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# Assessment of the impact of disregarding influencing factors on artisans performance in building construction projects in Tanzania

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**ABSTRACT**

The success of building construction projects in developing countries heavily relies on the specialized skills of artisans who are responsible for executing physical construction activities. However, the performance of these artisans depends on various influencing factors (IFs) that significantly affect their productivity and workmanship. This study aims to assess the impact of disregarding IFs on the performance of artisans in building construction projects in Tanzania. Using the individual performance theory, the study identifies the core IFs that influence artisans' performance and develops a structural equation modelling (SEM) to understand the inter-relationship between these IFs. The study collects data from 289 building construction projects through a non-probability technique and analyses it using SPSS-25 and AMOS-20. The study finds that the enforcement of IFs at construction sites by stakeholders in the construction industry is weak, which undermines the performance of artisans. Therefore, the study recommends that employers and supervisors should consider IFs during the construction process to achieve better results in terms of time, cost, and quality. The findings of this study can guide employers and supervisors in the construction industry to enhance the overall performance of building construction projects by improving the performance of artisans through ensuring that IFs are taken into consideration during the recruitment and construction process.



## 1. Introduction

Building project performance during construction is very important Egwunatum (2017) accessed by achieved workmanship and productivity during the construction process.  Four determinants, materials, equipment, plants, and people have been explained by many authors as key determinants for that workmanship and productivity (Alinaitwe et al., 2005; Farmer, 2016; Karimi et al. 2017; Moradi et al. 2017; Hussain et al. 2020). Each contributes to the achievement of workmanship, and productivity indicates the performance of building construction projects.  Materials, equipment, and plant contribute 60%, while the remaining 40% to the people (Alinaitwe et al., 2005; Moradi et al., 2017; Hussain et al., 2020). Achievement of workmanship and productivity advocates people as per this finding, including engineers, architects, quantity surveyors, managers, technicians, skilled laborer, and non-skilled laborer with their special skills applied during the construction process for different construction activities (Zannah et al., 2017). Skilled labour is a crucial group that has been discussed less frequently than other groups. Skilled labour, also referred to as skilled workforce, artisans, craftsmen, or tradesmen, perform all the necessary physical work required for end construction projects under contractors or clients (Alinaitwe et al. 2005; Farmer, 2016; Karimi et al., 2017; Moradi et al., 2017; Hussain et al., 2020). For the purposes of this study, the term "artisans" has been adopted to represent the concept of skilled laborer.  Akomah et al. (2020) explain that without artisans,

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architects' and engineers' designs for building construction projects cannot become physically tangible. Each construction activity for each project is unique and requires proper selection of artisans for their performance (Evarist et al., 2022) and consideration of influencing factors (IFs) that are categorized as external IFs and internal IFs for their performance (Zannah, 2016).

Internal IFs are vital individual characteristics that impact behavior and actions in a person to perform a certain activity regarded as a qualification (Campbell et al.,1993; Zannah, 2016). Kikwasi (2011) explain a level of qualifications awarded during the training process, which is either formal or informal specifically for artisans, and can be at level three, two, or national vocational awards (NVA). However, external IFs are actions that do not occur within the artisans but from the environment (Campbell et al.,1993; Zannah, 2016). These external IFs are considered by Campbell et al. (1993) as motivation factors that lead to the success of construction projects. Both internal and external IFs are significant for artisans to achieve their goals in executing construction activities (Zannah et al., 2017).

In Tanzania, like in many developing countries, the performance of building construction projects is heavily reliant on artisans who are primarily sourced through various means such as vocational training centers (VTCs), folk development colleges (FDCs), on-the-job training, and apprenticeships for the informal sector (MoEST, 2017). The artisans are skilled in various areas such as block/bricklaying, plastering, tiling, painting, steel fixing, carpentry, welding, plumbing, electrical work, aluminum fabrication, and equipment operation (Kikwasi, 2011). The technical skills possessed by these artisans are essential in ensuring that construction projects are completed to the desired standards, with minimal defects at all stages of construction. However, the performance of the artisans is evaluated based on observed defects after the completion of work, which can affect the time, cost, and quality of the construction project (Kikwasi, 2011). Due to these challenges, the Tanzanian government has attempted to address the skills deficiencies among artisans through various education reforms. These reforms were categorized into three phases; the first phase was from 1961 to 1967, which emphasized reforming the education system to reduce inequalities based on the colonial education system. The second phase, from 1967 to 1990, emphasized "Education for Self-Reliance" to build a socialist state, and the third phase focused on the transformation from socialist-oriented policies to a free-market economy known as structural adjustment programs (SAPs) (Nguliamali & Temu, 2014). Despite these efforts, the competence of artisans in their acquired skills remains a problem, affecting workmanship and productivity. They need more organized evaluation appropriate approach to mitigate those prevailing problems. The approach for evaluation of executor (contractor) for construction projects is monitored by public procurement regulatory authority (PPRA) and the contractor's registration board (CRB). Through PPRA and CRB for the executor (contractor), the evaluation focuses on financial capability, management, and technical personnel without consideration of artisans before and after awards of contracts (Rasheli, 2016), which waives consideration of IFs.

Numerous studies conducted in Tanzania have revealed the challenges faced by artisans in the construction industry. Kikwasi and Escalante (2018) found that a lack of formal training in construction concepts and drawing interpretation contributes to challenges among artisans that impact their performance. Similarly, Evarist et al. (2022) identified a shortage of experienced and skilled artisans as a significant constraint that leads to poor project delivery by contractors in terms of workmanship and productivity. While Kikwasi (2011) identified several ways of procuring artisans, such as referrals by professionals, friends, and relatives, among others, these studies have identified the challenges faced by artisans in their performance, but they have not considered the inter-relationship among IFs that affect artisans' performance.. Thus, this study aims to assess the impact of disregarding IFs on the performance of artisans in building construction projects. The study employs covariance and regression weight to evaluate the impact of disregarding IFs on the performance of artisans during the implementation of physical construction activities. Walling, blockwork, and plastering have been considered as reference activities for workmanship and productivity against the impact of disregarding IFs during the construction process. Table 1 and Fig. 1 illustrate the hypothesis and conceptual framework developed for the study.

**Table 1**
Hypotheses conceptual model for the study

| No. | Hypothesized description |
|---|---|
| | *For External factors* |
| H1 | Disregarding motivational factors (MF) for artisans' performance causes improper workmanship performance during construction. |
| H2 | Disregarding motivational factors (MF) for artisans' performance causes less productivity achievement during construction. |
| H3 | Disregarding formal training factors (FF) in recruitment for artisans causes improper workmanship performance during construction. |
| H4 | Disregarding formal training factors (FF) in recruitment for artisans causes less achievement of productivity during the construction process. |
| H5 | Disregarding the informal training factor (IF) in artisan recruitment causes improper workmanship performance during construction. |
| H6 | Disregarding an informal training factor (IF) in artisans' recruitment causes less achievement of productivity during construction. |
| | *For internal factors* |
| H7 | Disregarding qualification factors (QF) in artisan recruitment causes improper workmanship performance during construction. |
| H8 | Disregarding qualification factors (QF) in artisan recruitment causes less productivity achievement during construction. |

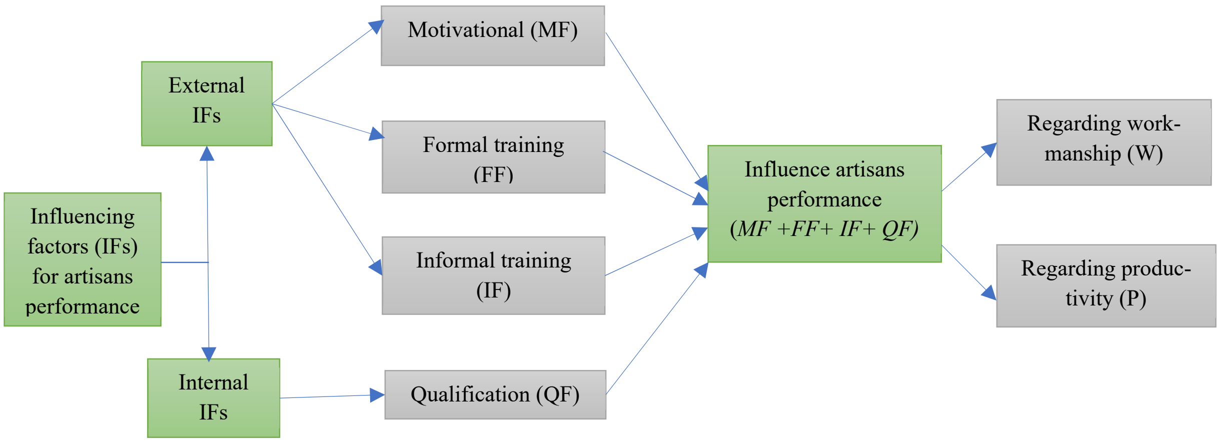


**Fig. 1.** A conceptual framework of the study

## 2. Literature review

The study reviewed the literature on constraining factors (CFs) mostly ranked from one to five for artisans' performance in construction, as in Table 2. However, it recognized that there are more CFs for the performance of artisans, which needs collective efforts to address it among artisans for their performance. Therefore, individuals cannot have enough capacity and capability to address them.

**Table 2**
Summary of supporting literature on CFs for artisans performing

| CFs | Supporting literature |
|---|---|
| Unfair wages payment | Fagbenle (2011), Zannah et al. (2017), Tam and Nguyen (2018) |
| Lack of experiences | Alinaitwe et al. (2005), Gundecha et al. (2012), Othman and Mydin (2014), Tam and Nguyen (2018), Mahamid (2013), Aziz (2014) |
| Lack of discipline among Labours | Alinaitwe et al. (2005), Gundecha et al. (2012), Tam and Nguyen (2018) |
| Weak in organizing production | Tam and Nguyen (2018) |
| Quality of working tools | Alinaitwe et al. (2005), Gundecha et al. (2012), Tam and Nguyen (2018) |
| Lack of communication between site management and labour force | Fagbenle (2011), Jarkas (2012) |
| Competence of construction management | Aziz (2014) |
| Construction supervision | Alinaitwe et al. (2005), Gundecha et al. (2012), Tam and Nguyen (2018) |
| Lack of incentive schemes | Aziz (2014), Zannah et al. (2017) |
| Safety equipment | Tam and Nguyen (2018) |
| Lack of providing labour with transportation | Jarkas (2012) |
| Physical ability to perform construction activities | Gundecha et al. (2012), Tam and Nguyen (2018), |
| Height of working place at the stages of the construction site | Tam and Nguyen (2018) |
| Lack of training | Fagbenle (2011), Zannah et al. (2017); |
| Shortage of the material at the site | Gundecha et al. (2012), Aziz (2014) |
| Accidents during construction | Gundecha et al. (2012) |
| Delays in responding to the requested information | Jarkas (2012) |
| Quality of building materials | Alinaitwe et al. (2005), Zannah, (2016), Zannah et al. (2017), Tam and Nguyen (2018) |
| Age of labours | Gundecha et al. (2012) |
| Change orders from the design or specification | Gundecha et al. (2012) |
| Working conditions which are not favourable | Fagbenle (2011), Alinaitwe et al. (2005), Tam and Nguyen (2018) |

### *2.1 Supporting theory for artisans' performance*

The performance of construction projects is influenced by the artisan's individual effort to execute physical construction activities (Hussain et al. 2020). Campbell and Wiernik (2015) argued that without individual performance, no team, unit, organizational or economic sector performance, respectively. Zannah et al. (2017) indicate artisans as individual performance. Murphy (1989); Bergman et al. (2008); Campbell and Wiernik (2015) described individual job performance as things that people do and actions they take that contribute to the organization's goals. In their model of job performance, Campbell et al. (1993) classified three determinants of individual job performance: declarative knowledge, procedural knowledge and motivation. Because of the significance of the model for artisans' performance, declarative knowledge and procedural knowledge indicate internal IFs and the motivational view as external IFs for artisans' performance. Fig. 2 elaborates more on the theory of individual job performance applied in the study.

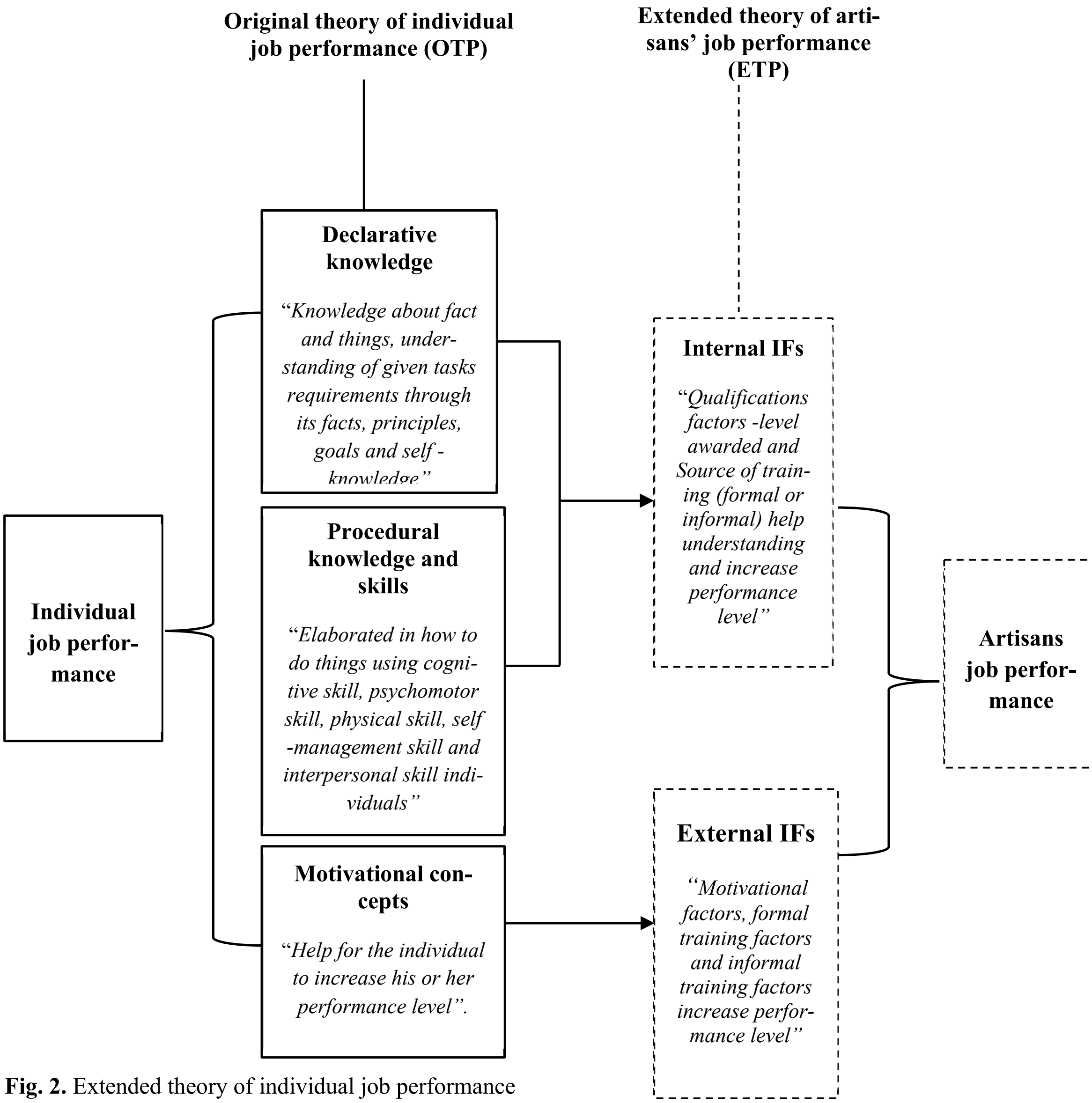


**Fig. 2.** Extended theory of individual job performance

**Source**: Modified from Campbell et al. (1993); Alinaitwe et al. (2005); Zannah et al. (2017)

## *2.2 View of IFs for artisans' performance*

From the studies discussed in Table 1 and Figure 2, CFs, OTP and ETP, respectively above, the authors established their views of the IFs constructs with their required observed variables as per Table 3. However, IFs constructs are recognized as many, which is not easy to manage at once. Therefore, the study is limited to motivational and training factors and qualifications factors for external IFs and internal IFs constructs with its observed variables, respectively, for artisans' performance.

**Table 3**
Summary of IFs for artisans' performance

| IFs construct variables | IFs Observed variables |
| --- | --- |
| **External IFs** | |
| Motivation factors | Offering food allowance |
| | Offering transport allowance |
| | Offering drinking water |
| | Make a payment of wages daily |
| | Make a payment of wages weekly |
| | Make a payment of wages monthly |
| | Provide a permanent contract |
| | Provide a temporal contract |
| | Offering food allowance |
| Formal training factors | Employ them based on acquiring vocational skills from formal methods of training |
| | Before engaging works, ask them if they know how to read and interpret the drawings |
| | Before engaging in work, ask them if they attend practical training |
| | Employ them based on acquiring internship training after graduation |
| | Before engaging in work, ask them if they properly completed the vocational training |
| Informal training factors | Employ them based on acquiring vocational skills through an apprenticeship approach |
| | Employ them based on consideration of only one specialization skill |
| | Before engaging works, ask them if they know how to use current tools and equipment for the construction process |
| | Employ them based on acquiring internship training after qualification |
| | Employ them based on having certifications from the government |
| | Employ them based on acquiring vocational skills through an apprenticeship approach |
| Working Conditions factors | Availability of health and safety precautions at the site, |
| | Consideration of weather conditions during working hours |
| | Provision of strong scaffolding for supporting hands-on-skilled labour during working |
| | Height of the building |
| Quality tools, equipment, and plants factors | Availability and enough up-to-date working tools, equipment, and plants |
| Site Management factors | Availability of complete drawings with minimum error at the site, |
| | Enough number of skilled workers during project execution |
| | Minimization of change of order during project executions, |
| | Time delivery of supply of materials and equipment to the site before execution |
| | Construction supervision |
| | Peace among skilled workers at site |
| | Communication between site management and labour force |
| **Internal IFs** | |
| Qualifications factors | Employ them due to their level of vocational skills for construction activities from the recognized training center |
| | Employ them due to having vocational skills certificates from the recognized training center |
| | Employ them based on work experience |
| | Employ them due to have self-management skills at the site |
| | Before engaging in work, ask them if they have teamwork skills for construction activities at the site |
| Behaviour factors | Self-management |
| | Efforts to have the discipline |
| | The capacity to communicate with others |
| | Being kind and humble |
| | Being at work at light time required |
| | Being lawful to any construction materials and others |
| | Struggling to have enough experience |
| Well-being factors | Being mental physically |
| | The ability to focus on the required task |
| | Maintaining physical ability |
| | Avoiding alcoholism |
| | Observing requirements for health and safety |
| | Ability to understand specifications required |

## 3. Research methodology

The research adopted a two-stage method for assessing the inter-relationship existing between external and internal factors against artisans' performance. Firstly, reviewing literature that assisted in determining a variable for IFs for artisans' performance for construction projects. Secondly was the quantitative approach, which helped to describe and test the relationships and examine the cause-and-effect interactions among the study variables through multivariate analysis methods using structural equation modelling (SEM). SEM is categorized as covariance-based SEM (CB-SEM), which tests confirmatory theory and how theory fits with observations (Hair et al. 2014) and Partial least squares SEM (PLS-SEM) which tests the association between multiple research items concurrently (Gyamfi et al., 2020). In this study CB-SEM, is adopted using criteria indicated in Table 4.

**Table 4**
CB-SEM criteria over PLS-SEM

| | Required criteria | Remark with the study | Reference |
|---|---|---|---|
| | **General CB-SEM criteria** | | |
| 1 | A sample size between 150 and 400 is considered a good sample in SEM analyses. | The requirement was achieved with a sample size of 289 | Hair et al. 2006 |
| 2 | CB-SEM is inherently a large sample analysis approach, while VB-SEM is more robust to small sample sizes | The sample is large, and CB-SEM has been given priority over VB-SEM. | Hair at el. 2014 |
| 3 | CB-SEM can protect from measurement error by explicitly estimating error variances, an aspect that VB-SEM cannot do. | CB-SEM was given priority over VB-SEM. | Gefen et al. 2011 |
| 4 | CB-SEM is recommended for single-item measures, whereas such measures lead to poor model quality in VB-SEM | CB-SEM was given priority over VB-SEM. | Diamantopoulos et al. 2012 |

**Source:** *Adapted from Hazen et al. (2015)*

Also, performing SEM models' fit and validity requires using appropriate model fit indices. It was portrayed by Hair at el. (2014) that using three to four fit indices provides adequate proof of model fit. In this study the chi-square ($\chi$ 2) value with degrees of freedom, comparative fit index (CFI) or Turker Lewis index (TLI), standardized root mean residual (SRMR) and root mean square error of approximation (RMSEA) were adopted. $\chi$ 2 addresses the overall measure of the difference between the sample covariance matrix and the model-implied covariance matrix required for a model to fit data adequately, $\chi$ 2 statistics should be low. It should portray an insignificant p-value, which implies no significant difference between actual data (reality) and the suggested model. The CFI or TLI, representing the amount of variance accounted for in a covariance matrix ranging from 0.0 to 1.0 were also adopted. A higher CFI or TLI value indicates a better model fit (Fan et al., 2016). Also, the SRMR and RMSEA consider the error of prediction in the population and thus depicts a better degree to which a model fits the population (Koh, 2010) where 0 indicates the perfect fit and higher values indicate the lack of fit (Chen et al. 2008). The acceptable RMSEA should be less than 0.07 and SRMR less than 0.08 with CFI above 0.92 (Hair et al. 2014).

The study has a sample size of 289 with 32 observed variables. According to Hair et al. (2014), such data follow under a sample size greater than 250 and with observed variables greater or equal to 30, which should adopt the limit of the fit index as indicated in Table 5 to have the model fit. The Cronbach alpha and item-total correlation of each initial construct should achieve the internal consistency test, tested using item analysis for the tool used for data collection, as per Table 10.

**Table 5**
Characteristics of fit indices demonstrating goodness-of-fit model

| Index | N > 250 |
|---|---|
| | 12 < m < 30 |
| $\chi^2$ | Significant p-value, 0.000 |
| CFI or TLI | Above 0.92 |
| RMSEA | Value < 0.07 (upper limit of 0.07*) with CFI of 0.90 or higher |
| SRMR | 0.08 or less (with CFI above 0.92) |

*Note:* m = number of observed variables; N= applies to the number of observations or sample size

**Source:** *Adapted from Hair at el. (2014)*

### *3.1 Population and sample size*

The study population cover building construction projects sites located in major cities *(Dar Es Salaam, Dodoma, Mwanza, Arusha and Mbeya)* representing other zones of Tanzania and registered to CRB, undertaken by contractors' class II up to class VII in the range of 5.0 billion to 101 million, due to the reason that, they cover both small and large projects and are mostly available in several regions and involve a large number of artisans to perform different construction activities. Major cities were selected due to having several registered ongoing building construction projects compared to non-major cities for collecting demanded data of large samples. To obtain the number of populations for this study, the researcher obtained from CRB a list of registered building projects from January 2019 to December 2020. After a thoroughly sorting, a researcher identified a total number of 1045 building projects undertaken by the said contractors in major cities, as indicated in Table 6. Since the population obtained is known, the sample size was obtained using a confidence interval for a population given by the following formula (Yamane 1967);

$$n = \frac{N}{1+N(e)^2} \tag{1}$$

where:
*n* stands for the sample size
*N* stands for the total number of populations
*e* stands for margin of error
Data used in sampling adopted the margin of error (e) 5% at the confidence level of 95%. This value is economical to be used, and they have been used in various studies (Ye and Tekla, 2020),

*The calculation for a population sample*

$$n = \frac{1045}{1+1045(0.05)^2} = 289.27 \sim 289 \tag{2}$$

The sample size of 289 obtained from the total population qualifies an application of SEM (Hair et al. 2006). The sample size of each region was kept proportional to the size of the population strata and multiplied by the proposed sample size (Kothari, 2014). It was important to give an equal chance to each region and ensure a sample that accurately reflects the population being studied (Malekela et al., 2017). After proportionate, from the list of each region, non-probability sampling was performed to select a specific project where data were collected.

### *3.2 Survey administration*

In this study, a structured questionnaire with a 5 Likert scale was applied due to its quite easy for the respondents to read out the whole list of scale descriptors (Dewes 2008). The questionnaire was administered through non-probability techniques using the physical approach method for both large and small projects, which is at least 45% of the construction process based on construction activities at the post-contract stage and being active for determining rich information for the assessment of relationship on factors influencing the performance of artisans. The data collection process by this method was quite good. All the sample sizes were visited as per distribution; see Table 6.

**Table 6**
Distributed and attained Questionnaire responses

| S/No | Major Cities | Population (Construction) site | Operationalization of Sites per Major City | Number of Construction Sites Representatives per Each Major City |
|---|---|---|---|---|
| 1 | Mbeya | 59 | 59*0.2766 | 16 |
| 2 | Dodoma | 113 | 113*0.2766 | 31 |
| 3 | Arusha | 108 | 108*0.2766 | 30 |
| 4 | Dar es Salaam | 604 | 604*0.2766 | 167 |
| 5 | Mwanza | 161 | 161*0.2766 | 45 |
| 6 | **Total** | **1045** | | **289** |

## *3.3 Data analysis*

The Statistical Package for Social Sciences (SPSS), version 25 and Analysis of Moment Structure (AMOS 20), the advanced SPSS, were employed to analyze the data. The researcher could only access AMOS software. But also, this software can handle reflective constructs. The sample size of 289, indicated in Table 6, qualifies an application of SEM as the analysis technique requiring a sample size of between 150 and 400 (Hair et al., 2014).

# 4. Results and Findings

*4.1 Demographic characteristics of respondents*

The demographic characteristics of the respondents were analyzed based on their positions at the building construction site, the number of artisans available at the site from different vocational training centers, and the presence of certificates. Table 7 presents the distribution of 289 respondents based on their position held for supervision, with 89 being mostly artisans and 8 being quantity surveyors, indicating the lowest count. Table 8 shows the numbers of artisans available at the site from various vocational training centers, with 2716 coming from the informal sector, followed by 1097 from the Vocational Education Training Authority (VETA), 194 from Technical Secondary Schools (TSC), and 126 from Focal Development Colleges (FDC). Among the 289 construction sites, 1372 artisans had certificates while 2761 did not, according to Table 9. The findings suggest that the majority of the artisans do not have certificates, implying that most of them acquire their skills from the informal sector. This could be due to a lack of sufficient vocational training centers in their local areas.

**Table 7**
Position held for supervision at the site for building construction projects

| Supervision position | Frequency | Per cent |
|---|---|---|
| Project Manager | 17 | 5.9 |
| Project Quantity Surveyor | 8 | 2.8 |
| Project Foreman | 80 | 27.7 |
| Project Architect | 10 | 3.5 |
| Project Site Engineer | 85 | 29.4 |
| Artisans | 89 | 30.8 |
| **Total** | **289** | **100.0** |

**Table 8**
Artisans available at site from different vocation training centres

| | Artisans available from TSC | Artisans available from FDC | Artisans available from VETA | Artisans available from informal sector |
|---|---|---|---|---|
| N | 289 | 289 | 289 | 289 |
| **Statistics (Sum)** | **194** | **126** | **1097** | **2716** |

**Table 9**
Artisans based on owning certificates

| | Artisans with certificates | Artisans with no certificates |
|---|---|---|
| N | 289 | 289 |
| **Statistics (Sum)** | **1372** | **2761** |

*4.2 Assessment of inter-relationship through CB-SEM*

To evaluate the inter-relationship between external and internal factors impacting artisans' performance, the study employed CB-SEM and conducted three fundamental procedures: evaluating the reliability of the instrument, assessing the measurement model, and evaluating the structural model.

*4.3 Assessment of instrument reliability*

The assessment of reliability is a crucial step in determining the consistency of variables being measured. Random or chance errors can affect reliability and must be accounted for (Hair et al., 2014). The study utilized two measurement scales to test reliability: Cronbach alpha and item-total correlation. Cronbach alpha measures internal consistency and ranges from 0 to 1, with values above 0.7 considered acceptable (Cortina, 1993). The item-total correlation measures discriminant validity and indicates how a latent construct differs from other constructs in a model. A value above 0.3 is deemed acceptable (Tapsir et al., 2018). In this study, the lowest Cronbach's Alpha was 0.810 for QF, while the highest was 0.980 for IF, indicating high internal consistency. Item-total correlations were mostly above 0.823, except for variables MF6 and QF4, which had acceptable medium values of 0.324 and 0.365, respectively (Tapsir et al., 2018), as presented in Table 10.

**Table 10**
Reliability analysis and item-total correlation of each initial construct

| Code | Constructs / observed variables | Means | Corrected Item-Total Correlation | Cronbach's Alpha if Item Deleted | Cronbach's Alpha |
|---|---|---|---|---|---|
| *MF* | *Motivational factor* | *3.021* | | | *0.901* |
| MF1 | Offering food allowance | 3.06 | 0.853 | 0.979 | |
| MF2 | Offering transport allowance | 3.05 | 0.843 | 0.979 | |
| MF3 | Offering drinking water | 2.97 | 0.868 | 0.979 | |
| MF4 | Make a payment of wages daily | 3.04 | 0.823 | 0.979 | |
| MF5 | Make a payment of wages weekly | 3.01 | 0.855 | 0.979 | |
| MF6 | Make a payment of wages monthly | 3.09 | 0.324* | 0.985 | |
| MF7 | Provide a permanent contract | 2.97 | 0.860 | 0.979 | |
| MF8 | Provide a temporal contract | 2.98 | 0.855 | 0.979 | |
| *FF* | *Formal training factors* | *2.974* | | | *0.973* |
| FF1 | Employ them based on acquiring vocational skills from formal methods of training | 3.01 | 0.838 | 0.979 | |
| FF2 | Before engaging works, ask them if they know how to read and interpret the drawings | 2.97 | 0.869 | 0.979 | |
| FF3 | Before engaging in work, ask them if they attend practical training | 2.97 | 0.876 | 0.979 | |
| FF4 | Employ them based on acquiring internship training after graduation | 2.97 | 0.869 | 0.979 | |
| FF5 | Before engaging in work, ask them if they properly completed the vocational training | 2.95 | 0.879 | 0.979 | |
| *IF* | *Informal training factors* | *3.062* | | | *0.980* |
| IF1 | Employ them based on acquiring vocational skills through an apprenticeship approach | 3.10 | 0.869 | 0.979 | |
| IF2 | Employ them based on consideration of only one specialization skill | 3.07 | 0.861 | 0.979 | |
| IF3 | Before engaging works, ask them if they know how to use current tools and equipment for the construction process | 3.05 | 0.860 | 0.979 | |
| IF4 | Employ them based on acquiring internship training after qualification | 3.02 | 0.865 | 0.979 | |
| IF5 | Employ them based on having certifications from the government | 3.06 | 0.854 | 0.979 | |
| *QF* | *Qualifications factors* | *3.062* | | | *0.810* |
| QF1 | Employ them due to their level of vocational skills for construction activities from the recognized training center | 3.05 | 0.851 | 0.979 | |
| QF2 | Employ them due to having vocational skills certificates from the recognized training center | 3.05 | 0.853 | 0.979 | |
| QF3 | Employ them based on work experience | 3.08 | 0.815 | 0.979 | |
| QF4 | Employ them due to have self-management skills at the site | 3.13 | 0.365* | 0.985 | |
| QF5 | Before engaging in work, ask them if they have teamwork skills for construction activities at the site | 2.99 | 0.865 | 0.979 | |
| *W* | *Workmanship for constructed blockwork walling* | *2.940* | | | *0.870* |
| W1 | Non-alignment and evenness achieved on constructed walling | 3.00 | 0.895 | 0.979 | |
| W2 | Availability of cracks and damages on constructed walling | 2.94 | 0.910 | 0.979 | |
| W3 | Sign of hollowness and delamination on constructed walling | 2.94 | 0.897 | 0.979 | |
| W4 | Non-joints aligned and with no consistent size to constructed walling | 2.92 | 0.897 | 0.979 | |
| W5 | Unsatisfactory general finishes outlook achieved on constructed walling | 2.91 | 0.911 | 0.979 | |
| *P* | *Productivity for construction activities* | *2.982* | | | *0.971* |
| P1 | Achievement of 1.35 m2 per hour for 230 mm thick blockwork walling | 3.00 | 0.902 | 0.979 | |
| P2 | Achievement of 4.68 m2 per hour for preparing and applying 15 mm thick plastering on walling | 3.00 | 0.902 | 0.979 | |
| P3 | Achievement of 1.88 m2 per hour for tiles floor finishing with size (500mm x 500mm x 9.5 mm thick), bedded on 12mm thick with cement mortar (1:3). | 2.98 | 0.892 | 0.979 | |
| P4 | Achievement of 0.025 tonnes per hour for preparing and fixing steel in position for 16 mm diameter to columns or beams | 2.95 | 0.906 | 0.979 | |

**Note:** Mean: > 3, High effect; =3, average effect; < 3, low effect

### *4.4 Assessment of the measurement model*

The measurement model assessment involved an examination of the reliability of individual items, convergent validity, measurement validity, and fitness of the measurement model using confirmatory factor analysis (CFA). CFA is a statistical procedure that confirms a set of observed variables (Mia et al. 2019) and allows for the testing of hypothesized relationships between observed variables and constructs. Fit indices such as P-value, $\chi2$, CFI, TLI, SRMR, and RMSEA proposed in the study were used to assess the CFA's goodness-of-fit. Figure 3 illustrates the relationship for the overall measurement model supported by the obtained fit indices of $\chi2$=1.806, p-value=0.000, TLI=0.973, CFI=0.976, SRMR=0.022, and RMSEA=0.053 after model modifications. The results indicate a well-fitted model that is theoretically supported, as shown in Table 5. Table 11 provides numerical data supported by estimates of standardized covariance among exogenous variables. Notably, all constructs with code (MF), (FF), (IF), (QF), (W), and (P) have a significant correlation relationship, with p-values <0.05.

**Table 11**

Estimates of standardized covariance for overall measurement model

| | | | Estimate | S.E. | C.R. | P | Label |
|---|---|---|---|---|---|---|---|
| MF | ↔ | FF | 0.528 | 0.052 | 10.094 | **** | |
| FF | ↔ | IF | 0.478 | 0.049 | 9.803 | **** | |
| IF | ↔ | QF | 0.495 | 0.051 | 9.745 | **** | |
| MF | ↔ | IF | 0.604 | 0.060 | 10.090 | **** | |
| FF | ↔ | W | 0.492 | 0.047 | 10.410 | **** | |
| MF | ↔ | W | 0.593 | 0.057 | 10.425 | **** | |
| MF | ↔ | P | 0.606 | 0.058 | 10.441 | **** | |
| FF | ↔ | P | 0.490 | 0.048 | 10.282 | **** | |
| IF | ↔ | P | 0.587 | 0.056 | 10.540 | **** | |
| QF | ↔ | P | 0.517 | 0.050 | 10.352 | **** | |
| QF | ↔ | W | 0.514 | 0.049 | 10.427 | **** | |
| MF | ↔ | QF | 0.534 | 0.054 | 9.923 | **** | |
| P | ↔ | W | 0.591 | 0.054 | 11.010 | **** | |
| FF | ↔ | QF | 0.493 | 0.047 | 10.481 | **** | |
| IF | ↔ | W | 0.576 | 0.055 | 10.531 | **** | |

**Note:** **** means the p-value at a significant level is <0.001: indicates; very highly statistically significant relationship (Mohamed et al. 2018).

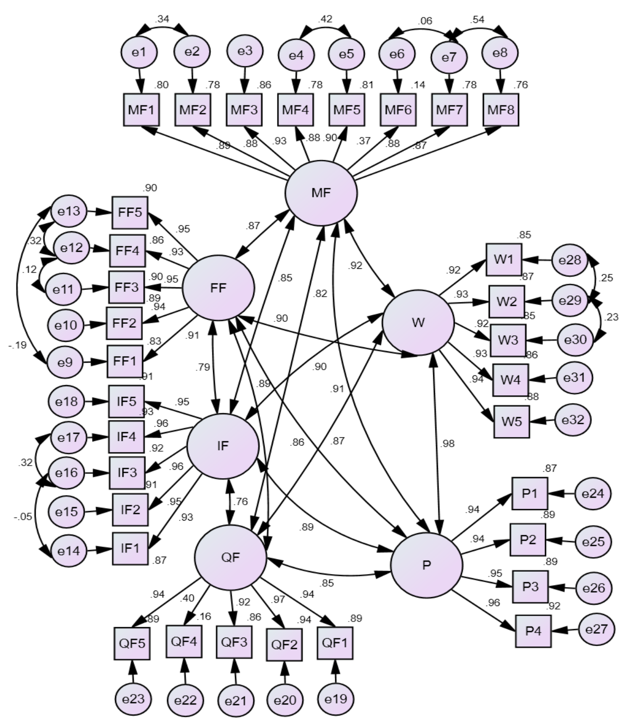


**Fig. 3.** Unstandardized parameter estimates of the overall measurement model
(Model fit statistics: *χ2 =1.806, p-value=0.000, TLI=0.973, CFI=0.976, SRMR=0.022 and RMSEA=0.053*)

*4.5 Assessment of structural model*

The evaluation of the structural model involves examining the inter-relationships among constructs and overall model fit (Hair et al. (2014), including structural path coefficients and parameter estimates (Koh and Rowlinson (2007). This study achieved adequate fit indices (χ2 = 2.061, p-value = 0.000, TLI = 0.965, CFI = 0.969, SRMR = 0.023, and RMSEA = 0.061) as required in Table 5. When comparing the level of significance (P-value) for regression weights between constructs (MF, FF, IF, QF) and dependent variables (W, P), highly statistically significant relationships at < 0.001 were found for (MF), (IF), and (QF), while (FF) had a p-value of 0.490, rejecting the hypothesis for dependent variable (P). Additionally, (MF), (IF), and (QF) were very highly statistically significant when compared with the dependent variable (W) at < 0.001, while (FF) were high statistically significant at < 0.010, as shown in Table 12.

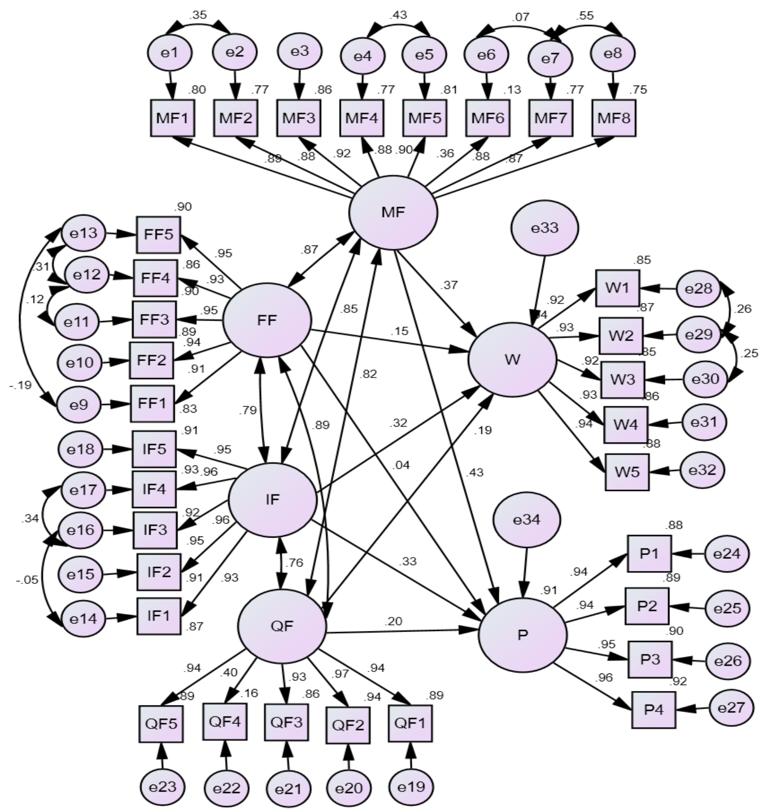


**Fig. 4.** Unstandardized parameter estimates of the overall structural model
*(*Model fit statistics: *$\chi 2$ =2.061, p-value=0.000, TLI=0.965, CFI=0.969, SRMR=0.023 and RMSEA=0.061)*

**Table 12**
Estimates of standardized regression weights for overall structural model

| | | | Estimate | S.E. | C.R. | P | Label |
|---|---|---|---|---|---|---|---|
| W | ← | MF | .333 | .051 | 6.493 | *** | |
| W | ← | FF | .158 | .061 | 2.577 | .010 | |
| W | ← | IF | .293 | .039 | 7.541 | *** | |
| W | ← | QF | .193 | .048 | 4.014 | *** | |
| P | ← | MF | .404 | .059 | 6.802 | *** | |
| P | ← | FF | .049 | .071 | .691 | .490 | |
| P | ← | IF | .311 | .045 | 6.999 | *** | |
| P | ← | QF | .210 | .055 | 3.798 | *** | |

**Note**
**** means the p-value at a significant level is <0.001
(i) p-value >0.050 indicates no statistically significant relationship;
(ii) p<0.05 indicates a statistically significant relationship;
(iii) p<0.01 indicates a highly statistically significant relationship; and
(iv) p < 0.001very highly statistically significant relationship (Mohamed et al. 2018).

In addition to evaluating the overall model fit, structural equation modeling (SEM) can also assess the significance and power of causal paths between variables using standardized path coefficients. A coefficient close to or greater than 0.5 indicates a large effect size, while a coefficient near or below 0.1 indicates a small effect size (Mohamed et.al, 2018). The developed SEM model in this study found that the Motivation Factor had the most significant impact on artisans' performance, with a path coefficient of 0.37 and 0.43 a highly statistically significant relationship for workmanship (W) and productivity (P) respectively. The formal training factors (FF) had the lowest impact, with a path coefficient of 0.04, indicate small improper effect when disregarded as illustrated in Fig. 4 and Tables 13.

**Table 13**
Standardized paths of a hypothesized model

| Hypothesis | Causal Path | Path Coefficient | P-value result |
|---|---|---|---|
| | *For External factors* | | |
| H1 | Disregarding motivational factors (MF) → causes improper workmanship | 0.37 | **** |
| H2 | Disregarding motivational factors (MF) → causes less productivity. | 0.43 | **** |
| H3 | Disregarding formal training factors (FF) → causes improper workmanship. | 0.15 | 0.010 |
| H4 | Disregarding formal training factors (FF) → causes less achievement of productivity. | 0.04 | 0.490 |
| H5 | Disregarding the informal training factor (IF) → causes improper workmanship. | 0.32 | **** |
| H6 | Disregarding an informal training factor (IF) → causes less achievement of productivity | 0.33 | **** |
| | *For internal factors* | | |
| H7 | Disregarding qualification factors (QF) → causes improper workmanship performance. | 0.19 | **** |
| H8 | Disregarding qualification factors (QF) → causes less productivity. | 0.20 | **** |

**Note**
**** means the p-value at a significant level is <0.001: indicates; very highly statistically significant relationship (Mohamed et al. 2018).

### *4.6 Discussion of the study result*

The statistical analysis results for hypotheses (H1), (H2), (H5), (H6), (H7), and (H8) are presented in Table 13, with p-values of <0.001 for each hypothesis. These results indicate that if the IFs are disregarded, there will be a high level of improper workmanship and productivity performance among the artisans. These findings are consistent with previous research by Zannah et al. (2017), which identified low wages payment and lack of incentive schemes as key factors that affect the performance of skilled laborers. Fagbenle (2011) also reported that unfair wages and lack of motivation negatively impact the performance of laborers. Tam and Nguyen (2018) highlighted the importance of different types of salary payments on the productivity of construction workers. Evarist et al. (2022) identified recruitment and selection practices as factors that influence the performance of laborers in construction projects. Kikwasi and Escalante (2018) stressed the need for attention to be given to the skills shortages among artisans on construction concepts and knowledge in the interpretation of drawings when employing them at the operative level to minimize poor performance regarding workmanship and productivity. These findings indicate that employers and supervisors need to focus on the IFs when engaging artisans for executing construction activities to ensure their optimal performance. The p-value for hypothesis (H3) is 0.010, which is less than the significance level of 0.05, indicating a highly statistically significant impact on improper workmanship performance for artisans when disregarded. The results are consistent with Kikwasi (2011) findings, which emphasize the importance of artisans' capacity to interpret drawings and specifications, use modern construction tools, and handle various types of materials in their performance. Thus, it is essential for artisans to stay updated with emerging technologies within the construction industry to improve their performance. The results of hypothesis (H4) indicate that formal training factors (FF) do not have a significant impact on the productivity performance of artisans when disregarded with the P-value is 0.490. This finding suggests that recruitment of artisans based solely on their vocational training may not be sufficient to ensure optimal productivity in the construction industry. The study by Kikwasi (2011) supports this idea by emphasizing the importance of on-the-job training and apprenticeship programs for skilled laborers to enhance their performance.

## 5. Conclusion

The study investigated the impact of internal and external influencing factors (IFs) on the performance of artisans in the construction industry in Tanzania. The results indicated that all IFs had a significant impact on the performance of artisans, with motivation factor (MF) having the highest impact on workmanship and productivity, followed by informal training factors (IF) and qualification factors (QF). Formal training factors (FF) did not have a significant impact on productivity. The findings suggest that employers and supervisors in the construction industry need to focus on IFs, particularly MF, IF, and QF, during the engagement of artisans to ensure optimal performance. Also, there is a need for ongoing training and upskilling of artisans to keep them updated with new technology and emerging construction concepts and knowledge. Finally, the study highlights the importance of recruiting artisans based on IFs that meets the demand of the construction industry.

### *5.1 Recommendation*

Based on the findings of this study, it is recommended that employers and supervisors in the construction industry focus on the identified influential factors (IFs) to improve the performance of artisans regarding workmanship and productivity.

Therefore, employers and supervisors should prioritize IFs to enhance artisans' performance. Additionally, there should be an emphasis on updating artisans' knowledge and skills on emerging technology and modern construction tools. The study also indicates that recruitment of artisans based solely on vocational training may not meet the demand of the construction industry. Hence, employers and supervisors should consider involving apprenticeship and on-job training programs to improve the performance of artisans. By addressing these recommendations, the performance of artisans in the construction industry in Tanzania can be improved, leading to improved productivity, workmanship and overall development of the construction industry.

### *5.2 Limitations and suggestions for future research*

Despite its valuable contributions, this study has some limitations. One of the main limitations is that the data was gathered only from building projects located in major cities in Tanzania, which may limit the generalization of the findings to other areas of the country. The study should be extended to include smaller cities to account for variations in standards of living. Secondly, the study was limited to a quantitative research approach, which may not provide an in-depth understanding of the factors affecting the performance of artisans. Future research could consider a qualitative approach to gain a more in-depth understanding of the experiences and perceptions of artisans regarding their performance and the factors that affect it. Lastly, the study only considered motivational, formal and informal training as external IFs and qualification as internal IFs for artisans' performance for registered (formal procedures) construction projects. Future research should explore other external and internal IFs, including informal construction procedures applied in most household constructions in Tanzania and other developing countries. This will provide a more comprehensive understanding of the factors that influence the performance of artisans in the construction industry.

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