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# ENHANCING PRODUCTIVITY IN CONSTRUCTION TRADES IN LABOUR-INTENSIVE CONSTRUCTION PROJECTS

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## ABSTRACT

**Purpose**: The study sought to investigate the factors impacting productivity in labour-intensive construction projects, focusing on bricklaying and concreting in Zambia.

**Design/Methodology/Approach:** This study adopted structured interviews and a questionnaire to collect data for 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. 150 sets of questionnaire were administered to stakeholders in the construction industry, and a response rate of 81% was obtained. The primary data was evaluated for validity and reliability and analysed using Statistical Package for Social Sciences software. The analysis revealed a positive and significant relationship between the factors of the independent variables and the dependent variable.

**Findings**: The data analysis revealed a positive and significant relationship between factors of the independent variables and the dependent variable. Among the research findings were the 36 key factors affecting productivity identified from the literature review and grouped as project-related, management-related, labour-related and industry-related. The extent of the impact of each factor on construction labour productivity was also established using descriptive statistics. The management and project-related factors were found to have the highest impact on workers' productivity.

**Research Limitation:** The study was limited to bricklaying and concreting trades. Other trades must be examined to check if the results are similar.

**Practical Implication:** Manpower planning and human resource management help improve the workforce's efficiency, thereby substantially increasing the number of youth and adults with relevant technical and vocational skills.

**Social Implication:** Labour productivity helps create meaningful employment, decent jobs, and entrepreneurship opportunities.

**Originality/Value:** The study sought to identify the factors impacting productivity in labour-intensive construction projects, explore the most critical variables and develop a model to improve construction output and build capacity.

***Keywords:*** *Construction. labour-intesive. management. productivity. worker*
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## INTRODUCTION

The construction sector is directly linked to any country's Gross Domestic Product (GDP) growth globally. Research conducted in most developing countries shows that the overall GDP receives a significant contribution from the construction sector, making it the highest contributor to national growth (Alaloul et al., 2021). A report on the construction industry's performance identified it as a key contributor to the economic growth of Zambia (NCC, 2004). According to Kakoma and Muya (2016), the size of the construction industry directly affects any nation's development. Lewis (2009) relates that the booming of the construction sector busts the country's economy. The impact of the construction sector's performance on a nation's economic development cannot be overemphasised.

Since the construction industry sets up infrastructure which supports other economic sectors, its importance goes beyond merely contributing to GDP growth. The sector's capability to create employment has also been noted by Dainty et al. (2004), Bodapati (2003) and Chen (1998), cited by Muya et al. (2007). Kirchberger (2020) also acknowledges that the construction sector is in a critical position to sustain the strategic sectors of a country's economy while employing many citizens. According to Henstridge and Rweyemanu (2017), wherever "construction is involved, there is likely to be a material impact on the labour market for a range of semi-skilled and skilled workers, such as construction workers, bricklayers, metal workers, carpenters, plumbers, and electricians." Hence, the sector's capacity and efficiency are critical to the national development goal, particularly those of developing countries.

Kirchberger (2020) and Ngoma et al. (2014) bemoaned the consequences of a poorly functioning construction sector. His research reviewed that such a sector would tend "to translate into high prices, leading to low levels of output for a given level of expenditure." Furthermore, such countries tend to have low local capacity and are forced to import construction services from foreign firms, limiting local employment generation, productivity and local content. In short, it could be deduced that the construction sector's productivity in turning a given amount of input into output has a wide-ranging consequence in providing essential infrastructure and services (Ngoma et al., 2014).

Unfortunately, the construction sector has habitually been a victim of countless challenges, including internal and external pressures that upset and impact its performance (Ofori, 2000; Ngoma et al., 2014). Poor performance, over-expenditure, and poor delivery challenge the delivery of public infrastructure (Ministry of Works and Supply, 2006). Ahmed et al. (2002) argued that delays in construction projects are a universal phenomenon usually accompanied by cost and time overruns.

Labour-intensive construction methods have employed local people when undertaking infrastructure projects in developing countries, contributing to economic growth (Bamfo-Agyei et al., 2020). These methods employ locally manufactured materials and create a higher requirement for products and services than highly mechanised projects (Thwala, 2007). Becker (1964) identified labour productivity as one of the critical variables impacting the competitive

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capability of organisations and nations. Unfortunately, labour productivity has not been recognised as an important contributor to the growth of organisations in most developing countries (Heshmati & Rashidghalam (2018), making it a critical risk in construction projects.

Ngoma et al. (2024) and Muya et al. (2013) relate that productivity challenges often lead to cost and time losses on construction projects. Abdelaal et al. (2015) revealed that the effects might 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 productivity problems. There is a need to develop methods to deal with productivity on site and develop a structured and coherent methodological approach to evaluate and monitor productivity levels in construction projects concerning labour and equipment. A model that would predict productivity can benefit construction firms and client organisations.

## LITERATURE REVIEW

### Labour Productivity in the Construction Sector

Globally, productivity has been identified as a crucial component of an organisation's growth strategy. It plays a key role at macro and micro levels, affecting the firm's performance. Productivity can be used to benchmark against world-class entities with best practices. Murari and Joshi (2019) described labour productivity as a measure of improving the production of the construction sector. They argue that it reflects the productivity of construction workers, which eventually affects the overall project performance. Lim (1996) also defined productivity as the ratio of output to input, while Chia et al. (2014) agreed that productivity is defined as the ratio of product output to input resources. Yi and Chan (2014) argued that labour productivity can be viewed as a concept used to measure the worker's efficiency and is calculated as the value of output produced by a worker per unit of time, such as an hour.

Project managers use productivity rates during planning and scheduling to reduce labour costs and improve workers' performance (Alinaitwe et al., 2007). The construction sector gradually created a significant labour productivity gap compared to other industries over the past five decades. Only 50% of the total construction time is estimated to be productive, impacting overall performance (Horman & Kenley, 2005). Labour is a significant component in the construction industry that accounts for 40% of the total cost of a project (Halwatura, 2015). Therefore, improving labour productivity is a practical approach to improving the industry's overall productivity.

The paper reviews labour-intensive construction projects that utilise construction workers and less equipment. These include Small and Medium Enterprise contractors that utilise labour-

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intensive methods as a tool for productivity due to their inability to own equipment. Labour-intensive methods are "programmes that generate more direct and indirect local employment opportunities and income by using locally available input, creating a greater demand for local products and services than high-technology programmes reliant on imported technology and equipment" (Thwala, 2007).

## Measurement of Labour Productivity on Construction Projects

Several studies have reviewed productivity measurement (Bamfo-Agyei et al., 2022; Vogl & Abdel-Wahab, 2015), long-term trends in productivity (Borg & Song, 2014), measured total (Hu & Liu, 2017) and partial factor productivity in terms of labour productivity (Choi et al., 2021). However, there has been a revealed evolution of productivity indices over time across several economies. Mostly, this is because productivity rates differ between projects due to the varying environments, characteristics and project management efforts for each project. Unfortunately, there is no model to assist stakeholders in planning their productivity. The existing models have shortcomings, as Zhao et al. (2014) identified. Therefore, there is a need to explore parameters and strategies for predicting improvements more accurately (Ngoma et al., 2024).

With increased competition in the construction industry, every organisation must measure its performance (Kulatunga et al., 2005; Mwanaumo et al., 2018). The measurement of performance has become the "language of progress of an organisation" (Rose, 1995), and no improvement in any business can be gained unless there is a measurement of its performance (Baldwin et al., 2001). Neely (1998) defined performance measurement as the "process of quantifying past actions, where measurement is the process of quantification and past actions determine current performance." Therefore, there is a need to measure the performance of contractors in the construction process and find out the factors affecting it. According to Cheung et al. (2006), project performance can be investigated and evaluated using many performance indicators expressed by factors such as time, cost, quality, client satisfaction, client changes, and health and safety.

## Risks in Construction Labour Productivity

Productivity-related challenges usually lead to cost and time losses on construction projects. According to Abdelaal et al. (2015), the 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. Therefore, methods must be developed to deal with on-site productivity and accurately measure it.

Unlike other sectors, one of the critical challenges in the construction sector is the divergences in the productivity measurements of labour. While others apply time, it is common for others

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to measure productivity using employment-based measures of labour input (O'Grady & McCabe, 2021). For example, a company may base its production rate on a 40-hour-per-week calculation for critical trades, while others may base it on 10 hours/day production. It is common in residential construction to account for production based on a piece-rate payment where hours typically exceed 40 per week. Since 25-35% of construction labour is self-employed, estimates of average weekly hours are problematic for this group. Easier methods of measurement are required. Below is a review of the challenges of labour productivity in different countries.

In South Africa, Sibiya et al. (2015) identified several factors affecting the construction industry's performance. These ranged from the project level to the national level and relate to the low capacity and capability of the local contractors and consultants caused by a weak resource base and inadequate experience. The industry has been affected by inadequate and erratic work opportunities. These inappropriate contract packaging of works favour foreign firms in donor-funded projects, low public investment in infrastructure projects, over-dependence on donor funding and inefficient and non-transparent procurement systems due to corruption and financial mismanagement in public/private sectors. There is also a lack of supportive institutional mechanisms regarding financial credit facilities, equipment for hire and professional development.

A study conducted by Makulsawatudom et al. (2004) in Thailand revealed that the construction sector faces many challenges resulting in low productivity. Like many countries, the sector has been dominated by many small companies whose contribution to the market share is only 9.9% compared to a few large companies with 21.5%. Responses from 34 project managers revealed challenges relating to a lack of materials, incomplete drawings, incompetent supervisors, poor communication, instruction time, poor site layouts, and delays in undertaking inspections and rework.

Almamlook et al. (2020) studied factors affecting labour productivity in Libya. The factors were grouped into management, technological, and human/labour. The most significant factors identified were lack of supervision, experience and skilled labour, Construction technology, coordination among construction industry disciplines, and errors in design drawings. These findings agree with those identified in Thailand.

## Construction Labour Productivity in Zambia

In Zambia, construction firms are graded according to their capacity to deliver a project based on previous contracts, level of access to credit, number of professional and technical staff, financial position, and state of technology. The grading uses Arabic numerals, with one being the highest attainable and 6 being the entry or lowest grade. According to NCC (2021), 10,245 construction firms were registered in 2021. Table 1 shows that the building category (B) had the highest number of registered construction firms at 3,885. Further, Grades 4, 5 and 6

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accounted for the highest number of registered construction firms in the building category, with 9 per cent (2411), 23 per cent (871) and 62 per cent (351), respectively. Additionally, grades 4, 5 and 6 also presented the highest number of registered construction firms in the civil engineering category, with 8 per cent (120), 20 per cent (287) and 63 per cent (917), respectively, in Figure 1. This confirmed that the construction industry in Zambia is predominantly labour-intensive and mainly composed of small and medium enterprise construction firms.

*Table 1: Registration Certificates issued to construction firms by Grade and Category*

| Grade | B | C | E | M | ME | R | TOTALS |
|---|---|---|---|---|---|---|---|
| **1** | 87 | 55 | 35 | 31 | 8 | 75 | **291** |
| **2** | 77 | 31 | 33 | 18 | 5 | 54 | **218** |
| **3** | 88 | 40 | 29 | 7 | 1 | 122 | **287** |
| **4** | 351 | 120 | 75 | 20 | 8 | 255 | **829** |
| **5** | 871 | 287 | 161 | 66 | 36 | 1073 | **2494** |
| **6** | 2411 | 917 | 517 | 453 | 201 | 1601 | **6100** |
| **S** | | | | | | | **26** |
| **TOTALS** | **3885** | **1450** | **850** | **595** | **259** | **3180** | **10245** |

*Source: NCC, 2021*

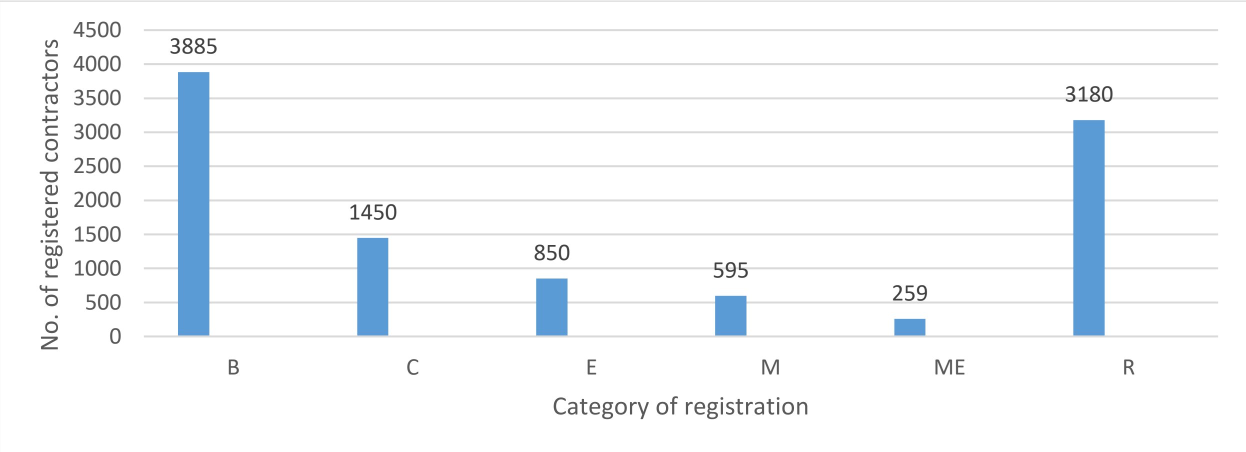


*Figure 1: Registration of Construction Firms by Category in 2021*
*Source: NCC, 2021*

With the growing demand for construction services in Zambia, the sector's productivity levels will demand more attention from policymakers than before (Cheelo & Liebenthal, 2020). There has been a growing need to monitor the impact of the factors driving construction productivity and infrastructure development in Zambia to improve the efficiency levels of the country's investments (Hernesniemi et al., 1996; Porter, 1990). Investing in innovation, research and development can enhance productivity and promote manufacturing competitiveness (Mattoussi & Ayadi, 2017).

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There is little evidence of research conducted on the extent of the impact of factors on the labour productivity of construction projects in Zambia. Sampa (2016) conducted a study to evaluate the effects of workers' welfare facilities on productivity in the Zambian construction industry. It identified poor employment conditions, lack of basic site amnesties and inadequate welfare facilities as factors affecting productivity. Existing literature focused on factors affecting the performance of the construction industry. Zulu and Chileshe (2008) argued that the construction industry in Zambia performs below expectations and that nothing can be learned from local ongoing projects that have not been completed or delayed. They concluded that the poor performance of contractors had huge implications on the competitiveness of their businesses.

Ngomi (2017) identified poor project financing and a lack of supervision skills, tools, and capacity as the primary indicators of poor performance in Zambia. Further, Sylvia (2017) identified poor financial management, a lack of communication on technical matters, a lack of project management skills, and failure to provide a safe working environment as factors inhibiting the performance of construction projects in Zambia.

**Importance of Labour Productivity**

Research revealed a profound interaction among the various factors influencing labour productivity. It explains important interrelationships and dependencies between different factors, offering frameworks for comprehending the interactions between the variables and enabling more focused interventions and productivity-boosting tactics on building sites.

Some scholars’ insights go beyond simple identification of factors to suggesting possible remedies to lessen the detrimental effects of specific factors on worker productivity. Measurement is the way construction professionals look for evidence-based methods to maximise worker performance and efficiency. Several researchers have significantly contributed to the field by thoroughly investigating the variables influencing labour productivity in the construction sector.

Further, some research at the industry level focused on productivity measurement (Bamfo-Agyei et al., 2022; Vogl & Abdel-Wahab, 2015), long-term productivity trends (Allmon et al., 2000) and measured total (Gal, 2013) or partial or single-factor productivity, in particular, labour productivity (Choi et al., 2016), and revealed the evolution of productivity indices over time across several economies or nations. Productivity rates differ between projects due to each project's varying environments, characteristics and project management efforts. There is a need to explore parameters and strategies for predicting improvements more accurately (Yi & Chan, 2014) as there are shortcomings in the existing models, as identified by Zhou and He (2013). Mirahadi and Zayedi (2016) contributed substantially to the body of knowledge of the variables affecting worker productivity in the construction sector. The study carefully identified and examined skill levels, working conditions, and project management techniques as some of the

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crucial factors. Their work provided a fundamental resource for researchers and construction professionals tackling labour-related issues by elucidating the complexities of these factors.

*Table 2: 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 (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 (2020) |
| 16 | Financial difficulties of owner or consultants | Murari and Joshi (2019) |
| 17 | Poor project communication | Bamfo-Agyei et al. (2022); Hickson and Ellis (2014) |
| 18 | Poor supervision | Bamfo-Agyei et al., (2020); Almamlook et al (2020) |
| 19 | Delays in correction of mistakes | Mahamid (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 (2020) |
| 24 | Lack of labour training | Kyei, and Bamfo-Agyei, (2021); 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) |

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| | | |
|---|---|---|
| 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 and Lim (2023) |
| 36 | Unfair labour laws | Palikhe et al (2019) |

Studies conducted by Atta (2012) have demonstrated the critical role of the physical workspace in determining worker productivity in the construction sector. The workplace creates an environment that is safe, orderly, and supportive of effective work practices. Adequate accessibility to work areas, well-maintained equipment, and effective layout planning facilitate the general seamless operation of construction projects. It reduces downtime and guarantees that workers can easily move between tasks when tools and materials are arranged in an accessible manner.

## Labour productivity factors

Productivity is understood to be the outcome of several interrelated factors. The literature identifies various factors that affect labour productivity in construction projects in different parts of the globe. The unique nature and character of labour-intensive construction projects require the process to be executed over a long period while going through a rigorous procedure with several components. Hence, labour productivity is affected by numerous factors.

The study identified 36 factors through a thorough analysis of the literature on labour productivity in the construction sector, non-participant observations and interviews. Situated at the centre of economic growth, the construction industry is complex, requiring new approaches to improvement, creative forecasting models, inventive benchmarking programmes, and a sophisticated comprehension of the variables affecting worker productivity. This review captures the complexity of the industry's pursuit of increased productivity and effectiveness. The probability of occurrence and the impact on labour productivity in construction projects was examined. The identified factors were divided into four groups as shown in Table 2. The factors influencing labour productivity were identified, highlighting the complex interactions between different components in construction projects. Understanding the subtleties of labour dynamics lays the groundwork for targeted interventions and strategic enhancements, ranging from the physical work environment to project planning and scheduling. The literature review highlights how critical it is to identify and address potential

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productivity barriers to create an atmosphere that supports the growth of the construction workforce.

## METHODS

The paper adopted mixed research, using quantitative and qualitative methods as the main techniques. Statistics were drawn from quantitative data, while human experiences and contextual depth through case study observations were added to the findings by qualitative data. These approaches guaranteed a more thorough and rigorous investigation of productivity enhancement in the construction sector.

This study was designed to address the research questions identified and achieve the objectives. It was considered essential to understand the study fully by logically setting out the various elements to avoid misunderstanding at any point in the research. Therefore, the research's problem statement, aims, and objectives were stated immediately. The present study employs a multi-paradigmatic approach that integrates qualitative and quantitative methodologies to investigate productivity enhancement in the construction sector. In addition to administering a structured questionnaire to managers and handymen engaged in these construction activities, the research design incorporates a case study on concreting and bricklaying.

To obtain comprehensive qualitative insights from important stakeholders, interviews were conducted on labour productivity improvement in bricklaying and concreting within the construction industry. A selection of professionals, including project managers, site engineers, bricklayers and handymen directly involved in concreting and bricklaying projects, was made based on their roles and areas of expertise. Various participant representations were sought to encompass various viewpoints and experiences within the construction industry. A non-probability sampling technique was used for the questionnaire survey since it involved selecting participants for special situations. A purposive sampling approach was adopted with an emphasis on judgment sampling due to the selection of unique cases that are especially informative and since the researcher wanted to identify particular types of cases for in-depth investigation. The purpose was to understand better those particular types of cases (Neuman, 2009). A total of 150 participants were targeted.

Three case studies of construction projects were selected and monitored for three months. The studies investigated the factors affecting the labour productivity of construction workers. Where possible, case studies highlighted how labour is managed given different project environments, levels of skills, and availability of resources and tools. Care was taken to differentiate these experiences according to the project environments of the different sites. This was to avoid the adoption and recommendation of unworkable and unrealistic principles.

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The data consisted of 108 hours of field-noted observation of construction processes, 26 hours of video-recorded construction activities, 23 individual interviews of Project Managers and Site Engineers (ranging from 27 to 54 minutes), and 67 reviewed documents. All these separate data items were incorporated into the interview and questionnaire survey to support the data collection tools.

**Methods of Analysis**

The data collected from the survey was analysed using descriptive statistical techniques. The quantitative data was analysed statistically to find trends, relationships, and statistically significant factors influencing productivity in these construction activities. An advanced and accurate analysis method was needed to arrange the large body of data systematically, quickly and reliably. For this purpose, the computer software Statistical Package for Social Science (SPSS) and Excel were chosen as the best options available. Regression and correlation are two of the techniques that were used for data analysis.

The research used the regression analysis method to evaluate the extent of the impact of factors on the labour productivity of construction workers in Zambia. A strata ordinal logistic regression model that focused on the interrelated connection between general factors (dependent variables), such as labour productivity of workers in a construction project, and effect factors (independent variables) was used. A 5-step process was adopted as follows:

*Step 1: Determining the research model*

According to Poole and O'Farrell (1971), an ordinal logistic regression model that focuses on the interrelated connection between general factors (dependent variables) such as labour productivity of workers in a construction project and effect factors (independent variables) can be defined as:

$$\text{Logit}\,(P(Y \leq j)) = \beta_{j0} + \beta_{j1} X_1 + \beta_{j2} X_2 + \beta_{j3} X_3 + \beta_{j4} X_4 + \cdots + \beta_{jp} X_p$$

Where: β is a free coefficient

$\beta_{j0}, \beta_{j1}, \beta_{j2}, \ldots \beta_{jp}$ are free coefficients

$X_1, X_2, X_3, X_4 \ldots, X_p$ are independent variables (factor effects components)

Y are dependent variables (labour productivity of workers in construction projects)

In other tools like stata, the ordinal logistic regression model is parameterised as shown below;

$$\text{Logit}\,(P(Y \leq j)) = \beta_{j0} - \beta_{j1} X_1 - \beta_{j2} X_2 - \beta_{j3} X_3 + \beta_{j4} X_4 - \cdots - \beta_{jp} X_p$$

The model in normal regression adds the coefficients for the explanatory variable to the intercept to obtain the predicted outcome (e.g. Y = a + bX) while in ordinal regression the model is parameterized as Y = a – bX.

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Where '**a**' is the Y-intercept

'**b**' is the coefficient of odds or the Beta Coefficients.

However, the predicted values do not change. They are done so to mean the following: Positive coefficients mean that higher explanatory variable values are associated with higher outcomes. In contrast, negative coefficients mean higher explanatory variable values are associated with lower outcomes.

*Step 2: Design of questionnaire survey form and data collection*

A questionnaire survey was designed to evaluate the impact of the key factors. To obtain a conclusive result on factors affecting labour productivity, 36 factors in four groups identified in the literature review and interviews were subjected to a questionnaire survey. Respondents were asked to rate the occurrence of the factors that affected labour productivity based on a Likert scale of 1 to 5. The size of the samples for the quantitative analysis was calculated using a formula for regression analysis: **$n \geq 50 + 10*p$.**

Where:

**n** is the size of the sample

**p** is the number of independent variables in the model.

Therefore, the indispensable size of the sample is $n \geq 50 + 10*4 = 50 + 10*4 = 90$ (Austin & Steyerberg, 2015).

*Step 3: Testing the reliability of the scale*

The internal consistency and reliability of the questionnaire were determined using a Cronbach's coefficient Alpha test. The reliability test conducted using Cronbach Alpha has standardised values, which are used as a control for comparing the findings (George & Mallery, 2003). Coefficients less than 0.5 were unacceptable, between 0.5 and 0.6 were poor, between 0.7 and 0.8 were acceptable, between 0.8 and 0.9 were good, and greater than 0.9 were considered excellent.

*Step 4: Determining the influence of each factor*

Through regression analysis, the influence of each factor was determined through coefficients. Based on the equation, positive coefficients meant higher explanatory variable values were associated with higher outcomes. In contrast, negative coefficients meant higher explanatory variable values were associated with lower outcomes. The higher coefficient depicted the significant effect on the overall factors of that factor. The coefficient has a valuation within -1 and can be defined as:

a) If is greater than 0, then there is a positive correlation between the independent and dependent variables.

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b) If the value β is less than 0, there is a negative correlation between the independent and dependent variables.
c) If the value β is closer to 1, the more coherent the correlation between independent and dependent variables is.
d) If the value β is closer to 0, the lower the correlation relationship between independent and dependent variables is.

**Validation of the model**

The LPRM was validated using practitioners within the Zambian construction industry. The process focused on the model's validity, legitimacy, and functionality. Ten directors in construction firms were targeted in the validation exercise. Responses were received from all the directors. The respondents were availed of the model to conduct their assessment. A brief overview of the model was presented to the participants before the commencement of the assessment. The model and results are presented in the subsections below.

## FINDINGS

*Development of a mathematical formulae model for measuring labour productivity*

*i) Labour Productivity Regression Model (equation) with actual parameters*

$$\text{Logit}(P(Y \leq j)) = \beta j0 - \beta j1\, X1 - \beta j2\, X2 - \beta j3\, X3 - \beta j4\, X4 - \cdots - \beta jp\, Xp$$

Where: Y are dependent variables (labour productivity of workers in construction projects)

β is a free coefficient

βj0, βj1, βj2, …βjp are free coefficients

X1, X2, X3, X4…,Xp are independent variables (factor effects components)

X1: Management-related factors β = 27.10972

X2: Project-related factors β = -88.1485

X3: Labour-related factors β = 62.37609

X4: Industry-related factors β = 69.02975

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Productivity $Level_{predicted}$ = 140.5665 – 27.10972 * Management-related factors – (-88.1485) *Project-related factors – 62.37609 * Labour-related factors – 69.02975 * Industry-related factors

Formulae: Y = 140.5665 – $27.10972_1$ – $(-88.1485_2$ – $62.37609_3$ – $69.02975_4$

Based on the results, it must be understood that Exp (B) or odds ratio is the predicted change in odds for a unit increase in the predictor. The "Exp" implies the exponential value of B; hence, when Exp (B) is less than 1, increasing variable values correspond to decreasing odds of the event's occurrence. When Exp (B) is greater than 1, increasing variable values corresponds to increasing odds of the event's occurrence.

Therefore, if we subtract one from the odds ratio and multiply by 100, we get the percentage change in odds of the dependent variable having a value 1.

*ii) Application of the Labour Productivity Regression Model*

a) Regression Equation Beta Coefficients (overall Model without Interaction)

Productivity $Level_{predicted}$ = 5.705 – 0.0255 * Management Related Factors – (-0.0745) * Project-related factors – (-0.00756) * Labour-related factors – (-0.2526) * Industry-related factors

When we plug in the values for independent variables (management-related factor, say, Poor site management practices = 1; project-related factor, say, Inefficiency of Equipment or tools = 0; labour-related factor, say, years of experience and skill = 10; and industry-related factor, say, Poor working environment = 0), we can predict the value of productivity level.

i.e. Y = 5.705 – $0.0255_1$ – $(-0.0745_2$ – $(-0.00756)_3$ – $(-0.2526)_4$

Productivity $Level_{predicted}$ = 5.705 – 0.0255 * 1 – (-0.0745) * 0 – (-0.00756) * 10 – (-0.2526) * 0

Productivity $Level_{predicted}$ = 5.75516

b) Labour Productivity Regression Equation B estimates (overall Model with Interaction Effect)




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Productivity $Level_{predicted}$ = 140.5665 – 27.10972 * Management-related factors – (-88.1485) *Project-related factors – 62.37609 * Labour-related factors – 69.02975 * Industry-related factors

i.e. Y = 140.5665 – $27.10972_1$ – (-$88.1485_2$ – $62.37609_3$ – $69.02975_4$

When we plug in the values for independent variables (management-related factor, say Poor site management practices = 1; project-related factor, say Inefficiency of Equipment or tools = 0; Labour related factor, say years of experience and skill = 10; and Industry related factor, say Poor working environment = 0) we can predict the value of productivity level.

*iii) Odd Ratios*

The higher odds are associated with the increasing influence of an independent variable (factor) on agreeing that productivity levels (dependent variable) are highly affected by the factor. While the lower odds imply that the increasing influence of an independent variable (factor) has a reducing effect (disagree) on the dependent variable.

*iv) Interaction Effect*

Where the codes represented above for the (dependent variable 1 = Strongly Disagree; 2 = Disagree; 3 = Moderately Agree; 4 = Agree; and 5 = Strongly Agree) while (Independent Variable codes 1 = Little or No Influence; 2 = Some Influence; 3 = Average Influence; 4 = Strong Influence; 5 = Very Strong Influence).

- Little or No Influence = Productivity $Level_{predicted}$ = 140.5665 – 27.10972*1 – (-88.1485) *1 – 62.37609*1 – 69.02975*1.
- Little or No Influence = Productivity $Level_{predicted}$ = 70.19944
- Some Influence = 140.5665 – 27.10972*2– (-88.1485) *2 – 62.37609*2 – 69.02975*2
  Some Influence = Productivity $Level_{predicted}$ = -0.16762
- Average Influence = Productivity $Level_{predicted}$ = 140.5665 – 27.10972*3 – (-88.1485) *3 – 62.37609*3 – 69.02975*3.

  Therefore, Average Influence = Productivity $Level_{predicted}$ = -70.5347
- Strong Influence = Productivity $Level_{predicted}$ = 140.5665 – 27.10972*4 – (-88.1485) *4 – 62.37609*4 – 69.02975*4.

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Therefore, Strong Influence = Productivity Level$_{predicted}$ = -140.902

- Very Strong Influence = Productivity Level$_{predicted}$ = 140.5665 – 27.10972*5 – (-88.1485) *5 – 62.37609*5 – 69.02975*5.
  Therefore, Very Strong Influence = Productivity Level$_{predicted}$ = -211.269

The significant positive effect highlights how several factors shape the productivity landscape and provides an important starting point for understanding how the independent variables work together.

The results show how several elements interact to determine productivity levels in labour-intensive construction projects. Overall, productivity outcomes are significantly shaped by the complex interactions between labour-related factors, industry-related factors, management-related factors and project-related factors. Each group factor contributes substantially to the production landscape despite having different coefficients, highlighting the complexity of the construction sector. The importance of good management practices is especially noteworthy, as evidenced by the fact that they rank highest among independent variables. This emphasises how crucial skilful management techniques are to maximise project performance and productivity. Even with a negative coefficient, project-related factors significantly affect production. This subtlety highlights that customised considerations about project-specific variables are necessary to maximise overall productivity results.

The labour-related factors highlight the significance of resolving issues and maximising workforce components for increased project productivity. The report emphasises how important it is for building firms to fund staff development initiatives, such as providing training and creating a happy workplace. Industry factors, which ranked fourth, emphasise the importance of considering external industry-specific factors for the best productivity outcomes. This external perspective is essential for comprehensively understanding production dynamics and strategic decision-making.

## DISCUSSION

### Linear Regression Analysis of Labour Productivity Factors

The findings of the interviews reviewed that the level of awareness of labour production outputs in the construction industry was low at 28%. The findings of this study tend to agree with Bamfo-Agyei et al. (2019) and Enshassi et al. (2007) that there is a need to increase awareness of labour productivity. It is evident that most Governments show little concern about the welfare of workers, and contracting companies have little awareness of the impact of factors on labour productivity. It also agrees with the assertions of Hiyassat et al. (2016) that there is a need to raise awareness among engineers and foremen about the importance of labour productivity.

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**Critical Construction Labour Productivity Indictors**

Scholars have reviewed the fact that the labour productivity of construction workers is impacted by many factors (Van, 2016). Their studies tend to agree with the factors affecting labour productivity in the construction sector. However, several productivity challenges remain unknown and require further investigation, especially in developing nations (Makulsawatudom & Emsley, 2002; Hai & Tam, 2019).

There is agreement that policies for increasing labour productivity are not similar for every nation; hence, the classification of the factors may vary (Polat & Arditi, 2005). Olomolaiye et al. (1998) confirm that the factors influencing productivity are rarely constant and are likely to differ from one country to another, from one project to another and even within the same project, depending on the environment and circumstances. Herbsman et al. (1990) classified the factors affecting productivity into two main groups: technological and administrative. Bamfo-Agyei et al. ( 2023) revealed that six critical components were derived from the 52 factors affecting the productivity of labour-intensive works on road construction, including appropriate tools, workers' knowledge of tools, recording of tools, material management, suitability of material, and isohyperthermic impact. It can be concluded that the six-component framework represents an adequate description of labour productivity optimisation for heavy labour-intensive public construction work in Ghana. Abdulaziz et al. (2012) conducted a study in Kuwait that included 45 productivity factors under four main groups: management, technological, human/labour, and external. Heizer et al. (1990) identified three groups, including characteristic factors of work, factors of working conditions and non-productive activities. Jiukun et al. (2009) identified 83 factors after investigating 2,000 artisan workers throughout the United States of America. Horner et al. (1989) identified 13 factors affecting productivity in construction projects in the UK. Absenteeism, number of operations on site, proportions of work subcontracted, site layout, crew size and composition, skill of labour, buildability, quality of supervision, method of working, incentive scheme, complexity of construction information, length of working days and availability of tools were listed as significant factors. The viewpoint seems to agree with the findings in this study, where 36 key indicators were identified, out of which Eight were project-related, twelve were management-related, 10 were labour-related, and six were industry-related.

**Performance of Construction Labour Productivity Factors in Construction Firms**

A key step towards maximising labour productivity and overall project efficiency is adopting a benchmarking and metrics program for construction performance (Nasir et al., 2012). This helps improve construction productivity and performance of a project or sector. Benchmarking and metrics programs allow construction firms to identify their areas of strength and those that require improvement by methodically measuring and assessing a construction project's performance against industry benchmarks (Ibid, 2012). Performance indicators are critical in assessing progress, devising improvements and comparing a company's performance to that of a different organisation (Wu et al., 2010). Benchmarking helps the construction industry foster a continuous improvement culture by providing a uniform framework for evaluation. One

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advantage of a benchmarking program is that it provides construction firms with a comparative analysis of their performance against peers in the sector.

According to Chukwudi et al. (2022), monitoring and evaluation impact employee productivity and are crucial to an organisation's long-term success. Unfortunately, most companies do not measure and monitor their workers' productivity. Managers do not equally focus on their workers' welfare, affecting productivity, safety, and health (Muhammad et al., 2015).

The emphasis on metrics highlights the significance of numerical data in assessing construction performance. Businesses can learn much about how efficiently their operations run by setting up and monitoring key performance indicators. Metrics like project completion times, resource utilisation rates, and safety records offer concrete standards for assessing performance and providing helpful information for streamlining procedures and strategies (Nasir et al., 2012). İşgören et al. (2009) reviewed the importance of industry cooperation and knowledge exchange in the construction sector to promote collective excellence. Building projects are complex undertakings that frequently call for synthesising knowledge from various stakeholders, including suppliers, contractors, engineers, and architects. Establishing a collaborative culture facilitates the convergence of diverse perspectives and skill sets, thereby promoting innovation and problem-solving on a larger scale.

## CONCLUSION

Literature review, observations, interviews and questionnaire survey identified Thirsty-Six constraint factors. Thirteen influential factors, namely: poor working environment, lack of experience and skill, overtime working, lack of labour motivation, poor sequencing of work, poor time planning and scheduling, poor site management practices, unsuitable materials, late issuance of construction materials, finance difficulties, working heights, shortage of equipment and tools and poor accessibility and location were identified. A regression analysis identified the influence of each factor using coefficients. The results showed that the positive coefficients meant higher explanatory variable values were associated with higher outcomes. In contrast, negative coefficients meant higher explanatory variable values were associated with lower outcomes. The higher coefficient depicted the significant effect on the overall factors of that factor. Management-related factors had the most significant impact on the labour productivity of construction workers in Zambia. The results highlighted the areas that require management's attention in construction firms.

### Practical Implication

Manpower planning and human resource management help improve the workforce's efficiency, thereby substantially increasing the number of youth and adults with relevant technical and vocational skills. They also help create meaningful employment, decent jobs, and entrepreneurship opportunities.

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**Social Implication**
Labour productivity helps create meaningful employment, decent jobs, and entrepreneurship opportunities.

**Originality**
The study sought to identify the factors impacting productivity in labour-intensive construction projects, explore the most critical variables and develop a model that can improve construction output and build capacity, thereby contributing to decent jobs, employment and entrepreneurship opportunities in the construction sector.

## REFERENCES

Abdelaal, M., Emam, H. & Farrell, P., (2015). Improving workflow in construction projects in GCC. The 2nd International Conference on Buildings, Construction and Environmental Engineering (BCEE2), Lebanon.

Abdel-Hamid, M. & Mohamed Abdelhaleem, H., (2022). Impact of poor labor productivity on Construction project cost. International Journal of Construction Management, 22(12), 2356-2363.

Ahmed, S.M., Azhar, S., Castillo, M. & Kappagantula, P., (2002). Construction delays in Florida: An empirical study. Final report. Department of Community Affairs, Florida, US.

Alaloul, W. S., Musarat, M. A., Rabbani, M. B. A., Iqbal, Q., Maqsoom, A. & Farooq, W., (2021). Construction Sector Contribution to Economic Stability: Malaysian GDP Distribution. Sustainability, 13(9), p.5012.

Alinaitwe, H. M., Mwakali, J. A. & Hansson, B., (2007). Factors affecting the productivity of Building craftsmen-studies of Uganda. Journal of Civil Engineering and Management, 13(3), pp.169-176.

Allmon, E., Haas, C. T., Borcherding, J. D. & Goodrum, P.M., (2000). US Construction Labor Productivity Trends, 1970–1998. Journal of construction engineering and management, 126(2), 97-104.

Almamlook, R., Bzizi, M., Al-Kbisbeh, M., Ali, T., & Almajiri, E., (2020). Factors affecting labour productivity in the construction industry. American Journal of Environmental Science and Engineering, 4(2), 24-30.

Alyew, A., Bassa, M., Reta, A. & Tora, M., (2020). A Study on Factors Affecting Labour Productivity on Construction Projects in Wolaita Zone, Ethiopia. Int. J. Eng. Res, 8(12), pp.817-822.

Assaad, R.H., El-Adaway, I.H., Hastak, M. & LaScola Needy, K., (2023). Key factors affecting labor productivity in offsite construction projects. Journal of Construction Engineering and Management, 149(1), p.04022158.

Attar, A.A., Gupta, A.K. & Desai, D.B., (2012). A study of various factors affecting labour productivity and methods to improve it. IOSR Journal of Mechanical and Civil Engineering (IOSR-JMCE), 1(3), pp.11–14.

*African Journal of Applied Research*
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*Peer reviewed: July 5, 2024*
*Revised: December 19, 2024*
*Published: April 2025*

Austin, P. C., & Steyerberg, E. W., (2015). The number of subjects per variable required in linear regression analyses. Journal of Clinical Epidemiology, 68(6), 627-636.

Baldwin, L.M., Klabunde, C.N., Green, P., Barlow, W. & Wright, G., (2006). In search of the perfect comorbidity measure for use with administrative claims data: does it exist? Medical care, 44(8), 745–753.

Bamfo-Agyei, E., Aigbavboa, C., & Thwala, W. D. (2022). Measuring productivity of labour-intensive work practices in road construction in Africa. Routledge.

Bamfo-Agyei, E., Aigbavboa, C., & Thwala, W. D. (2019). Measuring labour productivity in labour-intensive works on road construction in Ghana. In Advances in Human Factors, Sustainable Urban Planning and Infrastructure: Proceedings of the AHFE 2018 International Conference on Human Factors, Sustainable Urban Planning and Infrastructure, July 21-25, 2018, Loews Sapphire Falls Resort at Universal Studios, Orlando, Florida, USA 9 (pp. 515-523). Springer International Publishing.

Bamfo-Agyei, E., Thwala, D. W., & Aigbavboa, C. (2023). Optimisation of labourintensive productivity for construction projects in Ghana. Acta Structilia, 30(1), 122-154.

Bamfo-Agyei, E., Thwala, D. W., & Aigbavboa, C. O. (2020). Influence of workforce on productivity of labour-intensive works on feeder road construction in Ghana. African Journal of Applied Research, 6(1), 91-104.

Becker, G. S. (1964). Human Capital New York. Columbia University for the National Bureau of Economic Research.

Bodapati, S.N., (2003). Perspective on construction in the USA. Construction Information Quarterly, Volume 5 Number 4, pp 3-7, The Chartered Institute of Building.

Borg, L., & Högberg, L., (2014). Organization of laundry facility types and energy use in owner-occupied multi-family buildings in Sweden. Sustainability, 6(6), 3843-3860.

Cheelo C. & Liebenthal R., (2020). The Construction Sector in Zambia In Mining for Change: Natural Resources and Industry in Africa.  J. Page and F. Tarp (Ed), Oxford University Press.

Chen J.J., (1998). The Characteristics and current status of China's construction industry, Construction Management and Economics, 16, pp 711-719

Cheung, S. O., Wong, P. S. P., Fung, A. S. and Coffey, W. V., (2006). Predicting project performance through neural networks. International Journal of Project Management, 24(3), pp.207-215.

Chi, P., (2019). Working environment and labor efficiency of state owned enterprises and foreign corporations in Vietnam. Retrived on, 1, p.2022.

Chia, R., (2002). The Production of Management Knowledge: Strategies for Reducing Cost and Improving Service, Pitman Publishing, London.

Chia, W. K., Teo, M., Wang, W. W., Lee, B., Ang, S.F., Tai, W. M., Chee, C. L., Ng, J., Kan, R., Lim, W. T. & Tan, S. H., (2014). Adoptive T-cell transfer and chemotherapy in the first-line treatment of metastatic and/or locally recurrent nasopharyngeal carcinoma. Molecular Therapy, 22(1), pp.132-139.

Chinyio, E. A., Olomolaiye, P. O., Kometa, S. T. & Harris, F. C., (1998). A needs-based

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***African Journal of Applied Research***
***Vol. 11, No. 2 (2025), pp.367-391***
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*Peer reviewed: July 5, 2024*
*Revised: December 19, 2024*
*Published: April 2025*

methodology for classifying construction clients and selecting contractors. Construction Management & Economics, 16(1), 91–98.

Choi, K., Choe, C., & Lee, D., (2021). The effect of employing temporary workers on efficiency: Evidence from a meta-frontier analysis. SAGE Open, 11(4), 21582440211058199.

Choi, K., Lee, H.W., Bae, J. & Bilbo, D., (2016). Time-cost performance effect of change orders from accelerated contract provisions. Journal of Construction Engineering and Management, 142(3), p.04015085.

Chukwudi, K. C., Osibanjo, A. O., Bolodeoku, P. B., Ogunyemi, I. O., Ipelke, J. F., & Okpalaoka, C., 2022. The impact of monitoring and evaluation of learning and development outcomes on employee productivity. Academy of Strategic Management Journal, 21, 1-15.

Dainty A. R. J, Ison S. G. & Root D. S., (2004). Bridging the skills gap: a regionally driven strategy for resolving the construction labour market crisis, Engineering, Construction and Architectural Management, Volume 11, (4), 275–283.

Dai, J., Goodrum, P.M. and Maloney, W.F., (2009). Construction craft workers' perceptions of the factors affecting their productivity. Journal of Construction Engineering and Management, 135(3), 217–226.

Dilawer, S.A., 2014. Control the loss of labor productivity. Int. J. Civ. Struct. Eng. Res., 2(1), pp.104-110.

Enshassi, A., Mohamed, S., Mustafa, Z. A., & Mayer, P. E., (2007). Factors affecting labour productivity in building projects in the Gaza Strip. Journal of civil engineering and management, 13(4), 245–254.

Gal, P.N., (2013). Measuring total factor productivity at the firm level using OECD-ORBIS.

George D, & Mallery, P., (2003). SPSS for Windows step by step: A simple guide and reference. 11.0 update 4th edition Boston: Allyn & Bacon.

Gopal, T.S.R. & Murali, K., (2015). A critical review of factors influencing labour productivity in construction. IOSR Journal of Mechanical and Civil Engineering, 12(5), 47-51.

Hai, D. T., & Van Tam, N., 2019. Application of the regression model for evaluating factors affecting construction workers' labour productivity in Vietnam. The Open Construction & Building Technology Journal, 13(1).

Halwatura, R. U., (2015). Critical factors which govern labour productivity in the building construction industry in Sri Lanka. PM World Journal, 4(4), pp.1-13.

Herbsman, Z. & Ellis, R., (1990). Research of factors influencing construction productivity. Construction Management and Economics, 8(1), pp.49-61.

Hernesniemi H., M. Lammi, and P. Ylä-Anttila; P. Rouvinen (ed.), (1996). 'Advantage Finland: The Future of Finnish Industries'. Research Institute of the Finnish Economy (ETLA) and Finnish National Fund for Research and Development (SITRA). Helsinki: Taloustieto Oy.

Heshmati, A. and Rashidghalam, M., (2018). *Labour productivity in Kenyan manufacturing and service industries* (pp. 259–286). Springer International Publishing.

Hickson, B. G., & Ellis, L. A., (2014). Factors affecting construction labour productivity in

Trinidad and Tobago. The Journal of the Association of Professional Engineers of Trinidad and Tobago, 42(1), 4–11.

Hiyassat, M. A., Hiyari, M. A., & Sweis, G. J., (2016). Factors affecting construction labour productivity: a case study of Jordan. International Journal of Construction Management, 16(2), 138-149.

Horman, M. J. & Kenley, R., (2005). Quantifying levels of wasted time in construction with meta-analysis. Journal of construction engineering and management, 131(1), 52-61.

Horner, R. M. W., Talhouni, B. T. & Thomas H. R., (1989). Preliminary Results of Major Labour Productivity Monitoring Program. Proceedings of the 3rd Yugoslavian Symposium on Construction Management, Cavtat, 18-28.

Hu, X., & Liu, C., (2017). Total factor productivity measurement with carbon reduction. Engineering, construction and architectural management, 24(4), 575-592.

Jarkas, A.M. & Bitar, C.G., (2012). Factors affecting construction labor productivity in Kuwait. Journal of Construction Engineering and Management, 138(7), pp.811-820.

Jarkas, A. M., & Haupt, T. C., (2015). Major construction risk factors considered by general contractors in Qatar. Journal of Engineering, Design and Technology, 13(1), 165-194.

Irfan, M., Zahoor, H., Abbas, M. & Ali, Y. (2020). Determinants of labor productivity for building projects in Pakistan. Journal of Construction Engineering, Management & Innovation, 3(2), 85–100.

İşgören, N.Ç., Çınar, A., Tektaş, N., Oral, B., Büyükpehlivan, G., Ulusman, L., Öznaz, D., Polat, Z. & Uzmanoğlu, S., (2009). The importance of cooperation between vocational schools and industry. Procedia-Social and Behavioral Sciences, 1(1), pp.1313-1317.

Kaoma, C. & Muya, M., (2016). Artisan Gaps in the Construction Industry in Zambia. American Scientific Research Journal for Engineering, Technology, and Sciences (ASRJETS), 18(1), 235-251.

Kirchberger, M., (2020). The Construction Sector in Developing Countries: Some Key Issues. Mining for Change, pp.51-73.

Kyei, P., & Bamfo-Agyei, E. (2021). Determining Labour Productivity for Masonry Works on Construction Sites. African Journal of Applied Research, 7(1), 17-26.

Lewis, T.M., 2009. Quantifying the GDP Construction Relationship Economics for Modern Built Environmental. London: Taylor and Francis, pp.34-59

Lim, V.K., (1996). Job insecurity and its outcomes: Moderating effects of work-based and nonwork-based social support. Human relations, 49(2), pp.171–194.

Liu, Z., Liu, J., Hu, R., Yang, B., Huang, X. &Yang, L., (2023). Calendar events' influence on the relationship between metro ridership and the built environment: A heterogeneous effect analysis in Shenzhen, China. Tunnelling and Underground Space Technology, 141, p.105388.

Mahamid, I., (2020). Study of relationship between rework and labor productivity in Building Construction Projects. Revista de la construcción, 19(1), 30-40.

Makulsawatudom, A., Emsley, M. and Sinthawanarong, K., 2004. Critical factors influencing construction productivity in Thailand. The journal of KMITNB, 14 (3), pp.1-6.

Makulsawatudom, A. & Emsley, M., (2003), March. Factors affecting the productivity of the

*African Journal of Applied Research*
*Vol. 11, No. 2 (2025), pp.367-391*
*http://www.ajaronline.com*
*https://doi.org/10.26437/ajar.v11i2.1041*
*Received: February 21, 2024*
*Peer reviewed: July 5, 2024*
*Revised: December 19, 2024*
*Published: April 2025*

construction industry in Thailand: The foremen's perception. In Construction Research Congress: Wind of Change: Integration and Innovation (pp. 1-10).

Mattoussi, W., & M. Ayadi., (2017). 'The Dynamics of Exporting and Innovation'. Journal of African Economies, 26(1): 52–66.

Ministry of Works and Supply, (2006). Government of Republic of Zambia, Draft Policy for Public-Private Partnerships, Lusaka.

Mirahadi, F. & Zayed, T., (2016). Simulation-based construction productivity forecast using neural-network-driven fuzzy reasoning. Automation in Construction, 65, pp.102-115.

Moselhi, O. & Khan, Z., (2012). Significance ranking of parameters impacting construction labour productivity. Construction Innovation, 12(3), pp.272-296.

Muhammad, N. Z., Sani, A., Muhammad, A., Balubaid, S., Ituma, E. E., & Suleiman, J. H., (2015). Evaluation of factors affecting labour productivity in construction industry: a case study. Jurnal Teknologi, 77(12), 87-91.

Muhwezi, L., Acai, J. & Otim, G., (2014). An assessment of the factors causing delays on building construction projects in Uganda. International Journal of Construction Engineering and Management, 3(1), 13-23.

Murari, S. S., & Joshi, A. M., (2019). Factors affecting labour productivity in precast construction industry. In Proceedings of the fourth national conference on road and infrastructure.

Muya, M., Price, A.D.F. and Edum-Fotwe, F.T., (2007). Training levy to support construction craft skills training in Zambia. West Indian Journal of Engineering, 30(1), 37–44.

Muya, M., Kaliba, C., Sichombo, B. & Shakantu, W., (2013). Cost escalation, schedule overruns and quality shortfalls on construction projects: The case of Zambia. International Journal of Construction Management, 13(1), pp.53-68.

Mwanaumo, E. M., Thwala, W. D. & Mambwe, M., 2018. Multi Stakeholder Consultative Framework for Construction Health and Safety: Role of Client and Project Manager. Livingstone, Zambia, DII Conference Series, pp. 235-246.

Nasir, H., Haas, C.T., Rankin, J.H., Fayek, A.R., Forgues, D. & Ruwanpura, J., (2012). Development and implementation of a benchmarking and metrics program for construction performance and productivity improvement. Canadian Journal of Civil Engineering, 39(9), 957–967.

National Council for Construction, (2004). Development of contractor registration scheme with a focus on small-scale civil works contractors: final report.

National Council for Construction, (2021). Annual Report. Lusaka.

Neely, A., (1998). Three modes of measurement: theory and practice. International journal of business performance management, 1(1), 47–64.

Neuman, W. L. (2003). Social Research Methods: Qualitative and Quantitative Approaches, Relevance of social research, Vol. 8, available at: http://books.google.fr/books?id=nObtAAAAMAAJ.

Ngoma, S., Muya M., and Kaliba, C., 2014. Benefits, Constraints and Risks in Infrastructure Development via Public-Private Partnerships in Zambia. Journal of Construction in Developing Countries, 19(1), pp 15-33.

ISSN: 2408-7920

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Ngoma, S., Mwanaumo, E. M., & Kaliba, C., (2024). Measuring Productivity in Labour-Intensive Construction Projects in Zambia. Journal-Innovation, 76 (2), pp 476-485.
Ngomi, A., (2017). Factors affecting project performance among local contractors. The International Journal of Multi-Disciplinary Research ISSN, 3471–7102.
Nguyen, Q. T., Van Tam, N., Dinh, T. H. & Quy, N. L. D., (2020). Critical factors affecting labour productivity within construction project implementation: a project manager's perspective. Entrepreneurship and Sustainability Issues, 8(2), 751.
Nyoni, T. & Bonga, W.G., 2016. An empirical investigation of factors affecting construction sector labour productivity in Zimbabwe. International Journal of Business and Management Invention (IJBMI), 5(8), 68-79.
Ofori G., (2000). The knowledge-based economy and construction industries in developing countries. Proceedings: CIB W107 1st International conference: Creating a sustainable construction industry in developing countries, 11 to 13 November 2000, Stellenbosch, South Africa.
Ohueri, C.C., Enegbuma, W.I., Wong, N.H., Kuok, K.K. & Kenley, R., (2018). Labour productivity motivation framework for Iskandar Malaysia. Built Environment Project and Asset Management, 8(3), pp.293-304.
O'Grady, J. & McCabe, B., (2014). Productivity in the construction industry: concepts, trends, and measurement issues. University of Toronto.
Olomolaiye, P., Kaming, P., Holt, G., & Harris, F. (1996). "Factors influencing craftsmen's productivity in Indonesia", Int. J. Proj. Manag., 15, (1), 21-30.
Oo, B. L. & Lim, B.T.H. (2023). Women Workforces' Satisfaction with Personal Protective Equipment: A Case of the Australian Construction Industry. Buildings, 13(4), 959.
Palikhe, S., Kim, S. & Kim, J. J., (2019). Critical success factors and dynamic modeling of construction labour productivity. International Journal of Civil Engineering, 17(3), 427-442.
Polta, G., & Arditi, P. (2005). The JIT Management System in developing countries" Construction Management and Economics, 23(7), 697-712.
Poole, M. A., & O'Farrell, P. N., (1971). The assumptions of the linear regression model. Transactions of the Institute of British Geographers, 145–158.
Porter, M., (1990). The Competitive Advantage of Nations. New York: The Free Press.
Rose, N., (1996). The death of the social? Re-figuring the territory of government. International Journal of Human Resource Management, 25(3), 327–356.
Sampa, C., (2016). An evaluation of Worker's welfare facilities and its effects on productivity in the Zambian Construction Industry (Masters dissertation, University of Zambia).
Sylvia, C., (2017). An Investigation into the factors affecting project performance among contractors in Lusaka District of Zambia.
Thwala, W. D., (2007). Challenges facing labour-intensive public works programmes and projects in South Africa. International Journal of Construction Management, 7(2), 1-9.
Van Thanh, L., (2016). Relationship at work as a cause of occupational stress: the case of academic women in Vietnam. International journal of mental health systems, 10, pp.1-15.

ISSN: 2408-7920

*African Journal of Applied Research*
*Vol. 11, No. 2 (2025), pp.367-391*
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*Published: April 2025*

Vogl, B., & Abdel-Wahab, M., (2015). Measuring the construction industry's productivity performance: Critique of international productivity comparisons at industry level. Journal of construction engineering and management, 141(4), 04014085.

Wu, J., Du, H., Li, X. &Li, P., (2010). Creating and Delivering a Successful Knowledge Management Strategy, in Russ, M. (Ed.), Knowledge Management Strategies for Business Development, Business Science Reference, Hershey, pp. 261–272.

Yi, W. & Chan, A.P., (2014). A critical review of labour productivity research in construction journals. Journal of Management in Engineering, 30(2), 214–225.

Zhao, T. & Dungan, J. M., (2014). Improved baseline method to calculate lost construction productivity. Journal of Construction Engineering and Management, 140(2), p.06013006.

Zhou, W. & He, J.M., (2013). Generalized GM (1, 1) model and its application in forecasting of fuel production. Applied Mathematical Modelling, 37(9), pp.6234-6243.

ISSN: 2408-7920