

Factors Influencing Effective Productivity on Construction Sites in Nairobi County

Absalom H. V. Lamka, Sylvester Munguti Masu, Githae Wanyona, Stephen Dianga, Abednego Oswald Gwaya

Abstract- *The construction industry has been cited to have a multiplier effect in the performance of any economy. It is necessary to make the industry more efficient and effective in terms of better utilization of resources. Part of the most important resources include labor, materials and money. The lack of data on labor productivity in Kenya has made planning and estimation of activities on construction sites unpredictable. This paper is based on a study of labor productivity in Nairobi with the aim of providing up to date data on what can assist building consultants, contractors and developers in the planning and management of construction processes. The prioritization of the factors which affect productivity in labor intensive construction will enable the project team to leverage the limited resources at their disposal to improve the onsite labor management, in order to improve labor productivity efficiently. The research design used in this study was the survey methodology where project managers, contractors and developers were engaged on their experiences in Labor productivity in the construction industry. During the study, the participants were asked to rank and assess the factors that affect productivity on labor intensive construction. The paper has further compared its findings on labor outputs for selected operations (e.g. masonry and painting) with theoretical propositions from previous studies (Wachira,1999) and the practices in Kenya. The data obtained from the field was quantitatively analyzed using Statistical Package for Social Sciences (SPSS) and Microsoft Excel software. The study established that delivery of materials, adequacy of supervision and motivation of workers, are the most important factors affecting labor productivity. These factors can be improved through training in skills like planning, scheduling and motivation of workers. The results of this research can be used to excite academic research in this area. Furthermore, the findings are useful towards the necessary training for the construction industry to be more efficient and effective in Kenya.*

Keywords: *construction industry, labor productivity, intensive construction, output, productivity measurement, productivity improvement.*

Manuscript Received on November 2014.

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I. INTRODUCTION

A. Background

The building section of the construction industry is mainly concerned with the assembly of building materials which are supplied by the manufacturing sector and delivered to the site by the transportation sectors. To a large extent in Kenya, many of the buildings construction works still rely heavily on manual labor in their assembly. According to Mbiti (2008), the construction industry employs more than 800,000 people who are required to deliver the constructed facilities to the clients' on time, within budget and meeting specified standards of quality. All these may be feasible only if the predetermined levels of labor productivity are known by stakeholders in advance. The labor productivity of operatives on site might be affected negatively by a variety of factors which include; extraneous reasons, shortcomings of management, shortcoming of laborers and legislation (Heap, 1987). According to Wachira (1999) Kenya being a developing country is not an exception to the trends in other countries which are at crossroads with the building teams due to the latter not delivering the projects within the stipulated time. Delays in meeting construction activity completion times on site has caused losses on projects' profits to the contractors; increased costs to the clients and strained the working relationship between the parties in a project. This has been brought about by among others, the lack of validated labor productivity rates in the construction industry in Kenya to base their estimates (Wachira, 1999). The inaccurate determination of activity duration has in most cases led to the incorrect estimation of contract periods. Delays in completion of projects in the construction industry are indicators of productivity problems and it has been a big challenge. Labor productivity therefore has been one of the key determinants of the contract period of projects and could be improved through effective labor management.

II. RESEARCH PROBLEM

In the construction industry of developing countries, productivity loss is one of the greatest and severe problems arising from lack of documented data for estimating, scheduling and control of the project. In Kenya, there is an abundant supply of semi-skilled and unskilled labor which needs to be engaged so as to promote the creation of employment (KNBS, 2012). In order to provide social and economic advantage to the population, the construction industry has been under pressure to embrace labor intensive construction as one way of creating job opportunities for operatives in the labor market. Since labor intensive construction process is an important means to an end in (KNBS, 2012) the

application of labor output constants' and standards are key to ensure efficiency.

Lack of adequate home grown accurate data for Labor productivity rates in Kenya has made planning and estimating for activities on construction sites unpredictable and thereby affecting the delivery of construction projects within the stipulated time (Wachira, 1999). The limited documented cost data from bodies like Joint Building Council (JBC), Institute of Quantity Surveyors of Kenya (IQSK) are generalized and vary in detail and depth of their contents. The information from such sources require some adjustment and inputs to be factored in from experienced estimators before their application. Further, some firms also rely on tacit knowledge from their estimators and organization for estimating purposes. Such data which is not documented and its authenticity verified are subjective and differ from firm to firm leading to variations in labor productivity (Wachira, 1999). This state has among other causes been brought about by lack of labor productivity rates which leads to inaccurate determination of activity duration's and consequently, inadequate estimation of contract periods. The fluctuations in labor productivity rates in construction has remained a big challenge to developers and contractors in their decision-making processes over decades in the determination of activity durations and consequently, inadequate estimation of contract periods (Wachira, 1999). Despite the concern on lack of data for estimation, little research attention and documentation has been undertaken on construction sites to establish home grown data for planning, costing and budgeting in the construction industry in Kenya. This research therefore attempts to establish the key indicators of labor performance and rank them for sensitization to improve efficiency in the construction industry.

III. RESEARCH OBJECTIVES

The main objective of the study is to:

a) Identify and rank factors that affect labor productivity on labor intensive construction sites.

Other objectives were:

- b) Assess factors that affect labor productivity of construction workers.
- c) Evaluate various management strategies on labor productivity on labor intensive construction

IV. STUDY SIGNIFICANCE

The findings would be valuable in the construction industry as they will prioritize the factors that are associated with effective labor productivity on construction site. This would assist the planning for the resources to be used in the execution of the work and thereby improving labor productivity.

V. PRODUCTIVITY STUDIES

A. Introduction

Construction projects are generally unique and are built on sites with different work crews associated with different trades, level of education, religion, ethnicity and weather changes. As Thomas (2004) points out, only a third to one a half of operative' time is spent directly on work activities productively. Key factors that affect labor productivity in

construction have been obtained from works by (Kaming, 1997); (Olomolaiye, 1998); (Enshassi, 2007); who stated that the critical factors for increasing labor productivity in developing countries differ from that in developed countries. They further cited the following as labor productivity problems: lack of materials, rework, lack of equipment and tools, instruction delays, inspection delays, absenteeism, incompetency of supervisor, changing crew members, and lack of management systems and strategies. Wachira (1999) pointed out that information on construction-industry productivity lack reliability and credibility in terms of standard costing, planning durations of operations and gang size balancing. There was need therefore of developing a system for collection and evaluation of labor productivity data in the construction industry through work measurement technique. ILO (1996-2013) defines Work measurement as the application of techniques designed to establish the time for a qualified worker to carry out a specific job at a defined level of performance. Indeed, (ILO, 1996-2013) further pointed out the stages involved in work measurement as: selection of the work to be studied; record relevant data, measure the work in each element in terms of time and compile the standard time for the operation.

VI. THE CONSTRUCTION PROCESS

The construction industry is the sector involved with erection, repair and demolition of buildings and civil engineering structures in an economy. The industry provides constructed physical facilities which provide space where other activities may take place (Hillebrandt, 2000). *The building section of the construction industry is mainly concerned with the assembly of building materials which are supplied by the manufacturing sector and delivered to the site by the transportation sectors. To a large extent in Kenya, many of the buildings construction works still rely heavily on manual labor in their assembly which to some extent contributes to job creation.*

VII. INPUTS OF CONSTRUCTION

It has been noted that the major inputs in the intensive labor construction process are: materials, labor, capital, entrepreneurship, equipment and technology. These factors are critical to productivity outputs and represent the broad areas in which Project managers can take action to obtain better productivity (Heizer, 1990). Increased productivity in the construction industry can be viewed from two perspectives, the client and the contractor. From the client's perspective, increased productivity lowers costs, shortens construction schedules, offers more value for the money, and achieves better returns on investments. From the contractor's perspective, increased productivity leads to a more satisfied client, while also providing a competitive advantage, and in return leading to faster turnover and increased profits (Horner, 2001).

VIII. STRATEGIES OF MANAGING LABOR

Armstrong (2006), argues that strategic management involves introducing, eliminating, modifying, directing and guiding processes in such a way that all

individuals and teams are equipped with the skills, knowledge and competences they require to undertake current and future tasks required by the organization. Management strategies in the construction industry are geared towards increasing labor productivity by raising awareness of the need for a learning culture that leads to continuous improvement; developing the competence of managers to become actively involved in learning that leads to knowledge creation and expand learning capacity throughout the organization. Among the management strategies of improving labor productivity highlighted in this paper include:

A. Training:

This is the use of systematic and planned instruction activities to promote learning (Armstrong, 2006). It involves the use of formal processes to impart knowledge and help people to acquire the skills necessary for them to perform their jobs satisfactorily. According to Pedler et al., (1996), an organization that encourages reflection on lessons learnt attempts to understand the dynamics of its operating environment and anticipates likely changes to that environment so as to cope with opportunities and challenges thus becoming more competitive.

B. Mentoring:

The process of using specially selected and trained individuals to provide guidance, pragmatic advice and continuing support, which will help the person or persons allocated to them to learn and develop. It has been defined by Clutterbuck (2004) as: 'Off-line help from one person to another in making significant transitions in knowledge, work or thinking.' Mentoring helps people to learn on the job and thereby acquiring the particular skills required by the trainee.

C. Specialization:

This is the engendering a fragmentation of tasks that is compounded in a number of respects. The firm may specialize in certain works which lowers expense as there is greater skill level performance. Specialization normally encourages repetitive work which the personnel hits a ceiling of performance and will execute faster the tasks as they are aware of the steps involved in undertaking the operation (Enshassi, 2007). This view concurs with concept of the learning curve which is as illustrated in figure 1. Costs characteristically decline by 20-30% in real terms each time accumulated experience doubles, Ghemawat (1985)

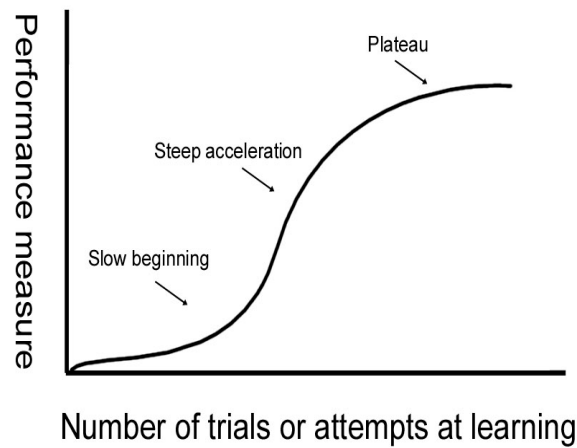


Figure 1: Standard Learning Curve
Source: Ghemawat, 1985

D. Outsourcing:

This is the contracting out of the works to a third party organization. The practice of contracting a business process out to a third party rather than staffing it internally is common in the modern economy. Kwakye (2000) argues that firms outsource to avoid certain types of costs and avoidance of burdensome regulations. Among the reasons firms elect to outsource include avoidance of; high taxes, high electricity costs, union dues and taxes for government mandated benefits.

E. Supply And Crew Sizing

Worker participation has been proven to be one of the most successful approaches in boosting productivity. When for example workers are added or deleted from a crew, it breaks up the original team effort and rhythm of the crew and results in loss of productivity. Therefore, it is important to engage site workers in construction productivity improvement (Wilcox, 2000). The appropriate ratio of pairing the skilled to unskilled laborers should be carefully planned by ensuring that both the mental and manual effort have been taken into account (Forster, 1989)

F. Work Measurement:

This is the application of techniques designed to establish the time for a qualified worker to carry out a specific job at a defined level of performance that is technique aimed at finding out how long a job ought to take by means of time studies (ILO, 1996-2013). In work measurement, the total work content of any job may be divided into three classes: 'basic work content' defined as the absolute minimum time in which an operation can be theoretically completed; 'unnecessary work' caused by bad design, specification, bad operational methods, and shortcomings of management and workers; 'ineffective work' defined as time when man and machine are idle due to extraneous reasons like weather or material shortages, shortcomings of Management like delay in provision of drawings and shortcomings of labor like Lateness, idleness (ILO, 1996-2013). The attempt to maximize productivity, which will lead to optimization of activity duration and consequently contract period, is focused on the

reduction of work content to as near the basic as possible and to eliminate ineffective work. According to Wachira (1999), there are various stages involved in work measurement: select the work to be studied; record all relevant data, examine the data and the detailed breakdown critically, measure the quantity of work in each element in terms of time and compile the standard time for the operation by including time allowances for relaxation, personal needs and contingency.

IX. MOTIVATION THEORIES

Motivation is an art targeted to getting people work willingly and inducing them to behave in a particular manner to achieve sustained high levels of performance on a task or goal (Armstrong, 2006). It explains why people at work behave in the way they do in terms of their efforts and the directions they are taking. It is also concerned with job satisfaction; the factors that create it and its impact on performance. Armstrong (2006) noted that the aim of motivation theory was to obtain added value through people in the sense that the value of their output exceeded the cost of generating it. There are several theories which have attempted to explain how motivation works in management circles. The theories propounded for motivation include:

A. Instrumentality or Classical Theory

Which states that rewards or punishments (carrots or sticks) serve as the means of ensuring that people behave or act in desired ways. The scientific management advocated by Fredrick W. Taylor 1947, is the first of the ‘classical management’ approach and emphasized increasing productivity of individual workers through the technical restructuring of work organization and the provision of monetary incentives as the motivator for higher levels of output.

B. Content or Needs Theory

Which focuses on the content of motivation. It states that motivation is essentially about taking action to satisfy needs, and identifies the main needs that influence behaviour. Needs theory was originated by Maslow 1954, and in their two-factor model, Herzberg et al (1957) listed needs which they termed ‘satisfiers’. McGregor Theory X and Y (people are generally lazy and Theory Y: people do want to work and are creative) completes the group of needs theory.

C. Process or Cognitive Theory

Which focuses on the psychological processes which affect motivation, by reference to expectations Vroom, 1964, goals (Latham and Elton Mayo’s ‘human relations approach’) following the ‘Hawthorne experiments’ concluded that people are motivated by other conditions than pay; these being the need for recognition and a sense of belonging. Mayo’s (1880 -1949) understanding of the workplace as ‘people in a social environment’ has relevant applications within the construction industry. The process theory encompasses the following: Expectancy theory, Goal theory, Equity theory

D. Conceptual Framework

In order to improve labor productivity on construction sites, there was need to investigate the factors that influence labor productivity. Presented below in figure 2 is the conceptual framework for the study showing how productivity

(dependent variables) is affected by six independent variables.

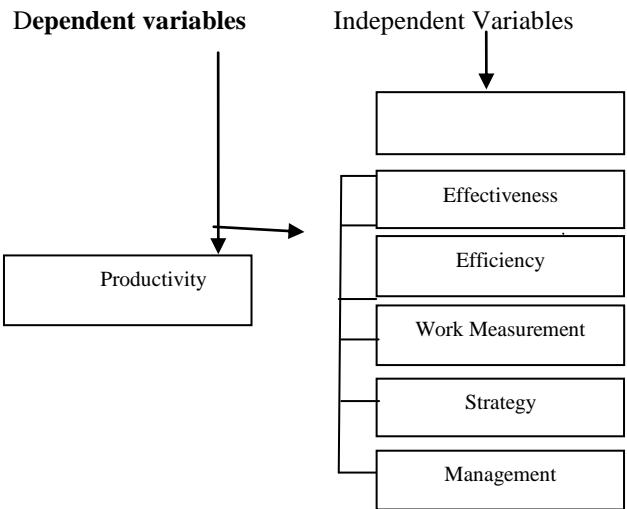


Figure 2: Conceptual Framework
Source: Field study (2014)

Which can be stated mathematically as:

$$P = P.P + E1 + E2 + W.M + ST + MA + e$$

Where P.P is Project Performance, E1 is Effectiveness, E2 is Efficiency, W.M Work Measurement, ST is strategy and MA is management while e is an error margin of other variables not in the equation.

X. METHODOLOGY

A. Survey Method

The research design used in this study is the survey methodology which supports an exploratory design of study. This was adopted because the problem of labor productivity lacks clues as to why there is no adequate empirical investigation done on the topic. This therefore warranted the need of developing concepts more clearly and establishing priorities. A questionnaire schedule was used to collect primary data. The questionnaires comprised of both structured and open ended questions and were administered to contractors, project managers and developers on live construction sites. This was in order to collect a detailed and all round data which provided a rich base for the analysis of the variables under consideration. It also provided sufficient, complete and accurate information without bias which maximized the reliability of the data. Random sampling was used in this study for the selection of the active construction sites. The criteria for picking of the respondents were their technical knowledge in the construction sector by putting into consideration the size of the project. Further, construction projects that were considered to have the desired information were picked and included in the sample. According to (Tromp, 2009), a researcher would need a minimum of 30 subjects in each group for co-relational and descriptive research. Since the concern of the survey was to gather information on labor productivity where the parties are predominantly project managers, developers and the contractors, a total of 50 of them were responsive from the initially targeted 60 subjects. This was largely due to the nature of the construction development in Nairobi County and the reliability of the conclusions that was to be drawn



from the research. The study also incorporated secondary data in the study. The information for secondary data was gathered from published documents which were already available. Sources of secondary construction- related data in Kenya included: Kenya Demographic Housing Survey; the Kenya informal settlements Improvement Programme (2010), Kenya Bureau of Statistics; United Nations Development Programme's Annual Housing Report; Internet, Journals articles, periodicals, conference papers, unpublished theses and research reports from reputable tertiary institutions.

XI. SURVEY FINDINGS

The results obtained through the field survey on factors affecting labor productivity on labor intensive construction sites are as follows:

A. Ranking of Factors that Affect Productivity

The 12 critical factors which negatively affect labor productivity on construction sites were identified from the literature review and were ranked by the respondents in accordance with their levels of impact on productivity. The factors were: Management system, Work planning and Scheduling, Incompetent supervisors, (Bilateral) Poor communication, Rework, Labor supply and work crews, Late deliveries of materials and equipment, Workers absenteeism and turnover, Motivation, Lack of training/skills, Poor site conditions (location, ground conditions, confinement) and safety at workplace. Table 1 below presents the findings from the respondents on the overall ranking order of the five core factors which influences the decline of labor productivity on construction sites.

Table 1: Labor Productivity Factors Ranking

Factors	% Score	Ranking
Lack of training/skills	90%	1
Work planning and Scheduling	80%	2
Incompetent supervisors	70%	3
Late deliveries of materials and equipment	65%	4
Motivation	60%	5

Source: Field Survey (2013)

The results from table 1 suggest that lack of training/skills is the hindrance to productivity that is considered /perceived by the stakeholders highly. The casual nature of employment of the construction workers has been cited as the negating factor in training employees since the contractors do not feel motivated to train non-permanent staff that can terminate their services without notice. All workers need continuous training and retraining in order to update their skills and keep abreast with new methods and emerging technologies in the construction industry. Motivation was perceived to have low influence on productivity as compared to the other four factors. Motivation may come in various forms such as

money, recognition, bonus, job security and participation in decision-making. Due to the casual nature of employment of the construction workers, motivation was not rated highly as there is lack of job continuity. The outcome further reinforces the findings from existing literature reviews of the pioneers of labor productivity studies in the construction industry including (Olomolaiye, 1998) (Ashworth, 1988)

B. Labor Productivity Outputs And Gang Sizes

The results obtained through the field survey on labor productivity output for 13 operations in the basic trades of masonry and painting are presented in the table 2 below as follows:

Table 2: Labor Productivity Outputs and Gang Sizes

S/No	Activity	Gang size (skilled: unskilled)	Labor Productivity (m ² /hr)
1	15 mm thick Plastering on walls	2:1	5
2	20 mm thick Plaster on soffits of suspended slab	2:1	4
3	25 mm thick Floor Screeding	1.1	3.5
4	225mm thick natural stone/SCB walling	1 : 2	1.1
5	150mm thick natural stone/SCB walling	1 : 1	1.5
6	100 mm thick natural stone/SCB walling	1 : 1	1.5
7	215mm thick standard brick walling	2:1	1
8	102.5mm thick standard brick walling	2:1	2
9	300 x 300 mm Ceramic Floor Tiling	4:1	4.6
10	200 x 250mm Glazed Wall Tiling	4:1	3.0
11	Prepare and Paint 3 coats of emulsion to smooth surfaces of plastered walls	4:1	20



12	Prepare and Paint 3 coats of emulsion to smooth surfaces of plastered ceiling	4:1	16
13	Prepare, knot, stop, prime and paint 3 coats of gloss paint to general surfaces of wood	4:1	6

Source: Field survey (2013)

From the study, painting on wall was conceived to have the highest productivity rate per squaremetre when compared to other tasks based on operations like brick walling and wall tilling which had lower productivity rates due to the higher manual and mental effort required. Consequently when costing such items some special consideration should be kept in mind to compensate for increase in time to execute the activities. The findings as indicated in table 3 show that the labor productivity of constructing for both a 100mm thick block wall/stone wall and 150mm thick block wall/stone wall is the same. Though the 100mm thick block wall/stone are lighter, it is more difficult to make them plumb during erection when compared to the 150mm thick walling. Furthermore the number of courses to be constructed with the 100mm thick walling in a day will be limited due to their slenderness. The respondents further stressed that the average labor constants quoted should be adjusted progressively to take into account the shape and storey height of the building. With the increase in height in walls for example, there will be need to increase the unskilled in the gang to take care of the additional lifts in the materials to the upper levels (Ashworth, 1988). For labor productivity results for painting, it was observed that the number of coats and the type of paint applied (whether water or oil based) will give different outcomes. The meaning and implications of the findings are that large surfaces are the greatest beneficiary of natural labor input. The workers output increases due to the straightforwardness of the work and the ease of supervision (Ashworth, 1988).

C. Strategies of Managing Labor

The significant management strategies of improving labor productivity obtained from the study included; training, mentorship, specialization, outsourcing, crew sizing and carrying out work measurement. Appropriate training to the workers came out strongly from the study as a key factor that affects labor productivity.

XII. CONCLUSION

The primary objective of this research was to identify, rank, assess the factors which affect labor productivity and evaluate various management strategies on labor productivity on labor intensive construction sites in Nairobi County. In this study, 12 critical factors were identified in total from the literature review and ranked in accordance with their levels of impact based on the views of project managers, contractors and developers. On the other hand, prevailing labor productivity outputs for 13 activities from trades of masonry and painting

were studied and the outcome from the findings were recorded. The findings from the study could be used as historical data in improving labor productivity in construction sites as estimating labor productivity is one of the most difficult aspects of preparing an estimate for bidding, or cost control. The paper further discussed the various management strategies of improving labor productivity which included; training, mentorship, specialization, outsourcing, crew sizing and carrying out work measurement. In order to have any meaningful improvement in labor performance in Kenya, there should be deliberate effort by the government to increase funding for Technical training and research especially on labor measurements.

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