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Validation of the Developed Structural Equation Model on Factors Influencing Artisans' Performance in Tanzanian Building Construction Projects

[1]Japhary Juma Shengeza*, [2]Joseph John Msambichaka, [1]Yazid Hassan Mwishwa

[1]College of Architecture and Construction Technology

[2]College of Engineering and Technology

[1,2]Mbeya University of Science and Technology, P.O.Box 131, Mbeya, Tanzania

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ABSTRACT

Artisans are key players in the construction industry. Artisans, in conjunction with other players, are responsible for turning drawings into tangible structures using materials and equipment. However, several reports suggest that their performance is inadequate, attributing it to poor workmanship and productivity. This study explores the Influencing Factors (IFs) for artisan performance and how disregarding these IFs leads to poor performance through the development of Structural Equation Modelling (SEM). The study focuses on validating the developed SEM on IFs categorised as Informal Training Factors (IF), Motivational Factors (MF), Qualification Factors (QF), and Formal Training Factors (FF) and their impacts regarding achievements of workmanship and productivity by artisans when disregarded. The study validates the SEM model using a questionnaire distributed among construction industry experts. The study results demonstrate that disregarding IFs has a high, negative impact on artisan performance. Specifically, IF was found to have the most significant effect on artisan performance when ignored, with a mean score of 4.09, followed by MF = 4.00, Q = 3.82, and FF = 3.55. In the case of the model's applicability, effectiveness, and adaptability, the mean scores were 4.00, 3.55, and 3.45, respectively, indicating that the construct depicted in the model is highly applicable. The study concludes that considering IFs for artisan performance is crucial for addressing the root causes of poor performance and improving project success in the construction industry.

*Corresponding author's e-mail address: japhary.shengeza@must.ac.tz (Shengeza, J.)

1.0 Introduction

1.1 Background

In Tanzania, informal construction methods dominate building construction (NBS, 2022). The National Bureau of Statistics 2022 census indicates that, under informal methods, 94% of the country's buildings, or 13,540,363, are non-multistorey and constructed using skilled labour, commonly known as artisans. Typically, informal methods operate without consultant supervision. The remaining 6%, or 68,724, are multistorey buildings primarily constructed using formal construction methods and supervised by contractors and consultants at pre- and post-contract stages (NBS, 2022).

Studies, such as the one by Kikwasi (2011), reveal poor performance by the artisans in delivering specialised skills as per provided specifications and expected productivity. The poor performance of artisans leads to lower workmanship quality, reduced productivity, and increased costs for project maintenance. It also results in longer anticipated completion times and lower-quality output that does not provide value for money. The negative effects of the poor performance of artisans on construction projects are well documented in various studies and are illustrated in Table 1.

In most cases, the observed poor performance of artisans for completed works, as per Table 1, is caused by disregarding an influencing factor (IF) for their performance (NAOT, 2021). Kikwasi (2011), Kikwasi (2013), Zannah (2016), and Evarist et al. (2022) explain that artisans' performance for assigned physical construction activities by contractors or any employer depends on the use of IFs, both external and internal factors in achieving the workmanship and productivity required during the construction process for building projects.

Regarding this matter, internal factors refer to individual characteristics that influence behaviour and actions in a person to perform a specific activity (Campbell et al. 1993). Furthermore, Campbell et al. (1993) described characteristics as understanding a given task through its facts, principles, and expected goals, primarily derived from self-management and interpersonal skills. In line with artisans' performance, it can be regarded as individual performance during construction, referring to having the required qualification, behaviour, and well-being factors. In cases of external factors, it is described as actions that do not occur within the artisans but from the environment (Zannah, 2016). Furthermore, Zannah (2016) considers the external support of artisans' performance as motivation during construction activities, consideration of training required during recruitment of an artisan, availability of quality tools, equipment, and plants, and overall site management. When artisans lack these features of internal factors and support from external factors attributed to poor performance in their specialised skills, as per Table 1, the IFs involve a wide range of factors influencing the performance of artisans associated with workmanship and productivity. non-achievement of workmanship and productivity, affecting the project performance indicators of cost and time required and the project's expected quality.

The scenario led to the development of IFs for the Artisans Performance Model (APM) through the Covariance-Based Structural Equational Model (CB-SEM). The APM developed using the Statistical Package for Social Sciences (SPSS), version 25, and Analysis of Moment Structures (AMOS), version 20, the advanced SPSS, aimed to provide a comprehensive understanding of the relationship between the impact of four latent variables on artisans' performance and project performance indicators. It also offers recommendations for effective intervention to improve the performance of artisans in building construction projects.

The present study is important because of the frequent reports of poor performance among artisans in construction projects (Kikwasi, 2011; NAOT, 2021). Additionally, the study contributes to the development of the methodology by highlighting the use of SEM in the construction field. The study's main goals are to describe the new SEM on quantified IFs for artists' performance and to test the new model outside of the sample to see how well it works, how it can be used, and how it can be changed to fit the construction industry.

Table 1
Poor Performance of Completed Work

Artisans' specialisation	Inappropriate work performance by Artisans	Source
Masonry	Existing floor cracking on parts of completed works	NAOT (2021)
	Wall cracks in some constructed walls	NAOT (2021)
	Plastering detaching from concrete works and blockwork	NAOT (2021)
Painter	Peeling off of bituminous painting at the foundation	NAOT (2021)
	Peeling off of internal painting	NAOT (2021)
	Painting detaching from plasterwork	Kikwasi (2011)
Tiler	Wall tiles of Laboratory tables peeled off	NAOT (2021)
	Improperly fixed and aligned tiles	Kikwasi (2011)
	Improper grouting for skirting and wall tiles in wet areas	Kikwasi (2011)
Carpenter	Trusses members joined with unsatisfactory number of nails	NAOT (2021)
	Poor joints of ceiling boards on timber supporting	Kikwasi (2011)
	Improper cutting roof sheets at endpoints of ridge and valley	NAOT (2021)
	Improper door shutters are not functioning correctly.	NAOT (2021)
Plumber	Leakage of waste pipe at joints	NAOT (2021) Kikwasi (2011)
	Improperly fixed water tapes for handwashing basin and flexible pipes for urinal	NAOT (2021)
	Stagnation of water in toilets	NAOT (2021)
Electrician	Improper switches connection	NAOT (2021)

1.2 CB-SEM Using AMOS

Structural Equation Modelling (SEM) is a comprehensive statistical method that explores relationships between observed and latent variables, effectively capturing both direct and indirect impacts of latent variables on the measured factors paradigm (Alaloul et al., 2020). CB-SEM is used for confirmatory testing, and PLS-SEM is used to look for links between different research elements (Gyamfi et al., 2020). Constructing a SEM model involves several steps.

Firstly, data reliability is ensured by assessing the internal consistency of the measurement instrument achieved through item analysis techniques, selecting items with corrected item-total correlations above 0.5, as recommended by Hair et al. (2014), and a Cronbach's alpha cutoff of 0.7, as indicated by George and Mallery (2003; Saidi and Siew (2019).

Secondly, model fit is evaluated using various fit indices. Chi-square, the Goodness-of-Fit Index (GFI), the Adjusted Goodness-of-Fit Index (AGFI), the Standardised Root Mean Square Residual (SRMSR), and the Root Mean Square Error of Approximation (RMSEA) measure how well the model fits with the data (McDonald and Ho, 2002; Dash and Paul, 2021). Incremental fit indices, including the Tucker-Lewis Index (TLI), Normed Fit Index (NFI), and Comparative Fit Index (CFI), compare the model's fit to a hypothetical model (Miles and Shevlin, 2007; Dash and Paul, 2021). Parsimonious fit indices like the Parsimonious Goodness of Fit Index (PGFI) and the Parsimonious Normed Fit Index (PNFI), usually used to compare models (Hooper et al., 2008; Dash and Paul, 2021), are considered. No agreed-upon number of indices considered acceptable for model testing in each category exists. However, Hair et al. (2014) proposed using three to four indices for any demonstrated model fit. Furthermore, Hooper et al. (2008) explained that it is neither necessary nor realistic to include every index that the program generates because doing so might overwhelm readers and reviewers. With numerous fit indices available, there's a temptation to select those suggesting the best fit. This study chose a minimum of two indices from each group, demonstrating acceptable fit, to showcase the developed model's fit.

Lastly, construct validity is determined in two-way approaches; first, the determination of convergent validity, reflecting the consistency among indicators measuring the same construct, is gauged by Average Variance Extracted (AVE) with a cutoff of 0.5 (Hair et al., 2010; Cheung et al., 2023). Second, the determination of discriminant validity, which measures how distinct a construct is from others, can be assessed by ensuring the square root of AVE is greater than the correlations between constructs, which is the most common way to access discriminate validity (Rönkkö and Cho, 2022; Cheung et al., 2023) or by using the heterotrait-monotrait (HTMT) ratio to ensure implied correlations are below 0.9 (Henseler et al., 2015), which is one of the most recent methods used (Shaffer et al., 2016; Afthanorhan et al., 2021; Mohd Dzin and Lay, 2021).

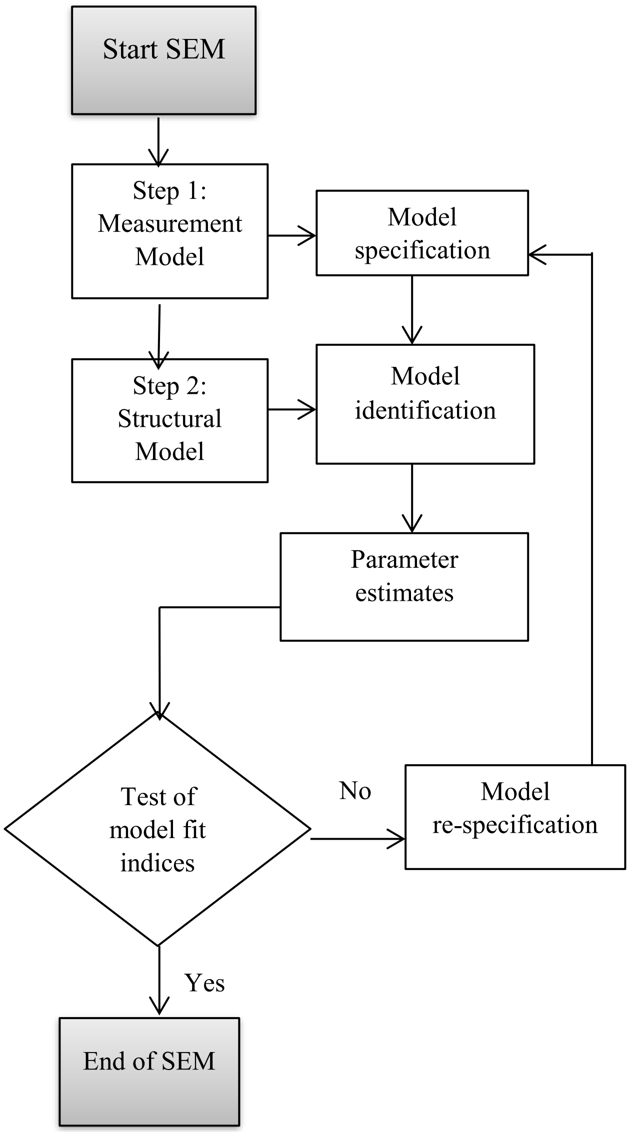
This study adopted CB-SEM, with a requisite sample size of 150 to 400, to examine construct variables within the individual performance theory applied to artisans' performance in construction projects. Based on Campbell et al. (1993), the theory encompasses internal factors of qualification concepts and external motivational aspects for artisans' performance. According to Hair et al. (2014), the evaluation of 3 to 4 fit indices confirmed satisfactory model fit, though this study went beyond the consideration of seven indices to enhance model assessment. Absolute fit indices involved $\chi 2$, SRMR, and RMSEA, where a low $\chi 2$ and non-significant p-value indicated a better fit. The desired values were RMSEA < 0.07 when equal to CFI > 0.92 (Hair et al., 2014) and SRMR <0.05. Incremental fit used CFI and TLI exceeded 0.92 (Hair et al., 2014; Fan et al., 2016), denoting higher explained variance. Lastly, parsimonious fit relied on PGFI and PNFI at the threshold of 0.5. For construct validity, AVE values with a 0.5 cutoff are the criteria required (Hair et al., 2010; Cheung et al., 2023), and HTMT ratios with less than or equal to 0.9 indicate discriminant validity (Henseler et al., 2015). Considering the correlations and the uncertainty associated with them, making them a better choice, mainly when correlations are in proximity, was employed to gain advantages over the square root of AVE values.

1.3 Developed CB-SEM Model

The CB-SEM model that was created has six parts: independent variables (external and internal factors) and dependent variables (workmanship and productivity) for building construction projects. These are used to test the hypothesis that was made, as shown in Table 9. Constructs forming independent variables for external factors are motivational, formal, and informal training, and internal factors are qualification factors. Motivational factors concern the incentive scheme strategies influencing the improper performance of artisans when disregarded by supervisors or employers in construction. Formal training, informal training, and qualification factors highlighted criteria required for the recruitment of artisans and how they influence improper performance when disregarded during construction activity assignments among supervisors or employers for the performance of building construction projects. The developed CB-SEM model followed the stages highlighted in Section 1.2 and Fig. 1, where the measurement model serves as the first step, focusing on assessing the relationships between observed variables and latent constructs. It aims to evaluate how the observed variables are related to the underlying constructs. On the other hand, the structural model is the second step, which examines latent variables' direct and indirect effects on measured factors. It explores the causal relationships between the latent variables and how they influence the observed variables (Mohammed *et* al., 2018).

Fig. 1

SEM Analysis Flowchart (Modified From Mohamed et al.,2018)



1.3.1 *The Characteristics of Respondents*

The study has a sample size of 289 with 32 observed variables. According to Hair et al. (2014), such data follow 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 described in subsection 2.1 to have the model fit. The analysis of the demographic characteristics looked at respondents' positions for supervision at the building construction site as shown in Table 2; for the positions held for supervision, 89 were mainly artisans, and eight project quantity surveyors indicate the lowest. The respondents were asked to use a 5-point Likert scale from 5 (strongly agree) to 1 (strongly disagree) to determine the key observed variables on IFs for their performance.

Table 2

The Characteristics of Respondents

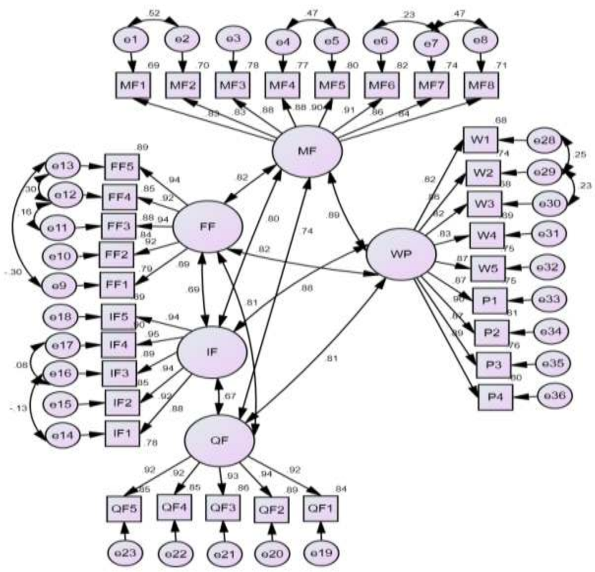
Supervision position	Frequency	Per cent
Project Manager	17	5.9
Project Quantity Surveyor	8	2.8
Project Foreman	80	27.7
Project Architect	10	3.5
Project Site Engineer	85	29.4
Artisans	89	30.8
Total	**289**	**100.0**

1.3.2 *Developed Measurement Mode*

Establishing the item-total correlation for each indicator during this phase helped determine internal consistency. Each variable exhibited a consistently high range from 0.864 to 0.956, and Cronbach's alpha for the constructs ranged from 0.810 to 0.98, indicating the instruments' robustness (George and Mallery, 2003; Creswell, 2010; Saidi and Siew, 2019), as shown in Table A.1. These findings paved the way for the subsequent step of ensuring the fitness of the measurement model. As shown in Fig. 1, model re-specification was done for certain indicators, such as MF1 and MF2, MF4 and MF5, and so on (see Fig. 2). This was done based on the advice of Mohamed et al. (2018). This step was undertaken to enhance the fit indices across all measures. The fit indices obtained met the required thresholds, with χ^2=707.894, df=438, relative chi-square (χ^2) = 1.616, p-value=0.000, SRMR=0.024, TLI=0.969, CFI=0.973, PNFI=0.780, PCFI=0.840, and RMSEA=0.070, as detailed in subsection 1.2. These indices facilitated the assessment of construct validity.

Fig. 2

Standardised Parameter Estimates of Final Measurement Model after Adjustment



After that, convergent validity was checked using the AVE, which was calculated from the factor loadings that were found during CFA. All AVE values surpassed the cutoff point of 0.5, as presented in Table 3. This fulfilment of the required threshold for convergent validity, in line with Hair et al. (2010) and Cheung et al. (2023), assured the researchers that the indicators effectively converged and faithfully represented their respective latent constructs.

After having the required acceptable values of convergent validity, the next step was to determine the discriminant validity. The discriminant validity was assessed using the HTMT ratio at a requirement of 0.9, as Henseler et al. (2015) recommended. After determining the values of the HTMT ratios, two constructs were found to be greater than 0.9. Specifically, the HTMT ratio for W to P was 0.977, and the HTMT ratio for W to MF was 0.910. These values indicated a failure to meet the requirements of discriminant validity, as presented in Table 4.

Further investigation and adjustments were undertaken to enhance discriminant validity in the measurement model before assessing the structural model. The first step involved considering the exclusion of respondents with low standard deviations for MF, W, and P for these specific constructs. From the initial 289 respondents, 67 with zero standard deviations were removed, resulting in 222 remaining respondents. This approach, similarly adopted by Latif et al. (2020), ensured a more representative sample and improved discriminant validity.

The second approach encompassed merging constructs W and P into a single construct named WP, a strategy (Farrell, 2010) recommended to address discriminant validity concerns. This consolidation created a more robust latent variable, effectively capturing core concepts and enhancing discriminant validity. to reinforce discriminant validity in the measurement model, ensuring an accurate representation of distinct concepts within the theoretical framework. Post-adjustments, the new HTMT ratios were below 0.9 for each correlation, meeting the discriminant validity requirement as described by Henseler et al. (2015). These adjustments were crucial to preparing the measurement model for subsequent structural model evaluation, as evident in Tables 5, 6, and Fig. 2 above.

Table 3

Convergent Validity Using Average Variance Extracted (AVE)

Construct Code	Indicator	Standardised Indicators Loading	The sum of squared Standardised loading	AVE
MF	MF1	0.883	6.423	0.803
	MF2	0.872		
	MF3	0.917		
	MF4	0.881		
	MF5	0.911		
	MF6	0.916		
	MF7	0.899		
	MF8	0.888		
FF	FF1	0.911	4.382	0.876
	FF2	0.945		
	FF3	0.951		
	FF4	0.927		
	FF5	0.946		
IF	IF1	0.930	4.538	0.908
	IF2	0.953		
	IF3	0.961		
	IF4	0.964		
	IF5	0.955		
QF	QF1	0.938	4.458	0.892
	QF2	0.964		
	QF3	0.929		
	QF4	0.940		
	QF5	0.950		
W	W1	0.935	4.308	0.862
	W2	0.945		
	W3	0.946		
	W4	0.958		
	W5	0.920		
P	P1	0.933	3.580	0.895
	P2	0.923		
	P3	0.927		
	P4	0.938		

Table 4

Discriminant Validity before Adjustment for Heterotrait-Monotrait (HTMT) Ratio

	W	P	QF	IF	FF	MF
W						
P	0.977*					
QF	0.874	0.853				
IF	0.895	0.886	0.767			
FF	0.892	0.861	0.888	0.789		
MF	0.910*	0.900	0.821	0.845	0.865	

Table 5

Average Correlations for Determination of Heterotrait-Monotrait (HTMT) Ratio After Adjustment

Code	Average Monotrait correlation	Code	Average Heterotrait correlation
WP	0.743	WP-QF	0.650
QF	0.860	WP-IF	0.700
IF	0.861	WP-FF	0.653
FF	0.851	WP-MF	0.661
MF	0.768	QF-IF	0.581
		QF-FF	0.680
		QF-MF	0.594
		IF-FF	0.592
		IF-MF	0.648
		FF-MF	0.655

Table 6

Discriminant Validity after Adjustment Using Heterotrait-Monotrait (HTMT) Ratio

	WP	QF	IF	FF	MF
WP					
QF	0.813				
IF	0.875	0.675			
FF	0.822	0.795	0.691		
MF	0.876	0.732	0.797	0.810	

1.3.3 *Assessment of the Developed Structural Model*

The assessment of the developed structural model involved a thorough examination of the construct's overall model fit, following guidelines by Hair et al. (2014), regression weights, and path coefficients (Koh and Rowlinson, 2007).

Regarding the model fit, several metrics were considered. The chi-square goodness-of-fit test yielded a p-value of 0.000, indicating a significant difference between the observed data and the model-implied covariance matrix. However, because of sample size effects, the chi-square to degrees of freedom ratio ($\chi 2/df$) value was lower than the recommended level of 2 to 3, which means there was a strong fit. It was 1.656. Additionally, the standardised root mean square residual (SRMR) and root mean square error of approximation (RMSEA) both scored favourably, with values of 0.025 and 0.072, respectively, below their respective thresholds, affirming the model's accuracy in prediction. The Tucker-Lewis Index (TLI) and the Comparative Fit Index (CFI) both had values above 0.90, at 0.942 and 0.948, respectively. This means that the models are much better than a null model and that there is strong comparative fit. For parsimonious fit, the Parsimonious Normed Fit Index (PNFI) and Parsimonious Comparative Fit Index (PCFI) were above the recommended 0.50 threshold, at 0.785 and 0.847, respectively.

These results demonstrate the model's balance between fit indices, as summarised in Table 7, suggesting that the model effectively captures the hypothesised relationships between latent constructs, providing robust evidence for the research hypotheses and a comprehensive understanding of the underlying concepts in the research context.

Table 7

Goodness of Fit Indices Values of the Final Structural Model

Type	Fit Index	Criteria	Value archived	Remarks
Absolute fit measures	Chi-square p-value	0.000	0.000	Achieved
	Chi-square/ df	< 2,3	1.656	Achieved
	SRMR	< 0.05	0.025	Achieved
	RMSEA	< 0.07	0.072	Achieved
Incremental fit measures	TLI	>0.92	0.942	Achieved
	CFI	>0.92	0.948	Achieved
Parsimonious fit measures	PNFI	>0.50	0.785	Achieved
	PCFI	>0.50	0.847	Achieved

Standardised regression weights in the final structural model revealed perceptive connections between latent constructs (MF, FF, IF, and QF) and the dependent variable (WP). The results show highly significant relationships (< 0.000) for (MF), (IF), and (QF), signifying strong influences of these constructs on (WP). These outcomes robustly supported the respective research hypotheses. Notably, these findings emphasise the pivotal role of influencing factors (IFs); overlooking them can lead to inadequate workmanship and productivity among artisans, which aligns with previous research. Zannah et al. (2017) highlighted wage issues; Fagbenle (2011) emphasised motivation; Tam and Nguyen (2018) explored salary types; Evarist et al. (2022) addressed recruitment; and Kikwasi and Escalante (2018) noted skill shortages, all impacting artisan performance. These findings underscore the need for prioritising IFs to optimise artisan performance in construction.

However, a different trend emerged for the dependent variable (WP), with a p-value of 0.135 for its relationship with (FF). This value exceeding the conventional 0.05 significance level led to rejecting the hypothesis connecting (FF) and (WP), suggesting that relying solely on vocational training during recruitment might not be adequate to ensure construction productivity. Kikwasi (2011) reinforces this by advocating on-the-job training for enhanced skilled labourer performance. Significant parameter estimates between (MF), (IF), and (QF) underscore these constructs' crucial roles in shaping (WP).

Regression weight estimates emphasised the strength of these links, with (IF) having the highest weight (0.370), followed by (MF) (0.277) and (QF) (0.211). These values highlight each construct's relative importance in explaining dependent variable variance, as summarised in Table 8. They offer deep insights into the latent construct and dependent variable connections.

In the assessment of the developed model using SEM, the focus was on understanding the significance and strength of causal paths through standardised path coefficients between latent constructs (H1 and H2; H3 and H4; H5 and H6; and H7 and H8) and the dependent variable, workmanship and productivity (WP). A path coefficient nearing or exceeding 0.5 signifies a substantial effect, while a coefficient around or below 0.1 indicates a smaller effect (Mohamed et al., 2018).

The most impactful hypotheses were H5 and H6, involving disregarding informal training factors (IF) leading to improper workmanship and productivity (WP). A sizeable path coefficient of 0.40 signifies a highly significant relationship, emphasising IF's crucial role in influencing artisans' performance and reinforcing the need to carefully consider all IF indicators during artisan recruitment, aligning with Kikwasi and Escalante's (2018) emphasis on

on addressing skill shortages and Evarist et al.'s (2022) advice on proper recruitment practices.

H1 and H2, concerning disregarding motivational factors (MF) leading to improper workmanship and productivity (WP), followed closely with a path coefficient of 0.30. While slightly lower than IF, it still indicates a significant relationship, underscoring MF's role in driving artisan performance. However, this resonates with Tam and Nguyen's (2018) findings on the impact of distinct salary payment approaches on artisans' motivation and performance.

H7 and H8, involving disregarding qualification factors (QF) leading to improper workmanship and productivity (WP), demonstrated a path coefficient of 0.23. Although smaller than IF and MF, it still holds significance, emphasising the role of qualifications in artisans' performance. It echoes Kikwasi and Escalante's (2018) observations on challenges in understanding construction drawings affecting workmanship.

On the other hand, H3 and H4, which pertain to disregarding formal training factors (FF) that cause improper workmanship and productivity (WP), had a more modest impact with a path coefficient of 0.12. Although statistically significant, FF's influence on artisan performance appeared comparatively limited, which aligns with Kikwasi's (2011) observations that FF alone might not sufficiently address the industry's skill demands, indicating the need for additional on-the-job training. In summary, standardised path coefficients offer insights into each factor's importance in influencing artisans' workmanship and productivity, as shown in Table 9 and Fig. 3.

Table 8
Estimates of Standardised Regression Weights for the Final Structural Model

Construct Code			Estimate	S.E.	C.R.	P-Value
WP	<-	IF	0.370	0.066	5.614	***
WP	<-	QF	0.211	0.063	3.353	***
WP	<-	FF	0.115	0.077	1.495	0.135
WP	<-	MF	0.277	0.082	3.373	***

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

Fig. 3
Standardised Parameter Estimates of Final Structural Model

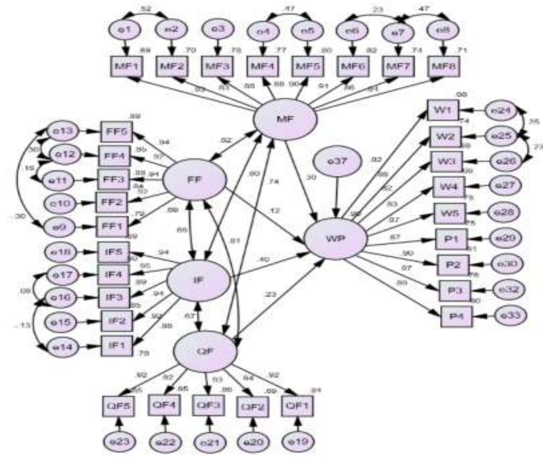


Table 9
Standardised Paths of a Hypothesised Model

Hypothesis	Causal Path	Path Coefficient	P-value
	For External factors		
H1, H2	Disregarding motivational factors (MF) → causes improper workmanship and less productivity achievement (WP) during construction.	0.30	***
H3, H4	Disregarding formal training factors (FF) → causes improper workmanship and less productivity achievement (WP) during construction.	0.12	0.135
H5, H6	Disregarding the informal training factor (IF) → causes improper workmanship and less productivity achievement (WP) during construction.	0.40	***
	For internal factors		
H7, H8	Disregarding qualification factors (QF) → causes improper workmanship and less productivity achievement (WP) during construction.	0.23	***

2.0 Materials and Methods

The quantitative method approach was utilised to validate the developed structural model out-of-sample for different participants (experts) who were not part of the primary study sample. A separate survey questionnaire was designed to assess the elements of the developed structural model. The questionnaire had six parts: qualification factors (QF), formal training factors (FF), motivational factors (MF) and formal training factors (FF). These are the independent variables that affect how well the artisans do their job, and workmanship (W) and productivity (P) are the dependent variables that show how well the artisans do their job in the construction process. To explain the developed model to the respondents, the questionnaire comprised four main sections: background information, introduction to the structural model and its parameter estimates, primary constructs, including attributes and specific validation questions, and general validation questions. A 5-point Likert scale questionnaire was used to obtain responses from the participants, rating the characteristics of the developed SEM from 5 = strongly agree to 1 = strongly disagree for closed questions.

2.1 Sampling Approach

The survey respondents were selected using purposive and chain sampling, which involved a three-stage methodology. Firstly, participants who qualified to validate the model were identified using their education level and professionalism regarding the construction and knowledge of statistical software for data analysis. Secondly, pre-defined criteria were used to determine the initial potential participants. Thirdly, identified respondents were asked for their availability. Lastly, those who agreed to participate were asked to recommend potential colleagues who would also be willing to participate. This sampling method was similar to that used in previous studies by Kavishe (2018) and Luvara (2020). The issues outlined in this section were considered during the research study to ensure internal validity, reliability, and external validity.

3.0 Results and Discussion

This subsection presents the results of the out-of-sample validation process for the structural model. The validation was conducted using structured questionnaires administered to experts or practitioners not involved in developing the model. Their opinions were sought to determine the model's applicability, effectiveness, and adaptability.

3.1 Profile of Survey Respondents

A group of 25 potential experts and practitioners from various African countries, such as Kenya, Uganda, Zimbabwe, and Tanzania, were identified and invited via email to participate in the out-of-sample validation process. Of these, six were from Kenya, four from Uganda, three from Zimbabwe, and twelve from Tanzania, making up 25 participants. Before the questionnaires were sent out, a call for willing participants was made, and all respondents met the criteria outlined in sub-subsection 2.1. The 25 experts and practitioners who agreed to participate were given the validating questionnaires, the developed structural model, and standardised path coefficients to assess. The questionnaires were e-mailed to those in Kenya, Uganda, and Zimbabwe.

In contrast, questionnaires were hand-delivered to those in Tanzania. Even though several reminders were sent to the participants, only 12 (48%) of the questionnaire participants responded. Sekaran and Bougie (2010) portrayed that a response rate of at least 30% is acceptable for surveys. Also, other researchers have submitted that surveys conducted via e-mail usually result in low response rates compared to face-to-face or hand delivery (Osei-Kyei and Chan 2015).

3.2 Demographic Information of the Respondents

As depicted in Table 10, the majority of the respondents, 66.6% (8 of 12), had sufficient knowledge of artisan performance and experience in SEM. 8.3% (1 of 12) respondents had 5–10 years of experience in his expertise, while 41.6% (5 of 12) had 11–15 years of experience, and 50% (6 of 12) had over 15 years of experience. In addition, all respondents possessed a minimum bachelor's degree level of education, of which 33.3% (4 of 12) had master's degree qualifications and 7 58.3% (7 of 12) had a PhD qualification. These findings portray that the respondents had the necessary knowledge and experience, which satisfied and conformed to the criteria set by the researcher and supported by Cheung (2009). Nevertheless, questionnaires administered to participants from Kenya, Uganda, and Zimbabwe were not received, apart from the efforts made by the researcher to increase their stimuli through several reminders. Hence, the researcher proceeded with the returned questionnaires and considered them sufficient, valid, and reliable based on the experiences and knowledge of the respondents and support from the literature.

3.3 Quantitative Validation Results

3.3.1 Rating Primary Constructs' Relationship

Table 11 presents the results of the out-of-sample validation process using a structured questionnaire administered to 25 experts and practitioners from different African countries. The questionnaire asked the respondents to rate the relationships depicted in the developed structural model using a five-point Likert scale and provide a rationale for their responses. The mean scores were calculated, and informal training factors (IF) received the highest rating with a mean score of 4.09, indicating a high influence on the improper performance of artisans when disregarded during construction. Qualification factors (QF) came in second with a mean score of 3.82, and motivational factors (MF) came in third with a mean score of 4.00.

Formal training factors (FF) received the lowest rating, with a mean score of 3.55, indicating an average effect. The results suggest that informal training and motivational factors play a significant role in improving the performance of artisans in construction, while formal training factors have less pronounced effects.

Table 10
Profile of Survey Respondents

No	Country	Current Position	Sector	Years of Experience	Education Level	Professional Background	Knowledge of Artisans' Performance	Knowledge of and Experience with Structural Models
1	Tanzania	Consultant	Private	11-15	BSc	Quantity Surveying	Yes	No
2	Tanzania	Researcher/Lecturer	Public University	11-15	PhD	Construction Management	Yes	Yes
3	Tanzania	Chief Executive Officer	Public	Over 15	PhD	Civil Engineering	Yes	Yes
4	Tanzania	Researcher/Lecturer	Private University	Over 15	PhD	Quantity Surveying	Yes	No
5	Tanzania	Quality Expert	Private	11-15	MSc	Civil Engineering	Yes	Yes
6	Tanzania	Consultant	Private	Over 15	MSc	Quantity Surveying	Yes	No
7	Tanzania	Researcher/Lecturer	Public University	Over 15	PhD	Quantity Surveying	Yes	Yes
8	Tanzania	Researcher And Consultant	Public University	11-15	MSc	SEM Expert/Computer Science	Yes	Yes
9	Tanzania	Researcher/Lecturer	Public University	Over 15	PhD	Architecture	Yes	Yes
10	Tanzania	Researcher/Lecturer	Public University	Over 15	PhD	SEM Expert/Economics	Yes	Yes
11	Tanzania	Researcher/Lecturer	Public University	5-10	PhD	Quantity Surveying	Yes	Yes
12	Tanzania	Project Manager	Public	11-15	MSc	Civil Engineering	Yes	No

Table 11

Results of Validation from the Questionnaire Survey

Model factors	Validation criteria	Respondents												Mean
		1	2	3	4	5	6	7	8	9	10	11	12	
Motivations	Disregarding motivational factors (MF) for artisans' performance influences improper workmanship and productivity performance during construction as per specification for building construction activities.	4	4	5	3	4	4	5	3	3	3	5	5	4.00
Formal training	Disregarding formal training factors (FF) in recruitment for artisans influencing improper performance on workmanship during the construction process as per specification for building construction activities.	5	4	4	3	4	4	3	4	2	4	4	3	3.55
Informal training	Disregarding an informal training factor (IF) in recruitment for artisans influencing improper performance on workmanship and productivity during the construction process as per specification for building construction activities	4	4	4	3	5	4	4	4	4	4	4	5	4.09
Qualifications	Disregarding qualification factors (QF) in recruitment for artisans influences improper workmanship and productivity performance during construction as per specification for building construction activities.	4	4	4	3	4	4	4	4	4	4	4	3	3.82

Note: Mean > 3 (High effect); Mean =3 (average effect); Mean < 3 (low effects)

3.3.2 Overall Applicability of the Structural Model

The study used three questions to evaluate the structural model's applicability, effectiveness, and adaptability. Table 12 shows that the mean scores for the model's applicability, effectiveness, and adaptability were 4.00, 3.55, and 3.45, respectively. These scores are considered high, indicating that the construct depicted in the model is highly applicable. The cutoff value set for this study was greater than 3, which was met or exceeded by all three measures, further supporting the model's validity.

Table 12

Results of Overall Applicability of the Structural Model

Validation criteria	Respondents												Mean
	1	2	3	4	5	6	7	8	9	10	11	12	
Applicability	4	3	3	4	5	3	5	4	3	5	5	4	4.00
Effectiveness	4	2	4	3	3	2	5	4	3	5	4	4	3.55
Adaptability	3	1	3	3	4	2	5	4	2	5	4	5	3.45

3.3.3 The Recommendations Obtained from the Questionnaire Survey

This section reports on the feedback obtained from the respondents regarding the developed structural model. Respondents were asked three questions about the model's deficiencies, benefits, and suggestions for improvement. Only one respondent expressed concern about the model's hypothesis being rejected due to the small effect size. However, the respondent concluded that the model had achieved its objective and did not require further improvement. Other respondents did not identify any significant deficiencies or areas for improvement. Respondents said that the benefits included being able to see how the many factors that affect artisans' work interact with each other and using qualitative variables to find connections between them. Additionally, respondents noted that the model could be adapted to other developing countries with similar economies to Tanzania.

4.0 Conclusion and Recommendation

The study's primary contribution is to emphasise the importance of considering influencing factors (IFs) in construction projects and identifying the impact of disregarding them on the performance of artisans. The study found that failing to account for IFs can significantly impact the performance of artisans in construction projects, specifically in terms of workmanship and productivity. Therefore, it is crucial to incorporate IFs in the construction process to improve project outcomes. The study develops a structural model that can be used to capture the complex interplay of factors affecting artisan performance. The model uses qualitative variables to establish relationships among variables, providing a framework for understanding the interdependencies of different factors and their impact on performance. Employers and supervisors can use this model to identify the IFs most relevant to their projects and develop strategies to address them. By addressing these IFs, employers can improve workmanship, productivity, and overall project performance.

The study's findings have significant repercussions for the construction industry, particularly in terms of evaluating and enhancing project performance in relation to artisan-performed construction activities. The findings can guide the development of interventions to enhance artisan performance in construction projects. Therefore, future research should investigate the interrelationships among other essential IFs, such as plant and equipment, experience, materials, supervision, site conditions, and behaviours. Additionally, it is necessary to investigate the extent to which IFs are inadequately performed in current practice.

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7.0 Reference

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Appendix

A.1

The Value of Mean, Correlation, and Cronbach Alpha

Code	Constructs / observed variables	Means	Corrected Item-Total Correlation	Cronbach's Alpha
MF	**Motivational factor**	**3.01**		**0.901**
MF1	Offering food allowance	3.06	0.877	
MF2	Offering transport allowance	3.05	0.862	
MF3	Offering drinking water	2.97	0.903	
MF4	Make a payment of wages daily	3.04	0.874	
MF5	Make a payment of wages weekly	3.01	0.901	
MF6	Make a payment of wages monthly	2.99	0.905	
MF7	Provide a permanent contract	2.97	0.890	
MF8	Provide a temporal contract	2.98	0.870	
FF	**Formal training factors**	**2.97**		**0.973**
FF1	Employ them based on acquiring vocational skills from formal methods of training	3.01	0.892	
FF2	Before engaging works, ask them if they know how to read and interpret the drawings	2.97	0.922	
FF3	Before engaging in work, ask them if they attend practical training	2.97	0.937	
FF4	Employ them based on acquiring internship training after graduation	2.97	0.924	
FF5	Before engaging in work, ask them if they properly completed the vocational training	2.95	0.933	
IF	**Informal training factors**	**3.06**		**0.980**
IF1	Employ them based on acquiring vocational skills through an apprenticeship approach	3.10	0.913	
IF2	Employ them based on consideration of only one specialisation skill	3.07	0.943	
IF3	Before engaging works, ask them if they know how to use current tools and equipment for the construction process	3.05	0.954	
IF4	Employ them based on acquiring internship training after qualification	3.02	0.956	
IF5	Employ them based on having certifications from the government	3.06	0.941	

QF	**Qualifications factors**	**3.04**		**0.810**
QF1	Employ them due to their level of vocational skills for construction activities from the recognised training centre	3.05	0.918	
QF2	Employ them due to having vocational skills certificates from the recognised training centre	3.05	0.951	
QF3	Employ them based on work experience	3.08	0.917	
QF4	Employ them due to have self-management skills at the site	3.03	0.927	
QF5	Before engaging in work, ask them if they have teamwork skills for construction activities at the site	2.99	0.935	
W	**Workmanship for constructed blockwork walling**	**2.94**		**0.870**
W1	Non-alignment and evenness achieved on constructed walling	3.00	0.906	
W2	Availability of cracks and damages on constructed walling	2.94	0.929	
W3	Sign of hollowness and delamination on constructed walling	2.94	0.917	
W4	Non-joints aligned and with no consistent size to constructed walling	2.92	0.908	
W5	Unsatisfactory general finishes outlook achieved on constructed walling	2.91	0.912	
P	**Productivity for construction activities**	**2.98**		**0.971**
P1	Achievement of 1.35 m^2 per hour for 230 mm thick blockwork walling	3.00	0.913	
P2	Achievement of 4.68 m^2 per hour for preparing and applying 15 mm thick plastering on walling	3.00	0.925	
P3	Achievement of 1.88 m^2 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	0.932	
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	0.940	