance. But doing this only in terms of profits which the most common way is not sufficient. Labour costs depend on the squared make up is the numbers of craftsman and labourer's.

According to Harris and MacCaffer (2001) since the primary task of continuation is bringing favorable condition for Management, work force and the resource to effectively and efficiently combine towards raising output constant and quality by achieving a given levels of output with fewer inputs while providing high rewards for those involved. Measuring productivity: In its construction site is inherently difficulty due to its labour intensive, diverse nature of the industry.

## **RESEARCH MOTIVATION**

There is no study on Labour output satisfaction on block work in the construction industry in Ghana, the study hopes to fill this gap in this area. The motivation behind this research is to determine the labour output in block work in Ghana. The research will evaluate the influence of the labour output of block work in predicting the completion time of projects. The factors affecting labour output on site will be considered.

There is a gap that exists in literature on the factors that affect labour output of block work in the construction industry in developing countries. This study therefore contributes in existing knowledge by establishing the factors that establish the labour output of block work activity using sampling techniques and determining the impact on completion time of the construction

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projects. Instead using existing models as conceptualized for developed countries using instrument such as SERVQUAL factors of labour output satisfaction which have not been considered in previous study will be evaluated as outcome variables. The study will use Structural Equation modeling to analyse and model the labour output in block work activity. Consequently, the study will add new knowledge on the factors that determine labour output of block work activity in the construction industry in Ghana. The innovative method and the outcome of the variable measures that will be used in the study will contribute to existing body of knowledge.

## **PROBLEM STATEMENT**

In recent years the rate of delays in the construction 'industry has raised a general concern by the general public to find out what actually is happening considering the basic resources available to construction firms .There is no standard method for determining the financial value of workers daily output. This levels contractors and building owners with the choices of paying huge sums of money or sometimes under paying workers for services rendered. This study is to set the stage for clients, contractors and other professionals in the building construction industry by providing them with labour output constants in the building industry. Amoah-Mensah in 1995 published the data for the output for both skill and unskilled labourers, which is over 20 years due to the span in years this output might not be realistic in the current situation.

Contractor's construction time and cost depend on the output of the labour but delays in the construction industry have raised a general concern by the public in other to determine actually what is happening. Considering the basic resources that were available to construction industry productivity remains an interesting subject and a dominant issue in construction sector, promising efficient usage of resources and cost saving and ultimately affecting the bottom line of every effort in the construction sector. This study is to set the for client, contractors and other professionals in the building industry. (Olomolaiye et al, 1998)

## **Aim of the study and Objectives**

This research is to establish the labour output for block work using activity sampling techniques.

The objectives of the study are:

- (RO1) To identify the factors that determines the labour satisfaction on the construction of block work.
- (RO2) To investigate the current theories and literature that has been published on labour satisfaction and identifies the gaps.

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- (RO3) To identify the critical factors that conveys about labour satisfaction and to examine if the factors that determine satisfaction in other cultural contexts, in the same in Ghana.
- (RO4) To evaluate the critical factors that affects labour output of block work in Ghana
- (RO5) To develop a holistically labour output model for block work.
- (RO6) To determine the validity of the conceptualized labour output model for block work.

## **THEORETICAL VIEWS ON LABOUR OUTPUT SATISFACTION**

Labour output is one of the most important issues in both developed and developing countries.

Developed countries are aware that productivity is very important for economical growth and social welfare. Developing countries which face unemployment problems, inflation, and resource scarcity and growth rate decline try to utilize its resources in such a way that achieve economical growth and improve citizen's life. Yi and Chan (2014) summarized three main measurements of construction labor productivity at activity, project and industry levels; the major differences between these measurements are the source of data, the level of aggregation, the definition of the production process and the completeness. Hanna et al., (2005) noted that Labor productivity is reflected by the ratio between total product output and total input resource from an economic perspective). Productivity is one of the key measures of utilization of human and financial resources because it is a strong indicator of efficient use of available resources (Hanna et al., 2005). While the economic performance of construction becomes the focus of interest, the gross value or the value added of the production per employee over a certain time period is used to reflect the labor productivity, where the key economic indicators within the construction industry are collected in order to compute the productivity of the referenced region and time period (Li and Liu, 2010; Chia et al., 2012).

### **Work measurement**

Work measurement is the application of techniques designed to establish the time for an average worker to carry out a specified manufacturing task at a defined level of performance. It is concerned with the length of time it takes to complete a work task assigned to a specific job.

Revealing existing causes of ineffective time through study, important though it is, is perhaps less important in the long term than the setting of sound time standards, since these will continue to apply as long as the work to which they refer continues to be done. They will also show up any ineffective time or additional work which may occur once they have been established.

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At the activity level, labor productivity is widely reflected by hourly outputs, where a labor hour and physical quantity of work completed are used as input unit and output, respectively (Hanna et al.,2008). Ma et al., (2016) noted that external factors can barely control the actual physical quantity and working hours, the hourly output measurement of productivity can provide an accurate proxy for construction activity efficiency. At the project level, the aggregation is composed of a series of construction activities with different units of measurements. Therefore, the efficiency of the whole construction process is reflected by the ratio between expected productivity and actual productivity, which is determined by the work days and quantities installed under consideration and practice, respectively Ma et al., (2016).

To provide information on which the planning and scheduling of production can be based, including the plant and labour requirements for carrying out the programmed of work and the utilization of available capacity. To provide information on which estimates for tenders, selling prices and delivery promises can be based. To set standards of machine utilization and labour performance this can be used for any of the above purposes and as a basis for incentive schemes. To provide information for labour-cost control and to enable standard costs to be fixed and maintained. It is thus clear that work measurement provides the basic information necessary for all the activities of organizing and controlling the work of an enterprise in which the time element plays a part. Its uses in connection with these activities will be more clearly seen when we have shown how the standard time is obtained. Cornwell & Cornwell (2006) assert that, "You can't manage what you can't measure". Measurement is crucial before a management activity is executed. However, it should be noted that an incorrect measurement of labour performance can lead to incorrect and warped decisions by the management team. Therefore, the importance of measuring the right thing at the right time to reflect the true conditions of a company cannot be over emphasized. The measurements should offer the management an opportunity to make effective and accurate decisions. The various techniques available to supply information need to be explored so as to identify the right measurement technique for prevalent conditions. These techniques include: time studies, work sampling, subjective evaluations and) personal recording of activities (Przemeck & Grund, 2008). Many of these techniques have involved over time. Use of technological advances makes it easier to efficiently acquire accurate results.

### **Time study**

Time study is a method used to determine the actual time required to complete a task. It takes into account time allowances and delays. Time studies enable the management to make effective decisions aimed at improving the efficiency of the entities operating within the system. It is important to realize that accurate time studies yield positive results and inaccurate time studies can create many problems (Freivalds, 2009) as mentioned earlier.

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## **Work sampling**

On the other hand, work sampling was developed for the first time in 1935 (Fitzgerald, 2009). Work sampling is the activity of taking randomly distributed observations of activities; these activities can include both humans and machines, with the objective of determining their utilization (Fitzgerald, 2009). The fundamental principle of work sampling is that it is based on the laws of probability (Freivalds, 2009). Work sampling only takes samples rather than continuous observation of the object being studied. This allows for the acquisition of reasonably accurate representations of the work under study, without the drawbacks of continuous monitoring. Work sampling is also observed as a low cost alternative method for determining of workforce utilization (Fitzgerald, 2009). In work sampling, the accuracy of the results is linked to the number of samples taken in the study (Sitting, 2000), as well as the time period during which the analysis is performed. It is, therefore, important that the analyst understands the operations of the company so as to identify an appropriate time frame for the study. The analyst needs to select a sample size that represents the true conditions of the system accurately, while also understanding the capabilities of the observer. Some standards have been developed to aid in making selections about the number of samples in a study. One such guideline is not to exceed 8 observations per hour (Sitting, 2000). With the understanding that statistical methods form the basis of work sampling, the input data needs to be randomly collected and unbiased (Fitzgerald, 2009). If these conditions are not met the data will not deliver reasonable results. These inaccuracies can include continuity errors (in which small changes in input data represent small changes in the output data), and consistency errors (in which similar runs will not reflect similar results), (Bakker, 2010). Traditionally work sampling does not determine the effectiveness of workers but rather whether they are working or not. It does this by recording the amount of time workers spend on certain activities (Fitzgerald, 2009). Thorough planning needs to be done prior to the start of the work sampling study. The following procedure covers the work sampling process from the objective identification step through to the analysis of the results (Freivalds, 2009).

## **Activity sampling**

Activity sampling is a technique through which information can be obtained not only quickly and economically but also to predetermine levels of accuracy. It is a method that measures the time labor spent in various categories of activities (Thomas, 1991).

A sequence of project-based studies were carried out to investigate the factors influencing construction labor productivity, with the purpose of maintaining construction development (Goodrum and Haas, 2002; Jarkas and Bitar, 2012; Loosemore, 2014). Based on a collection of substantial cross-sectional data, detailed insights into construction labor productivity were

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provided at the project level. The productivity ratio can reflect performance efficiency, where differences between various construction activities can be diminished.

Activity sampling can be defined as a technique in which a large number of instantaneous Observations are made over a period of time of workers, machines, or processes. Each Observation records what is happening at that instant and the percentage of observations recorded for a particular activity or delay is a measure of the percentage of time during which that activity or delay occurs Activity sampling study provides the necessary information to help determine how time is being employed by the workforce, identify the problem area that cause the work delay, and set up a base line measure for productivity improvement. The main advantage of using activity sampling is that it allows a larger number of machines or men to be studied at one time that can be managed using a continuous time study. This leads to a broader picture of the efficiency of a particular operation than that obtained from a more concentrated but continuous study on a smaller group. Oglesby, (2002) suggested that there are general rules for activity sampling that need to be observed and these are :

- a) The observer must be able quickly to identify the individuals to be included in and excluded from the sampling;
- b) There should be an equal likelihood of observing every worker;
- c) Observation must have no sequential relationship;
- d) The basic characteristics of the work situation must remain the same while the Observations are being made.

### **Activity sampling theory**

Activity sampling concepts based on two facts, first fact is a working day can be subdivided into three major parts: productive, contributory, and unproductive time (Oglesby, 2002).

Productive time: time spent in elements directly involved in the actual process of putting together or adding to a unit being constructed.

Contributory time: time spent in elements not directly added to but essential to finish the unit;

Unproductive time: idle time or time spent in not useful or all other elements. Second fact on which activity sampling based is small number of chance occurrences tends to form the same distribution pattern as the whole operation. Thus it is a mathematical technique closely associated with statistics and the theory of probability (Olomolaiye, 1998).

Activity sampling being based on a sample of observations must adhere to certain statistical principles and rules to obtain a proper representation of the studied operation. Any sampling carried out should be large enough to be statistically valid – can be used to predict the characteristics of studied operation with a desirable degree of accuracy.

The following formula can be used to calculate the required sample size and achieve the specified confidence level and accuracy criteria

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$$N = \frac{Z^2 \times P \times (1 - P)}{L^2}$$

Where:

N = number of observations required;

P = proportion of the total operation being observed;

L = limit (in percentage) of accuracy required; and

Z = standard normal variable depending on the level of confidence.

In construction work, it is generally accepted that 95 percent confidence limits with limit of error of  $\pm 5$  percent give satisfactory results that can assist in making a real contribution to increase effectiveness. The value of proportion of the total operation being observed, for construction work usually falls within the limits of 0.40 to 0.6. For construction work, 384 observations are normally accepted as a minimum satisfactory number of observations which allow statistically significant results to be obtained (Oglesby, 2002).

## RESEARCH METHODOLOGY

On-site productivity study will be conducted on block work activity to determine the time spent in carrying out an activity. Site observations and structured questionnaire will be used in this research. Daily visit method of observation of labour productivity will be adopted throughout the study. This involved personal observation of labour activities on the selected work on projects. The strategy here was to visit the site daily and interact with the foreman and workers in order to record the dates, number of workers, starting time, closing time and measurement of length/breadth of work done (quantities) of each worker.

The studied population will include 200 contractors who have valid registration from the ministry of works and housing in Ghana.

In all a total number of 320 respondents on site 80 of them will be masons; 160 will also be labourers; 40 contractors and 40 site engineers at the construction site in the ten regions of Ghana will be considered.

The study used convenience sampling techniques in data collection; a random sampling technique was adopted to select respondents. The sample was selected randomly from each level of contractor's categories. The contractor's union list is ordered by the company number, one lists of contractors were prepared to represent for only one category. The randomly selection among the lists was done by the researcher using non-replacement random selection.

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With this type of research instruments of data collection, first-hand information will be gathered from the study area of the project. The methods the researcher that will be use under the primary methods are; interviews; structured questionnaires and observations

The analysis will be carried out through structural equation modeling which will be used in the development of the labour output model.

### **Delimitations of the Study**

The scope of this thesis focused on labour output of block work on construction sites in Ghana. The study focus on the factors that influence labour output of block work activity of the construction process. The study was restricted in 40 construction sites each in the 10 regions of Ghana and focused on block work activities.

### **Ethical Consideration**

Ethical issues will be considered in carrying out the study. Respondents will not be forced to participate in the research. The privacy of the respondents will be respected by ensuring confidentiality in not making available identifying information to anyone was not directly involved in the study. The respondents will be anonymous throughout the study.

### **Overview of study**

This study focused on the background of the study and the problem statement. The aim and objectives will be considered. Research questions will be presented and the research methodology will be stated. The ethical consideration will be clearly stated.

The theoretical and conceptual views of literature on labour output satisfaction evaluated a survey of related literatures from books, journal articles and conference papers from relevant sources.

The gaps observed in labour output satisfaction on block work activity which was not evaluated holistically taking consideration of developing countries like Ghana in previous model will be considered. These gaps forms the additional new constructs in the current study's of conceptual framework. The gaps that will be identified are the needs and expectations of the workforce and their impacts on the block work activity.

Studies conducted in other Africa countries including Ghana, Nigeria South Africa, Zambia, Kenya, Tanzania and Egypt will be considered in relation to the labour output on blockwork. This will assist to identify other factors that affect their labour output on block work.

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The development of labour output on block work in South Africa and the suitable model that is used in the country will be focused. The factors that affect the labour satisfaction will be considered and its impact on the construction process.

The methodology that will be used to collect the data of the study will be stated. It will give the sampling technique in selecting the sample size and research instrument used in gathering information from the respondents. Findings from review of literature on existing models on labour output will be discussed. This forms a basis of conceptual labour output model's theory. The hypothesised labour output model will be stated. The findings will be stated based on the said objectives from the questionnaire survey. The analysis and interpretation of result obtained from the questionnaire and discussion on the model will be covered. The conclusion and recommendations of this study will be considered and recommendation for future work will be stated.

## **CONCLUSION AND THE WAY FORWARD**

The long-run trend of the growth in construction productivity at an industry level was explored, suggesting that exogenous technological progress and the existence of capital are the most important factors influencing construction labor productivity changes (Mills 2016). This research has giving insight to other research works on labour output in the construction industry in other countries and the study looked at the Panel error correction models (ECMs) implemented to to the data for the Australian construction industry.

The long-run equilibrium and dynamics of construction labor productivity across the Australian states and territories have been revealed. The developed models have been further used to simulate regional construction productivity in order to discover the regional clusters for Australian construction labor productivity.

The study will help in developing a model that will focusing in forecasting the labour output in Ghana. At the site management level, a daily progress report must include the required information necessary to obtain the baseline productivity. It is strongly recommended to develop a benchmarking standard for each construction firm in Ghana, which may lead to an improvement in the national construction productivity.

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