Innovations

Measuring Productivity in Labour-Intensive Construction Projects in Zambia

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Abstract

Purpose: *Labour productivity has been identified as one of the causes of the decline in the construction sector's growth, mainly because factors, strategies and parameters for predicting improvements have not been fully explored. The study aimedat identifying and assessing factors contributing to labour productivity in construction projects in Zambia.* ***Design/Methodology/Approach:*** *The study adopted a cross-sectional descriptive design using quantitative methods. Data was collected from 150 structured questionnaires administered to Project Managers, Site Engineers, General Foremen, Bricklayers and Handymen with a response rate of 81%obtained. 122 respondents confirmed the extent of the impact of the factors through a survey questionnaire whose scale was tested using Cronbach's Alpha which was found to be > 0.8. The primary data which was obtained from questionnaires was analyzed using descriptive statistics.* ***Findings:*** *The study identified 36 key factors of productivity and grouped them as project-related, management-related, labour-related and industry-related. The top five ranked factors included: working heights, poor time planning and scheduling, poor sequencing of work, lack of experience and skill, and poor working environment. The study confirmed through 74.60% of the participants that productivity is highly affected negatively by the presence of Project-related, Management-related, Industry-related and labour-related factors. Based on the findings, there is a need for construction firm managers to develop a strategy to measure, monitor and document data on the labour productivity of every project activity and site, in order to increase organizational efficiency.* ***Implications/Research Limitations:*** *The study did not focus on productivity from projects dependent on plant and equipment but rather focused on labour-intensive projects. Furthermore, the present study focused on specific trades such as bricklaying and concreting. Similar studies aimed at enhancing productivity in plant and equipment or other trades would provide further information in coming up with more comprehensive policies.* ***Practical Implications:*** *This study's findings are key to improving productivity in labour-intensive construction projects and generating data for decision-making by policymakers and construction managers.* ***Originality/Value:*** *With the identified decline in the growth of the construction sector, enhancing labour productivity is being encouraged though there is evidence that strategies and parameters for predicting improvements have not been fully explored. Thus, the current study is among the few to be undertaken in Zambia and provides critical industry information for planning and enhancement of labour productivity in the construction sector.*

Keywords: *Productivity; Labour Intensive Projects; Performance; management*

1 Introduction

Labour-intensive construction methods have historically been utilized in developing infrastructure works. These methods offer employment to local people while contributing to the growth of

organizations and nations. Labour-intensive construction projects also utilize a lot of materials manufactured locally, thereby creating a higher requirement for products and services than highly mechanized projects (Thwala, 2007). Becker (1964) noted that labour productivity is one of the critical variables impacting the competitive capability of an organization as well as a nation. However, labour productivity has not been taken as an important contributor to the growth of organizations in most developing countries (Heshmati and Rashidghalam (2018), thereby making it a critical risk in construction projects.

Human resourcesis a strategic input in construction productivity, a component that mainly depends on workforce efficiency and effectiveness. The productivity of the construction sector in turning a given amount of input into output has wide-ranging consequences in providing essential infrastructure and services. Unfortunately, there has been a noticeable decline in construction productivity (Hewage and Ruwanpura, 2006; Hickson and Ellis, 2014). The need to understand the impact of factors affecting labour productivity in construction projects is critical due to its high-risk nature. On average, labour alone accounts for 40% of the direct cost in large projects (Greenberg, 2015).

Development of this resource is critical in improving productivity since the sector is characterized as labour-intensive. Concerns about productivity in the construction industry as it relates to labour, materials and equipment have been highlighted. Challenges related to productivity lead to cost and time losses on construction projects, resulting in a "lack of coordination, unidentified scope leading to poor planning, lack of monitoring and control, unrealistic schedules, poor implementation, and incorrect resource allocation" (Abdelaal et al., 2015). Globally, there is a general worry about the vulnerability of projects in terms of time and cost overrun due to problems of productivity. In Zambia, studies have reviewed that construction productivity is low due to factors relating to motivation, compensation and long working hours (Cheelo and Liebental, 2020).

Studies have reviewed that best practice manuals explaining modern labour-based construction methods, manufacturing methods and technologies need to be formulated. Before undertaking such a process, it is important to investigate the factors driving labour productivity. There is a need to provide sufficient technical information on such methods and technologies to enable those responsible for the design of projects to make confident and informed choices regarding their use in projects (Wellington and Mpendulo, 2008).

2 Challenges Associated with Labour Productivity

Challenges related to productivity oftentimes lead to cost and time losses on construction projects. According to Abdelaal et al, (2015), the resulting effects may be evidenced through "lack of coordination, unidentified scope leading to poor planning, lack of monitoring and control, unrealistic schedules, poor implementation, and incorrect resource allocation" among other reasons. Globally, there is a general worry about the vulnerability of projects in terms of time and cost overrun due to problems of productivity. There is a need to come up with methods to deal with productivity on-site.

Lim (1996) defined productivity as the ratio of output to input. Productivity rates are used by project managers during planning and scheduling in order to reduce labour costs and improve the performance of workers (Alinaitwe et al., 2006). The construction sector gradually created a significant labour productivity gap compared to other industries over the past five decades. It is estimated that only 50% of the total construction time is productive (Horman& Kenley, 2005). Labour is a major component in the construction industry that accounts for 40% of the total cost of a project (Halwatura, 2015). Hence, it can be argued that improving labour productivity is an effective approach to improving the overall productivity of the industry.

3 Labour productivity in Zambia

Since the demand side of construction services in Zambia is expected to grow, the productivity levels in the sector demand more attention from policymakers than ever before (Cheelo and Liebenthal, 2020). Attention needs to be given to the factors driving construction productivity and infrastructure development in Zambia in order to improve the efficiency levels of the country's investments.

Research and development in any industry is critical to productivity and structural transformation. Coupled with innovation, technological advances create a ripple effect, which in turn provide other economic sectors with novel methods of improving productivity (Lombe, 2018; Colander, 2017; Hernesniemi et al, 1996; Porter, 1990). Several studies conducted provide evidence that investing in R&D and innovation can enhance productivity and promote manufacturing competitiveness (Mattoussi and Ayadi 2017). It is therefore important to investigate the current performance trends in the construction sectorand , identify possible unique factors present in labour-intensive projects that affect productivity while exploring the opportunities in construction projects that could help improve productivity and spur further economic growth of nations.

There is a need for a structured and coherent methodological approach to evaluate and monitor productivity levels in construction projects with respect to labour and equipment. A model that would predict productivity would not only benefit construction companies but also client organizations, thereby bringing back the lost confidence and stimulating GDP growth. The study will close the existing knowledge gap identified through a literature review using an integrated approach to performance management. The outcomes of the study will contribute to the body of knowledge through the development of the model to predict productivity in labour-intensive construction projects. It will analyze productivity in labour-intensive construction projects in Zambia and find out what affects the performance of the sector, review key performance indicators unique to labour-intensive construction projects and identify tools for measuring the performance of construction projects. These indicators can then be used for benchmarking purposes and be a key component of any organization's move towards achieving best practices in order to overcome performance problems.

The unique nature and characteristics of labour-intensive construction projects make the process executed over a long period of time while going through a rigorous process having several components. Hence, labour productivity is affected by numerous factors. The study identified factors from the literature review and examined their impact on labour productivity in construction projects. The study identified 36 factors and divided them into 4 groups as shown in Table 1.

There is no evidence of research conducted on the extent of the impact of factors on labour productivity of construction projects in Zambia. This study used descriptive statistics to evaluate the impact of 4 group factors on productivity in labour-intensive construction projects in Zambia.

Table 1: Factors influencing labour productivity

A	Project-related Factors	Reference
1	Poor site access and logistics	Assaad, et al., (2023)
2	Reworks	Hickson and Ellis(2014); Mahamid, I. (2020)
3	Poor estimation	Abdel-Hamid and Abdelhaleem (2022)
4	Poor accessibility and location of materials	Jarkas, et al (2015)
5	Challenging working height	Dilawer (2014); Moselhi and Khan (2012)
6	Job size and complexity	Moselhi and Khan (2012)
7	Shortage of equipment or tools	Almamlook et al (2020)

8	Inefficiency of equipment or tools	Almamlook et al (2020)
B	**Management-related Factors**	
9	Poor time planning and scheduling	Almamloo et al (2020)
10	Poor site management practices	Hickson and Ellis (2014)
11	Unsuitable materials	Nyoni and Bonga (2016).
12	Poor sequencing of work	Alinaitwe et al (2007)
13	Late issuance of progress payment by clients to contractor	Muhwezi et al (2014)
14	Late issuance of construction drawings	Palikhe et al (2019)
15	Non-payment of suppliers	Muhwezi et al (2014);Mahamid, I. (2020)
16	Financial difficulties of the owner or consultants	Murari and Joshi(2019)
17	Poor project communication	Hickson and Ellis (2014)
18	Poor supervision	Almamlook et al (2020)
19	Delays in correction of mistakes	Mahamid, I. (2020)
20	Unavailability of materials	Hickson and Ellis (2014)
C	**Labour-related Factors**	
21	Physical fatigue	Irfan et al (2020)
22	Absenteeism	Gopal and Murali (2015)
23	Lack of labour	Mahamid, I. (2020)
24	Lack of labour training	Almamlook et al (2020)
25	Lack of meetings with labour teams	Alyew et al (2020)
26	High frequency of public holidays	Liu et al (2023)
27	Lack of experienced and skilled labour	Hickson and Ellis(2014); Mahamid(2020)
28	Lack of labour motivation	Ohueri et al (2018)
29	Salary delays	Nguyen et al (2020)
30	Overtime working	Jarkas et al (2015)
D	**Industry-related Factors**	
31	Poor working environment	Chi (2019)
32	Poor weather conditions	Jarkas et al (2015)
33	Lack of knowledge in construction technology	Jarkas et al (2015)
34	Poor coordination among construction trades and disciplines	Jarkas et al (2012)
35	Lack of personal protective equipment	Oo et al (2023)
36	Unfair labour laws	Palikhe et al (2019)

Studies at the industry level focused on productivity measurement (Vogl and Abdel-Wahab, 2015), long-term productivity trends (Allmon, 2000) and measured total (Gal, 2013) or partial or single factor productivity, in particular, labour productivity (Choi et al, 2016), and revealed evolution of productivity indices over time across several economies. Productivity rates differ between projects due to the varying environments, characteristics and project management efforts for each project. There is a need to explore parameters and strategies for predicting improvements more accurately (Yi and Chan, 2014); Shortcomings in the existing models as identified by Zhao et al (2013).

4 Materials and Methods

This study adopted structured interviews and a questionnaire to collect data for each of the dependent and independent variables. The independent variables were project-related, management-related, labour-related and industry-related factors while labour productivity was the dependent variable.

The study adopted a descriptive cross-sectional survey design, and data was collected using a structured questionnaire containing closed-ended questions. The literature review informed the development process of the instrument used in data collection. The study was conducted in Zambia and participants were selected from the National Council for Construction database of contractors registered under Civil and Building Categories. This is because most of the companies in this category undertake bricklaying and concrete work.

A total of 150 questionnaires mostly Project Managers, Site Engineers, General Foremen, Bricklayers and Handymen were purposively sampled and 122 participated in the study. The respondents were nominated based on their working experience in bricklaying and concreting trades. The gathered data was analyzed using descriptive statistics.

5 Results

5.1 Respondent's Characteristics

A response rate of 81% was obtained. The respondents included; 18% Project Managers, 12%% Site Engineers, 23% General Foremen, 32% Bricklayers and 15% Handymen. The primary data obtained from questionnaires were evaluated for validity and reliability and analyzed using Statistical Package for Social Sciences software.

5.2 Reliability and validity of the questionnaire

In order to determine the internal consistency of the questionnaire, a reliability test was conducted using Cronbach Alpha which had standardized values that were used as control for comparison of the findings. Table 2 shows the Cronbach Alpha standard values as shown by the rule of George and Mallery (2003).

Table 2: Cronbach Alpha Standard values

Standard Values	Interpretation of the Value
Greater Than Zero Point Nine (>0.9)	Excellent
Between Zero Point Eight &Nine (> 0.8 &<0.9)	Good
Between Zero Point Seven &Eight (> 0.7 &<0.8)	Acceptable
Between Zero Point Six &Seven (> 0.6 &<0.7)	Questionable
Between Zero Point Five &Six (> 0.5 &<0.6)	Poor
Less Than Zero Point Five (<0.5)	Unacceptable

Table 4.1 shows the actual output of the findings of the internal consistency of the questionnaire based on the findings as per each factor being considered. The findings show that the questionnaire is valid and reliable through internal consistency.

Table 3: Cronbach Alpha Output of the Variables in the Questionnaire

Name of the Variable	Cronbach Alpha	Interpretation of the Value
Project Related Factors	0.823	Good
Management Related Factors	0.911	Excellent
Labour Related Factors	0.919	Excellent
Industry Related Factors	0.821	Good

Structured interviews were conducted with 15 Project Managers with experience in the construction industry who have worked for Civil and Building Contractors registered with the National Council for Construction. The data provided input into the questionnaire. Furthermore, 10 Contractors were requested to go through the questionnaire and prove its validity. Using descriptive statistics, the perception of respondents on the extent of influence of the identified factors on the rate of production was obtained.

5.3 Knowledge of labour production outputs in the Construction Industry

The study assessed whether the respondent organizations had agreed labour outputs or not. It was revealed that only 32.8% respondents had agreed labour outputs as an organization while 67.2% did not have.

Furthermore, the study revealed that only 27.9% of the respondents were aware about labour outputs while 72.1% were unaware.

Table 4: Knowledge of Labour Production Outputs by Organizations

Labour Production Outputs	Yes (%)	No (%)	Neutral (%)	Total (%)
Organization Agreed Outputs	32.8	67.2	-	100
Organization Awareness Levels	27.9	72.1	-	100
Impact of Factors	74.6	9	16.4	100

5.4 Impact of factors on Labour Productivity in Zambia

An assessment of the impact of the factors on productivity was undertaken. The study revealed that 74.60% of respondents agreed that productivity is highly affected negatively by the presence of Project-related, Management-related, Industry-related and labour-related factors. It was also noted that 9.0% disagreed while 16.4% neither agreed nor disagreed as in Table 2.

Table 5: Ranking of the level of project-related factors

Factor	Cumulative % of Occurrence	Rank
Working Height	79.60	**1**
Shortage of Equipment or tools	75.50	**2**
Poor Accessibility and Location	73.00	**3**
Poor site access and Logistics	70.50	**4**
Reworks	70.50	**4**
Job Size & Complexity	68.80	**5**
Inefficiency of Equipment or tools	68.00	**5**
Poor Estimation	66.40	**6**

Source: Author, 2023

Table 6: Ranking of the level of management-related factors

Factor	Cumulative % of Occurrence	Rank
Poor sequencing of work	79.50	**1**
Poor time planning and scheduling	78.00	**2**
Poor site management practices	76.20	**3**
Unsuitable materials	76.20	**3**
Late issuance of construction drawing	73.80	**4**
Finance difficulty	73.80	**4**
Non-payment of Supplies	72.20	**5**
Poor Project communication	72.10	**6**
Delays in the correction of mistakes	70.50	**7**
Late issuance of progress payment	69.60	**8**
Unavailability of material	69.60	**8**
Poor supervision team	68.00	**9**

Source: Author, 2023

Table 7: Ranking of the level of labour-related factors

Factor	Cumulative % of Occurrence	Rank
Lack of Experience and Skill	74.60	**1**
Overtime working	73.80	**2**
Lack of labour motivation	73.70	**3**
Lack of labour	72.90	**4**
Salary Delays	72.20	**5**
Lack of labour training	71.30	**6**
Frequency of holidays	69.70	**7**
Absenteeism	68.90	**8**
Physical Fatigue	68.00	**9**
Lack of meetings with labour teams	67.20	**10**

Source: Author, 2023

Table 8: Ranking of the level of industry-related factors

Factor	Cumulative % of Occurrence	Rank
Poor working environment	73.80	**1**
Lack of knowledge in construction technology	71.30	**2**
Poor coordination among construction industry-related	71.30	**3**
Weather conditions	69.60	**4**
Lack of personal protective equipment	68.70	**5**
Unfair labour laws	65.70	**6**

Source: Author, 2023

7 Discussion of Results

7.1 Impact levels of factors on productivity in construction projects in Zambia

The analysis of the results confirmed that the identified factors in Tables 5, 6, 7 and 8are prevalent and have an impact on productivity in labour-intensive construction projects in Zambia. It was agreed that

these independent variables are appropriate and have statistical significance. The findings agree with Hickson & Ellis (2014) that certain factors contribute to the performance of construction productivity. Furthermore, the study established that project and management-related factors had the highest impact on productivity while labour and industry-related factorshad a medium level of impact on the labour productivity of construction workers in Zambia.

The project-related and management-related factors such as working height and poor sequencing of work had the highest individual impact on labour productivity at 79.60% and 79.50% respectively.The management-related factors such as poor time planning and scheduling with animpact levelof 78% ranked 3rd, whilepoor site management practices (76.2%) and use of unsuitable materials (76%) were ranked 4thand 5threspectively. The project-related factor of shortage of equipment or tools was ranked 6th at 75.5%. The study revealed that lack of meetings with labour teams (67.2%), poor estimation (66.4%) and unfair labour laws (65.7%) were lowly ranked, yet stakeholders still need to monitor them as they equally impact productivity.

Construction managers and project managers need to closely monitor these identified high-ranked factors as they are critical in the performance of their workforce.

7.2 Implications of the Findings

The study findings suggested that developing nations like Zambia must develop policies and legal frameworks that encourage and enhance productivity measurement systems specifically for the construction sector. The policy must stimulate the determinants of labour productivity such as a good working environment, motivation of construction workers, time and resource management, process planning and site management in labour-intensive construction projects. These findings are critical to informing the development of policies and the relevant legal framework on labour productivity in the construction sector.

8 Conclusion

The study highlights the influencefactors on productivity in labour-intensive construction projects. Through the literature review, 4-factor groups impacting labour productivity in construction projects in Zambia were identified and listed. These included factors related to the project, factors related to management, factors related to labour and factors related to the industry. 122 questionnaires were collected for analysis and from the data collected through the survey, the authors used descriptive statistics to evaluate and rank the impact of the factor groups. The study highlighted working height, poor sequencing of work, poor time planning and scheduling, shortage of equipment tools, poor site management practices and use of unsuitable materials as the leading factors hampering productivity. The study implored the government to build capacity among contractors through project organization, planning and management. Furthermore, there is a need for construction firm managers to develop a strategy to measure, monitor and document data on the labour productivity of every project activity and site, in order to increase organizational efficiency.

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