The Impact of Unskilled Labor on Project Performance

(An Empirical Study on Construction Companies in Yemen)

Iskander H. A. Sattar [1,*]
Fatima Iqbal Khudabakhsh Wazir [1]

Received: 18 August 2025
Revised: 06 October 2025
Accepted: 07 October 2025

[1] Department of Business Administration Section, Faculty of Administrative, Sciences, University of Science and Technology – Aden, Yemen
* Corresponding author. E-mail: i.abdulsattar@aden.ust.edu

The Impact of Unskilled Labor on Project Performance (An Empirical Study on Construction Companies in Yemen)

Abstract:

A scarcity of skilled labor can have a substantial impact on project performance; the problem of unskilled labor performance is one of the critical components of labor construction performance that must be addressed in order for construction companies to execute successful projects. This study adopted a quantitative method approach and utilized a descriptive and explanatory research design. The total population for this study was 900 employees.

Krejcie and Morgan's's (1970) table wastable was applied for determining the sample size, and based on the total population (900), the sample size for this study is 269. The study's objectives were met by distributing a structured quantitative questionnaire to 269 respondents from construction companies, including project managers, engineers, laborers, supervisors, and contractors. The response rate was 100%. Cronbach's alpha isalpha is used to measure reliability and ensure consistent results. The findings indicate that lack of training inefficiently adversely impacts project performance. The study noticed that a lack of construction knowledge, workmanship, and experience did not independently predict project performance, their impact could be mitigated by results that include rework rates, productivity levels and overall task completion.

Keywords: *unskilled labors, project performance, construction companies, construction projects, skill gaps, rework, project delays, cost overruns.*

أثر العمالة الغير ماهرة على أداء المشروع: دراسة على شركات المقاولات في اليمن

إسكندر حسن عبد الستار [1،*]
فاطمة اقبال خدابخش وزير [1]

الملخص:

يمكن أن يكون لندرة العمالة الماهرة تأثير كبير على أداء المشروع؛ وتعد مشكلة أداء العمالة غير الماهرة أحد المكونات الأساسية لأداء عمالة البناء التي يجب معالجتها حتى تتمكن شركات البناء من تنفيذ مشاريع ناجحة. اعتمدت هذه الدراسة على منهج كمي واستخدمت تصميم بحث وصفي وتوضيحي. بلغ إجمالي عدد السكان لهذه الدراسة 900 موظف. تم تطبيق جدول Krejcie and Morgan (1970) لتحديد حجم العينة المناسب، وبناءً على إجمالي عدد السكان (900)، فإن حجم العينة المناسب لهذه الدراسة هو 269. تم تحقيق أهداف الدراسة من خلال توزيع استبيان كمي منظم على 269 مستجيباً من شركات البناء، بما في ذلك مديري المشاريع والمهندسين والعمال والمشرفين والمقاولين. كان معدل الاستجابة 100٪. تم استخدام ألفا كرونباخ لقياس الموثوقية وضمان اتساق النتائج. تشير النتائج إلى أن نقص التدريب يؤثر سلباً بشكل كبير على أداء المشروع. حدد التحليل بشكل قاطع أن نقص التدريب هو أهم مؤشر سلبي مباشر لأداء المشروع. وفي حين لاحظت الدراسة أن الافتقار إلى المعرفة والمهارة والخبرة في مجال البناء لا يتنبأ بشكل مستقل بأداء المشروع، فإن تأثيرها يمكن التخفيف منه من خلال نتائج وظيفية أكثر مباشرة تشمل معدلات إعادة العمل ومستويات الإنتاجية وحوادث السلامة وإكمال المهمة بشكل عام.

الكلمات المفتاحية: : ***العمالة غير الماهرة، أداء المشروع، شركات البناء، مشاريع البناء، فجوات المهارات، إعادة العمل، تأخيرات المشروع، تجاوز التكاليف.***

[1] قسم إدارة الاعمال ، كلية العلوم الإدارية - جامعة العلوم و التكنولوجيا، عدن، اليمن
[*] عنوان المراسلة: i.abdulsattar@aden.ust.edu

Study Background :

The construction industry's performance is closely tied to worker skills. Skilled labor boosts productivity, safety, and timely delivery, while unskilled labor often causes delays, cost overruns, and quality issues. Education, training, and experience are key to improving labor effectiveness. This study presents a framework to assess unskilled labor's impact on project performance in Yemen's public construction sector, stressing the importance of vocational training and proper recruitment. It aims to provide evidence and recommendations to enhance labor competencies for better construction outcomes.

Problem Statement:

Labor skills are essential to the success of small and medium construction projects, with performance being critical across all project sizes. In many developing countries, a lack of training and experience among low-skilled workers leads to delays, increased costs, and poor outcomes. While skilled and knowledgeable workers improve performance, low labor productivity remains a major barrier to business and economic growth. Previous studies have mostly ignored the specific role of unskilled labor. This study aims to fill that gap by examining its impact on project performance in construction firms in Aden, Yemen.

Study Objectives:

The main objective in this study is

To analyze the significant impact of unskilled laborers on PP.

The sub-objectives of the study are:

1. To identify the significant impact of lack of training on PP.
2. To explore the significant impact of lack of construction knowledge on PP.
3. To identify the significant impact of lack of workmanship on PP.
4. To analyze the significant impact of lack of construction experience on PP.

Study Questions:

The aim of this study is in particular to clarify the question of how unskilled personnel affect project performance. The following study questions were investigated:

The main question in the study is:

Do unskilled laborers have a significant impact on PP?

The sub-questions in the study are:

1. Does lack of training have a significant impact on PP?
2. Does lack of construction knowledge have a significant impact on PP?
3. Does lack of workmanship have a significant impact on PP?
4. Does lack of construction experience have a significant impact on PP?

Significance of the Study:

This study highlights the impact of unskilled labor on construction project performance and urges further research. It guides firms and consultants on selecting qualified, cost-effective labor to improve outcomes. The research involves 900 workers from four companies across residential and commercial projects. The study involves multiple construction companies—Electromicha, Zasco, Noor Aden, and Yemeni Construction—focusing on both residential and commercial projects. The total workforce across these companies is 900, including administrative staff, managers, engineers, and contractors.

Literature Review:

This section provides a literature review of various studies on construction project implementation. This includes a theoretical overview, a conceptual framework, an empirical review of the relevant study for the topic, and a summary.

Unskilled Labor:

Unskilled labor in construction consists of low-paying, low-security manual jobs needing minimal training. Poor performance often stems from weak supervision and management. Although construction methods are traditional, unskilled workers adapt quickly to new technologies (Sommerville, 2007; Noe, 2010).

Project Performance:

This study finds that unskilled labor negatively affects project performance in design-build construction, causing delays, cost overruns, safety risks, and poor quality. Aging workers, lack of training, and poor recruitment worsen these issues. Improving performance requires skilled labor, effective training, leadership, and better planning (Norman & Binka, 2015).

Lack of Training:

Training equips employees with the knowledge, skills, and behaviors necessary for effective job performance. It improves productivity, workforce development, and organizational performance (Olaniyan & Ojo, 2008; Khan et al., 2011).

Lack of Construction Knowledge:

Knowledge is crucial in construction for efficient execution and informed decision-making. Knowledge management helps capture experience and improve outcomes through better learning and project planning (Norman & Binka, 2015).

Lack of Workmanship:

Artistry in construction is debated: Pye defines it as quality of execution, while Risatti focuses on the maker's skill. Concrete quality relies on materials and worker skill. Most building failures result from human errors, particularly poor workmanship, harming quality and reputation.

Lack of Construction Experience:

While skilled workers meet national standards, weak enforcement of regulations has led to a shortage of these workers in construction.

Study Conceptual Framework:

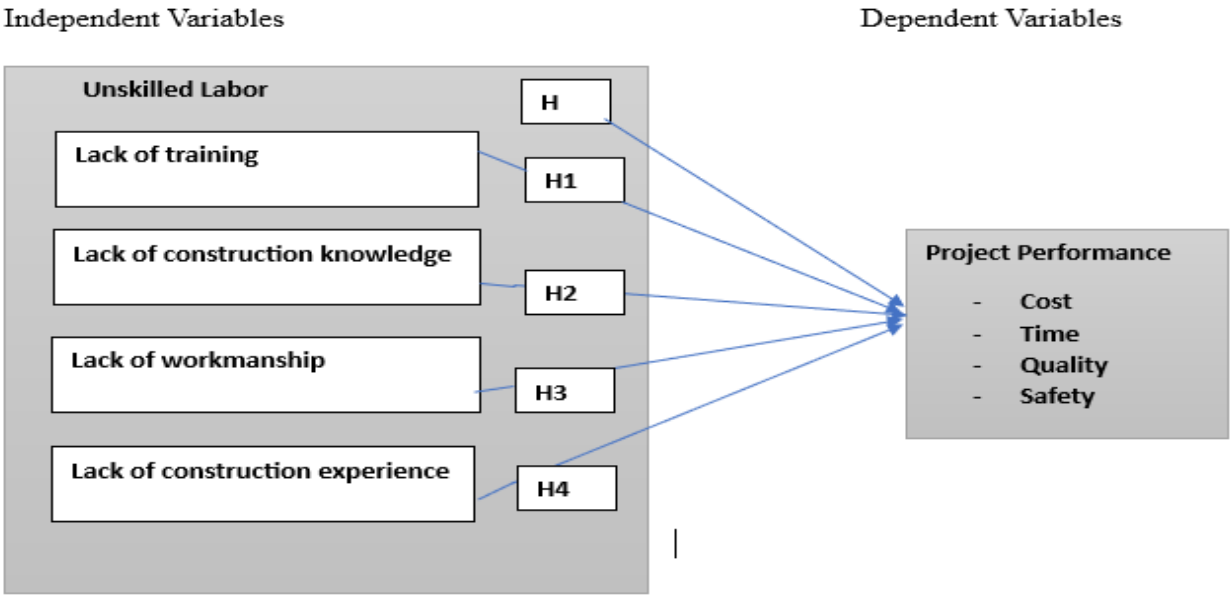

Figure 1. Conceptual framework.

Source: Prepared by the Researchers in reference with the previous literature.

Study Hypotheses:

Studies recognize the importance of workers in construction performance, but the impact of unskilled labor on infrastructure projects is often overlooked. To address this gap, the study proposes relevant hypotheses for a comprehensive analysis.

H: Unskilled labors is significantly associated with PP.

H1: Lack of training is significantly associated with project PP.

H2: Lack of construction knowledge is significantly associated with PP.

H3: Poor workmanship is significantly associated with PP.

H4: Lack of construction experience is significantly associated with PP.

STUDY METHODOLOGY

This part details the quantitative study methods used, focusing on the questionnaire as the data collection instrument. It acknowledges potential downsides of surveys. The aim is to analyze the correlation between unskilled labor and project performance in construction, outlining the strategies for data collection and analysis to test the hypothesis. Ethical approval was obtained from the university's concerned department prior to data collection. All participants received a detailed information sheet. Participation was voluntary, and respondents were assured of anonymity and confidentiality. Data was stored securely and only accessible to the research-concerned members.

Study Population and Sampling

Study Population

The population of this study is the top managers, supervisors, civil and architecture engineers, and contractors at Zasco, Noor Aden, and Electromecha construction companies in Aden, with a total of 900 concerned employees. For this study, projects during the year of 2024 were taken based on data availability in the construction management unit.

Sample Size

Using the Krejcie and Morgan (1970) table, a population of 900 required a sample size of 269. The researchers distributed questionnaires to all employees and collected exactly 269 completed responses, meeting the target sample size.

Instrumentation Applied

The researchers custom-designed a questionnaire for this study because existing online resources lacked relevant content, frameworks, or variables. The design was refined based on expert feedback. It employed a five-point Likert scale (1=strongly disagree to 5=strongly agree) to measure key variables. The study considered the following measurement:

- Project Performance Items Measurement
- Lack of Training Items Measurement
- Lack of Knowledge in Construction Project Item Measurement
- Lack of Workmanship Items Measurement
- Lack of Experience in Construction Items Measurement

Data Collection:

Data was collected from both primary and secondary sources. Secondary data came from existing literature, while primary data was gathered through a Google Forms questionnaire. Researchers contacted respondents directly, promoting honest responses and enabling quick, efficient data collection.

DATA ANALYSIS

Table 1. Normality Assessment

	Skewness		Kurtosis	
	Statistic	Std. Error	Statistic	Std. Error
Project Performance	-1.277-	.149	1.191	.296
Lack of Training	-1.081-	.149	.844	.296
Lack of Knowledge	-.886-	.149	.104	.296
Lack of Workmanship	-.762-	.149	-.281-	.296
Lack of Experience in construction	-.814-	.149	-.322-	.296
Unskilled Labor	-1.068-	.149	.069	.296

Table 1 shows all constructs are within the acceptable skewness range (-2 to +2), indicating general normality. Project Performance (-1.277, 1.191) and Lack of Training (-1.081, 0.844) are slightly left-skewed; Lack of Knowledge (-0.886, 0.104) is near normal; Lack of Workmanship (-0.762, -0.281) and Lack of Experience (-0.814, -0.322) are mildly skewed/flat; and Unskilled Labor (-1.068, 0.069) is near normal. Thus, data is valid for further analysis.

Sample Profile

A survey questionnaire was issued to 269 employees of construction companies. The current study got 269 questionnaires, all of which were legitimate. As a result, the overall response rate was 100 percent. The respondents' characteristics explored in the following subsections using frequency analysis.

Table 2. Gender Frequency

Gender		
	N	%
Female	45	16.7%
Male	224	83.3%

As displayed in Table (4.2), the sample characteristics related to gender reveal a clear distribution among participants. Out of 269 respondents, 45 (16.7%) are female, while 224 (83.3%) are male. The lower percentage of females is due to the type and characteristics of the construction work limitation.

Table 3. Age Frequency

Age		
	N	%
20-30	25	9.3%
31-45	161	59.9%
≥46	83	30.9%

As shown in Table (4.2.2), the age distribution of the sample shows a diverse range of participants. Among the 269 respondents, 9.3% are aged between 20 and

30 years, 59.9% fall within the 31 to 45-year age group, and 30.9% are aged 46 years and older.

Table 4. Education Level Frequency

Education Level		
	N	%
Bachelor	159	59.1%
Diploma	26	9.7%
Master	57	21.2%
PhD	25	9.3%
Secondary	2	0.7%

Table (4) shows that the education level distribution among the sample illustrates a range of qualifications among the respondents. Of the 269 participants, 59.1% hold a bachelor's degree, 9.7% have a diploma, 21.2% possess a master's degree, and 9.3% have completed their PhD. Additionally, a small percentage, 0.7%, have only completed secondary education.

Table 5. Position Frequency

Position		
	N	%
Contractor	28	10.4%
Engineer	170	63.2%
Supervisor	44	16.4%
Top Management	27	10.0%

Table (5) shows that the distribution of positions among the respondents highlights the roles within the sample. Out of 269 participants, 10.4% are contractors, 63.2% are engineers, 16.4% hold the position of supervisor, and 10.0% are in top management.

Table 6. Experience Frequency

Experience		
	N	%
≤1	2	0.7%
2-5	19	7.1%
6-10	81	30.1%
>10	167	62.1%

As shown in Table (6), the experience distribution among the respondents shows a wide range of work backgrounds. Among the 269 participants, 0.7% have 1 year or less of experience, 7.1% have 2 to 5 years, 30.1% possess 6 to 10 years, and a significant majority, 62.1%, have more than 10 years of experience.

Table 7. Descriptive Statistics

Average range	Label
1-1.8	Very Low
1.8-2.6	Low
2.6-3.4	Moderate
3.4-4.2	High
4.2-5	Very High

Descriptive Statistics of Project Performance

Table 8. Descriptive Statistics of PP

No	Item	Mean	SD	RII	Label
1	PP1	3.930	0.931	78.6%	High
2	PP2	3.860	0.984	77.2%	High
3	PP3	3.780	1.037	75.6%	High
4	PP4	3.880	0.987	77.6%	High
5	PP5	3.910	0.906	78.2%	High
e	Project Performance	3.870	0.708	77.4%	High

Table 8 shows that the study sample generally perceives project performance as high, with an overall mean score of 3.870 (σ=0.708). PP1 received the highest perception of performance (mean = 3.930, σ=0.931), while PP3 had the lowest rating (mean = 3.780, σ=1.037).

Table 9. Dimensions of Unskilled labor

	Mean	SD	RII	Label
Lack of Training	3.8327	0.7143	76.7%	High
Lack of Knowledge	3.7375	0.7752	74.8%	High
Lack of Workmanship	3.6796	0.7312	73.6%	High
Lack of Experience in construction	3.7056	0.7556	74.1%	High
Unskilled Labor	3.7388	0.6480	74.8%	High

Unskilled labor issues are rated high (overall mean = 3.74, σ = 0.65). The top concern is lack of training (3.83, σ = 0.71), followed by lack of experience (3.71), lack of knowledge (3.74), and lack of workmanship (3.68). All dimensions indicate a strong need for workforce improvement.

Descriptive Statistics of Lack of Training

Table 10. Descriptive Statistics of LT

No	Item	Mean	SD	RII	Label
1	LT1	3.880	0.929	77.6%	High
2	LT2	3.740	1.058	74.8%	High
3	LT3	3.930	0.940	78.6%	High
4	LT4	3.900	0.921	78.0%	High
5	LT5	3.710	1.040	74.2%	High
	Lack of Training	3.833	0.714	76.7%	High

Table 10 shows Lack of Training is rated high (mean = 3.833, σ = 0.714). LT3 is the top concern (mean = 3.930, σ = 0.940), while LT5 ranks lowest (mean = 3.710, σ = 1.040).

Descriptive Statistics of Lack of Construction Knowledge

Table 11. Descriptive Statistics of LCK

No	Item	Mean	SD	RII	Label
1	LK1	3.720	1.003	74.4%	High
2	LK2	3.750	0.964	75.0%	High
3	LK3	3.670	1.032	73.4%	High
4	LK4	3.750	1.003	75.0%	High
5	LK5	3.790	0.964	75.8%	High
e	Lack of Knowledge	3.738	0.775	74.8%	High

Table 11 indicates lack of knowledge is rated high (mean = 3.736, SD = 0.957). LK5 ranks highest (mean = 3.790, SD = 0.964), while LK3 ranks lowest (mean = 3.670, SD = 1.032).

Table 4.11 shows lack of knowledge is perceived as high (mean = 3.738, SD = 0.775). LK5 is the highest concern (mean = 3.790, SD = 0.964), while LK3 is the lowest (mean = 3.670, SD = 1.032).

Descriptive Statistics of Lack of Workmanship

Table 12. Descriptive Statistics of LW

No	Item	Mean	SD	RII	Label
1	LW1	3.680	0.943	73.6%	High
2	LW2	3.580	0.938	71.6%	High
3	LW3	3.760	0.960	75.2%	High
4	LW4	3.700	0.966	74.0%	High
5	LW5	3.680	0.994	73.6%	High
p	Lack of Workmanship	3.680	0.731	73.6%	High

Table 12 shows lack of workmanship is rated high (mean = 3.680, SD = 0.731). LW3 ranks highest (mean = 3.760, SD = 0.960), indicating it is the main concern. Conversely, LW2 ranks the lowest, with a mean of 3.580 and a standard deviation of 0.938, indicating that it received comparatively lower ratings.

Lack of Experience in Construction

Table 13. Descriptive Statistics of LEC

No	Item	Mean	SD	RII	Label
1	LE1	3.710	0.961	74.2%	High
2	LE2	3.670	1.015	73.4%	High
3	LE3	3.630	0.971	72.6%	High
4	LE4	3.700	1.012	74.0%	High
5	LE5	3.820	0.993	76.4%	High
	Lack of Experience in construction	3.706	0.756	74.1%	High

Respondents generally perceive a high lack of experience in construction, with an overall mean score of 3.706. The item with the highest concern is LE5 (mean: 3.820), while the lowest is LE3 (mean: 3.630).

Hypothesis Testing

Testing the main hypothesis of the study:

H1: Unskilled labor is significantly associated with project performance.

Table 14. Model Summary[b]

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.411a	.169	.166	.64668

a. Predictors: (Constant), Unskilled Labor

b. Dependent Variable: Project Performance

The Model Summary shows a moderate negative correlation (R = 0.411) between unskilled labor and project performance. An R-squared value of 0.169 indicates that 16.9% of the variation in project performance is explained by unskilled labor, highlighting its impact while suggesting other factors also contribute significantly.

Testing sub-hypotheses

H1: Lack of training is significantly associated with project performance.

H2: Lack of construction knowledge is significantly associated with project performance.

H3: Lack of workmanship is significantly associated with project performance.

H4: Lack of construction experience is significantly associated with project performance.

The regression analysis results for testing the sub-hypotheses offer a detailed view of how each predictor—lack of training, knowledge, workmanship, and experience— affects the project performance.

Table 15. Model Summary[b]

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.479a	.229	.218	.62627

a. Predictors: (Constant), LEC, LT, LK, LW.

b. Dependent Variable: Project Performance

Unskilled labor has a moderate negative correlation with project performance (R=0.411), meaning as one increases, the other tends to decrease. The level of unskilled labor accounts for 16.9% of the variability in project performance (R^2=0.169).

DISCUSSION

Recapitulation of the Study

This study investigated the impact of work competencies and frameworks on project performance within Aden's construction sector, where the workforce is primarily unskilled. Based on a sample of 269 employees from a total population of 900, the findings provide empirical evidence. The analysis revealed a negative correlation between project performance and various dimensions of unskilled labor. Specifically, lack of training had the strongest negative correlation ($r = -0.468$), indicating that as training deficiencies rise, project performance tends to fall. Similarly, lack of knowledge ($r = -0.354$), poor workmanship ($r = -0.309$), and insufficient construction experience ($r = -0.305$) all correlated negatively with project performance, suggesting these gaps contribute to lower project outcomes.

The findings reveal a significant negative impact of unskilled labor on project performance. Specifically, the regression analysis shows that unskilled labor is negatively correlated with project performance ($B = 0.449$, $t = -7.369$, $p < 0.001$). This means that for every unit increase in unskilled labor, project output is expected to decrease by 0.449 units, confirming the study's main hypothesis.

Examining the coefficients table provides insights into the individual contributions of each predictor variable:

Q1: Does unskilled labor have a significant impact on project performance?

In order to answer Question 1, the study's main hypothesis was developed, which assumes that (H) unskilled labor has a significant negative impact on project performance ($B = -0.449$, $p < 0.001$), supporting the study's main hypothesis.

Q2: Does lack of training have a significant impact on project performance?

In order to answer Question 2, Study hypothesis one was developed, which assumes that (H1) lack of training significantly harms project performance, as shown by a coefficient of -0.393 and a statistically significant p-value (<.001).

Q3: Does lack of knowledge have a significant impact on project performance?

In order to answer Question 3, study hypothesis two was developed, which assumes that (H2) lack of knowledge doesn't significantly impact project performance on its own in this model ($B=-0.115$, $p=.217$). This suggests that having knowledge is not enough and must be applied effectively to improve outcomes.

Q4: Does lack of workmanship have a significant impact on project performance?

In order to answer Question 4, Study hypothesis three was developed, which assumes that (H3) lack of workmanship doesn't significantly impact project

performance (B=0.005, p=.960). This indicates that, within this study's context, variations in workmanship quality do not independently affect project outcomes.

Q5: Does lack of experience have a significant impact on project performance?

In order to answer Question 5, Study hypothesis four was developed, which assumes that (H4) lack of experience in construction does not have a significant impact on project performance (B=−0.003, p=.978). This suggests that a lack of experience alone does not meaningfully affect project outcomes.

Conclusion

This study aims to examine the impact of unskilled labor (lack of training, lack of construction knowledge, lack of quality craftsmanship, and lack of construction experience) and project performance among private construction companies in Aden, Yemen. All 269 employees of the company received this study questionnaire to examine the influence of unskilled work and project performance based on their personal evaluations and to measure the extent to which these characteristics actually affect employees' JP. The response rate is 100%. The reliability results range of the online questionnaire is between .780 and .839, so the Cronbach's alpha of all the variables is 80%. The study used time horizon one-shot cross-sectional study data collected once to answer the study questions. The study has four hypotheses, as follows:

H: Unskilled labor is significantly associated with project performance.

H1: Lack of training is significantly associated with project performance.

H2: Lack of construction knowledge is significantly associated with project performance.

H3: Lack of workmanship is significantly associated with project performance.

H4: Lack of construction experience is significantly associated with project performance.

The first independent variable, lack of training, has a significant negative effect on project performance. This means a higher lack of training is strongly associated with reduced project performance. This factor stands out as the primary influence on performance.

The second independent variable, lack of knowledge, does not independently predict project performance. Although there is a slight negative relationship, the high p-value suggests that this variable does not significantly influence performance.

The third independent variable, lack of workmanship, shows no significant impact on project performance, indicating that variations in workmanship quality do not, independently, contribute to changes in project performance.

The fourth independent variable, lack of experience in construction, does not show a meaningful effect on project performance alone and does not significantly affect project outcomes.

Recommendations

This thesis studied unskilled labor's impact on Aden's construction projects, finding lack of training as the main cause of delays, rework, and poor quality that harm performance. Other factors like knowledge and experience affect outcomes indirectly through issues like rework and productivity. As a result, the major recommendation for construction companies in Aden is to prioritize and substantially invest in comprehensive training programs for their workforce. Furthermore, future studies should delve deeper into the specific mediating roles of these operational outcomes to fully elucidate how factors like construction knowledge, workmanship, and experience indirectly affect overall project success.

Future Study

The current study suggests that additional studies should focus on the key factors influencing project performance in construction projects. New factors or variables must be taken into future studies, including rework rates, productivity levels, safety incidents, and overall task completion. A comparable study ought to be performed to confirm the findings of this study by gathering data from unskilled workers on construction sites. Moreover, further investigation should explore the motivational impacts of training in enhancing the performance of unskilled workers at construction sites.

References:

Abbasi, S., et al. (2020) Perceptions of students regarding e-learning during Covid-19 at a private medical college. *Pakistan Journal of Medical Science, 36*, S57-S61.

https://doi.org/10.12669/pjms.36.COVID19-S4.2766

Aguinis, H., & Kraiger, K., (2009). Benefits of training and development for individuals and teams, organizations, and society. *Annual Review of Psychology, 60*, 451–474.

Al-Ghassani, A. M., Robinson, H. S, Carrillo, P. M., & Anumba, C. J. (2004). Developing a business case for knowledge management: The impact approach, *Construction Management and Economics, Taylor & Francis Journals, 22*(7), 733-743.

Allen, J., & Van der Velden, R. (2001). *Educational mismatches versus skill mismatches: Effects on wages, job satisfaction, and on-the-job search.* Oxford Economic Papers, 53, 434-452. https://doi.org/10.1093/oep/53.3.434

Arditi, D., Member, ASCE., & Gunaydin, H. M. (1998). Factors that affect process quality in the life cycle of building projects. *Journal of Construction Engineering and Management, 124*(3). https://doi.org/10.1061/(ASCE)0733-9364(1998)124:3(194)

Atkinson, A. R. (1999). The role of human error in construction defects. *Structural Survey, 17*(4), 231–236.

Assaf, S. A., & Al-Hejji, S. (2006). Causes of delay in large construction projects. *International Journal of Project Management 24*(4):349-357. DOI:10.1016/j.ijproman.2005.11.010

Au-Yong, C. P., Ali, A. S., & Ahmad, F. (2013). Office building maintenance: Cost prediction model. *Građevinar, 65*(9), 803–809.

Awwal, M. I. (2014). Importance of strategic aspect in project management: A literature critique.*, 3*(4).

Bheemaiah, K., & Smith, M. J. (2015). *Inequality, technology and job polarization of the youth labor market in Europe.* https://ssrn.com/abstract=2615605

Chang-Richards, Y., Wilkinson, S., Seville, E., & Brunsdon, D. (2017). Effects of a major disaster on skills shortages in the construction industry: Lessons learned from New Zealand. *Engineering, Construction and Architectural Management, 24*(1), 2–20.

Chan, P. W. M., & Kaka, A., (2007). Productivity improvements: Understand the workforce perceptions of productivity first. *Personnel Review, 36*(4), 564

Chan, D. W. M., & Kumaraswamy, M. M. (2002). Compressing construction durations: Lessons learned from Hong Kong building projects. *International Journal of Project Management 20*(1):23-35. DOI:10.1016/S0263-7863(00)00032-6

Chatterjee, S. (2013). Simple rules for designing business models. *California Management Review, 55*, 97-124. https://doi.org/10.1525/cmr.2013.55.2.97

Collis, J., & Hussey. R. (2014). *Business Study: A practical guide for undergraduate and postgraduate students.4th Ed*, Palgrave Macmillan ISBN: 978-0-230-30183-2

Creswell, J. W., & Creswell, J. D. (2018). *Study design: Qualitative, quantitative, and mixed methods approaches.* Los Angeles: Sage.

Cserháti, G., & Szabó, L. (2014). The relationship between success criteria and success factors in organisational event projects. *International Journal of Project Management, 32*(4), 613–624.

Cullen, K., & Parker, D. W. (2015), Improving performance in project-based management: synthesizing strategic theories. *International Journal of Productivity and Performance Management, 64*(5), 608 - 624

Dainty, A., Moore, D., & Murray, M. (2006). *Communication in construction theory and practice.* Wikipedia, p.4.

Danso, H., (2014). Poor workmanship and lack of plant / equipment problems in the construction industry in Kumasi, Ghana. *International Journal of Management Study, 2*(3), 60–70.

Davenport, T. H., & Prusak, L. (1998). *Working knowledge: How organizations manage what they know*. Boston: Harvard Business School Press.

De Grip, A., & Sauermann, J. (2011). The effects of training on own and co-worker productivity: Evidence from a field experiment. *The Economic Journal,122*(560), 376–399.

Demirkesen, S., & Ozorhon, B. (2017). Impact of integration management on construction project management performance. *International Journal of Project Management, 35*(8), 1639–1654.

Drucker, P. (1999). Knowledge worker productivity: The biggest challenge. *California Management Review, 41*, 79- 94.

Easton, G., & Rosenzweig, E. D. (2004). The role of experience in six Sigma project success: An empirical analysis of improvement projects. *Journal of Operations Management 30*(7-8): 481-493. DOI:10.1016/j.jom.2012.08.002

El-Gohary, K. M., & Aziz, R. F. (2014). Factors influencing construction labor productivity in Egypt. *Journal of Management in Engineering, 30*(1), 1–9.

El Khouly, H. Rushdi, M., & Abdel-Magied, R. K. F. (2017). Eco-friendly date-seed nanofillers for polyethylene terephthalate composite reinforcement. *IOP Publishing Materials Study Express, February 20207*(2). DOI:10.1088/2053-1591/ab6daa

Fagbenle, O. I. (2011). Factor affecting the performance of labour in Nigerian construction sites. *Mediterranean Journal of Social Sciences, 2*(2), 251–257.

Faraj, S., & Sproull, L. (2000) Coordinating expertise in software development teams. *Management Science, 46*, 1554-1568. http://dx.doi.org/10.1287/mnsc.46.12.1554.12072

Frank, G., & Sarstedt, M. (2019). Heuristics versus statistics in discriminant validity testing: A comparison of four procedures. *Internet Study, 29*(3), 430–447.

Franklin, M., & Cristina, D. M. (2015). Project Management Success: A Bibliometric Analysis. *Revista de Gestão e Projetos - GeP, 6*(1), 28-44. DOI: 10.5585/gep.v6i1.310

Gaillard, J. C., & Mercer, J. *From knowledge to action: Bridging gaps in disaster risk reduction*. https://doi.org/10.1177/0309132512446717

Garstenauer, A., Blackburn, T., & Olson, B. (2014). A knowledge management based approach to quality management for large manufacturing organizations. *Engineering Management Journal, 26*(4), 47-58.

Gerges, M. (2015). *Investigation into the labour factors affecting project performance within the Egyptian construction industry.,* (June).

Giacomo, G., Serdar, Y., & Tatikonda, S. (2007). On the error exponent of Markov channels with ISI and feedback. DOI:10.1109/ITW.2007.4313071

Glazner, J., Bondy, J., Lezotte, D. C., Lipscomb, H., & Guarini, K. (2005). Factors contributing to construction injury at Denver international airport. *American Journal of Industrial Medicine, 47*(1), 27–36.

Götz, O., Liehr-Gobbers, K., & Krafft, M. (2010). Evaluation of structural equation models using the Partial Least Squares (PLS) approach. In *Handbook of partial least squares* (691–711). Berlin, Heidelberg: Springer.

Green, F., & McIntosh, S. (2007). Is there a genuine under-utilization of skills among the over-qualified? *Applied Economics*, 39:427–439.

Gündüz, M., Nielsen, Y., & Özdemir, M. (2013). Quantification of delay factors using the relative importance index method for construction projects in Turkey. *Journal of Management in Engineering, 29*(2), 133–139.

Habibi, A., Mukminin, A., Najwan, J., & Haswindy, S. (2018). Investigating EFL classroom management in Pesantren: A case study. *The Qualitative Report 23*(9):2205-2123. DOI:10.46743/2160-3715/2018.3117

Haigh, R. P., & Amaratunga, D. (2010). An integrative review of the built environment discipline's role in the development of society's resilience to disasters. *International Journal of Disaster Resilience in the Built Environment 1*(1):11-24. DOI:10.1108/17595901011026454

Hair, J. F., Jr., Hult, G. T. M., Ringle, C., & Sarstedt, M. (2016). *A primer on partial least squares structural equation modeling (PLS-SEM)* (2nd ed.). Sage.

Hair, J. F., Jr., Ringle, C. M., & Sarstedt, M. (2011). PLS-SEM: Indeed, a silver bullet. *The Journal of Marketing Theory and Practice, 19*(2), 139–152.

Hair, J. F., Jr., Ringle, C. M., & Sarstedt, M. (2013). Partial least squares structural equation modeling: Rigorous applications, better results and higher acceptance. *Long Range Planning, 46*(1–2), 1–12.

Hair, J. F., Jr., Risher, J. J., Sarstedt, M., & Ringle, C. M. (2019). When to use and how to report the results of PLS-SEM. *European Business Review, 31*(1), 2–24.

Hair, J. F., Jr., Sarstedt, M., Ringle, C. M., & Mena, J. A. (2012). An assessment of the use of partial least squares structural equation modeling in marketing Study. *Journal of the Academy of Marketing Science, 40*(3), 414–433.

Hanna, A. S., Taylor, C. S., & Sullivan, K. T. (2005). Impact of extended overtime on construction labor performance. *Journal of Construction Engineering and Management, 131*(6), 734–739.

Hartog, J. (2000). Human capital as an instrument of analysis for the economics of education. *European Journal of Education, 35*(1), 7-20. https://doi.org/10.1111/1467-3435.00002

Hauber, R. (2002). *Performance measurement in der Forschung und Entwicklung Konzeption und Methodik*.

Henseler, J., Ringle, C. M., & Sinkovics, R. (2009). The use of partial least squares path modeling in international marketing. *Advances in International Marketing, 20*(3), 277–319.

Heravi, G., & Eslamdoost, E. (2015). Applying artificial neural networks for measuring and predicting construction-labor productivity. *Journal of Construction Engineering and Management, 141*(10), 04015032.

Higgins, J., Thompson, S., & Spiegelhalter, D. (2009). A re-evaluation of random-effects meta-analysis. Journal of the Royal Statistical Society. DOI:10.1111/j.1467-985X.2008.00552.x

Ho, P. H. K. (2016). Labour and skill shortages in Hong Kong's construction industry. *Engineering, Construction and Architectural Management, 23*(4), 533–550.

Hossein, K., Dadi, G. B., Goodrum, P., & Srinivasan, C. (2018). Impact of skilled labor availability on construction project cost performance. *Journal of Construction Engineering and Management, 144*(7), 1–10.

Hoxha, L. (2017). *Relationship between project managers' age, years of project experience, and project success.* Doctoral Dissertation, Walden University.

Hussain, S., Zhu, F., Ali, Z., Aslam, H., & Hussain, A. (2018b). Critical delaying factors: Public sector building projects in Gilgit-Baltistan, Pakistan. *Buildings, 8*(1), 6.

Husseini, A. A. (1992). The importance of Manpower training and management to the construction industry. In B. Olateju (ed.), *Proceedings of the National Seminar on Effective Contract Management in the Construction Industry*, 119–130.

Hwang, J. W., Kim, H., Kim, K. O, Lee, H. S, & Choi, Y. S. (2012) Manufacture and characterization of Silkworm Gland Hydrolysate. *Journal of Sericin and Entomology Science, 50*, 76-81.

Ireni-Saban, L. (2012). *Challenging disaster administration: Toward community-based disaster resilience.* https://doi.org/10.1177/0095399712438375

Iyer, K. C., & Jha, K. N. (2005) Factors affecting cost performance: Evidence from the Indian construction projects. *International Journal of Project Management, 23*, 283-295. https://doi.org/10.1016/j.ijproman.2004.10.003

Jannadi, M. O. (1996). Factors affecting the safety of the construction industry. *Building Study & Information, 24*(2), 108–112.

Jarkas, A. M., (2010). Critical investigation into the applicability of the learning curve theory to rebar fixing labour productivity. *Journal of Construction Engineering and Management, 136*(12), 1279–1288.

Jöreskog, K., G. (1970). A general method for estimating a linear structural equation system. *ETS Study Bulletin Series, 1970*(2), 255–284.

Josephson, P. –E., & Hammarlund, Y. (2011). The causes and costs of defects in construction: A study of seven building projects. *Automation in Construction, 8*(6), 681-687. https://doi.org/10.1016/S0926-5805(98)00114-9

Joslin, R., & Müller, R. (2016). Identifying interesting project phenomena using philosophical and methodological triangulation. *International Journal of Project Management, 34*, 1043-1056. https://doi.org/10.1016/j.ijproman.2016.05.005

Judge, W. Q., Witt, M. A., Zattoni, A., et al. (2014) Corporate governance and IPO underpricing in a cross-national sample: A multilevel knowledge-based view. *Strategic Management Journal, 36*, 1174-1185. https://doi.org/10.1002/smj.2275

Juran, M., & Godfrey, A. (1998). *Juran's quality handbook. 5th Ed*, Washington DC: McGraw-Hill Companies, Inc.

Karimi, H., Taylor, T. R. B., & Goodrum, P. M. (2017). Analysis of the impact of craft labour availability on North American construction project productivity and schedule performance. *Construction Management and Economics, 35*(6), 368–380.

Karimi, H., Taylor, T. R. B., Goodrum, P. M., & Srinivasan, C. (2016). Quantitative analysis of the impact of craft worker availability on construction project safety performance. *Construction Innovation, 16*(3), 307–322.

Kazaz, A., Manisali, E., & Ulubeyyli, S. (2008). Effect of basic motivational factors on construction workforce productivity in Turkey. *Journal of Civil Engineering and Management, 14*(2), 95-106.

Keng, C., & Hamzah, R. (2011). *Study of quality management in construction projects.*

Engineering, Business.

Khan, R. A. G., Khan, F. A. & Khan, M. A., (2011). *Impact of training and development on organizational performance.*

Kothari, C. R. (2004). *Study methodology: Methods and techniques. 2nd Ed*, New Delhi: New Age International Publishers.

Krejcie, R. V., & Morgan, D. W. (1970). Determining sample size for Study activities. *Educational and Psychological Measurement, 30*, 607-610.

Kuykendall, C. J. O. (2007). *Key factors affecting labor productivity in the construction*.

Lan, Oo., & Proust, G., & Lim, B TH. (2012). *An empirical study of communication competence of civil engineering graduates – Implication of engineering curriculums.*

Laslo, Z., & Gurevich, G. (2014). Enhancing project on time within budget performance by implementing proper control routines. *Management, 19*(72), 53-69. https://doi.org/10.7595/management.fon.2014.0019

Leedy, P. D., & Ormrod, J. E. (2005). *Practical Study: Planning and design.* Upper Saddle River, NJ: Prentice Hall. http://www.worldcat.org/title/practical-Study-planning-and-design/oclc/53831701

Lermen, F. H., Morais, M., Matos, C., & Röder, R. (2016). Optimization of times and costs of project of horizontal laminator production using PERT/CPM technical. *Independent Journal of Management & Production 7*(3):833-853. DOI:10.14807/ijmp.v7i3.423

Love, P. E. D., & Edwards, D. J. (2005), Calculating total rework costs in Australian construction projects, *Civil Engineering and Environmental Systems, 22*, 11.

Love, P. E. D., & Li, H. (2000). Quantifying the causes and costs of rework in construction. *Construction Management and Economics, 18*(4), 479–490.

Mahamid, I. (2011). Risk matrix for factors affecting time delay in road construction projects: Owners' perspective. *Engineering, Construction and Architectural Management, 18*(6), 609–617.

McGuinness, S., Pouliakas, K., & Redmond, P. (2017). *How useful is the concept of skills mismatch?* IZA – Institute of Labor Economics.

McKenney, M. J., & Handley, H. (2019). Identifying and quantifying personnel skill gaps. *Proceedings of the Human Factors and Ergonomics Society Annual Meeting 63*(1):332-336.

DOI:10.1177/1071181319631078

Meng, X. (2012). The effect of relationship management on project performance in construction. *International Journal of Project Management, 30*(2), 188–198.

Mir, F. A., Pinnington, A. H. (2014). Exploring the value of project management: Linking project management performance and project success. *International Journal of Project Management, 32*, 202-217.

Malalgoda, C., Amaratunga, D., Haigh, R. P. (2014). Challenges in Creating a Disaster Resilient Built Environment. *Procedia Economics and Finance 18*. DOI:10.1016/S2212-5671(14)00997-6

Margolis, D. N. (2014). *By choice and by necessity: Entrepreneurship and self-employment in the developing world.* Centre d'Economie de la Sorbonne; IZA Institute of Labor Economics; World Bank - Social Protection Unit (HDNSP); Paris School of Economics.

McGowan, M. A., & Andrews, D. (2017). Study in labor economics 45. In book: *Skill Mismatch in Labor Markets*, 199-241. DOI:10.1108/S0147-912120170000045006

Mugenda, O. M., & Mugenda, A. G. (2003). *Study methods, quantitative and qualitative approaches.* ACT, Nairobi.

Muthuveloo, R., Shanmugam, N., & Teoh, A. P. (2017). The impact of tacit knowledge management on organizational performance: Evidence from Malaysia. *Asia Pacific Management Review, 22*(4), 192–201.

Naoum, S. G. (2016). Factors influencing labor performance on construction sites: A state-of-the-art literature review and a survey. *International Journal of Productivity and Performance Management, 65*(3), 401–421.

Nicholls, G. M., Lewis, N. A., & Eschenbach, T. G. (2015). *Using agile project management to maximize you and your coauthors' productivity*. Conference: ASEE Annual Proceedings 2015At: Seattle.

Noe, R. A. (2010). *Employee training and development, 5th Ed*. McGraw-Hill.

Norman, I. D., & Binka, F. N. (2015). Leadership abilities, skills and knowledge in building Disaster Resilience and Response Issues in Business Management and Economics, 3(3), 44-58. http://dx.doi.org/10.15739/IBME.2014.014

O'Brien, B. C. (2014). Standards for reporting qualitative Study: A synthesis of recommendations. Academic Medicine 89(9). DOI:10.1097/ACM.0000000000000388

Ofori, G., (2012). Developing the construction industry in Ghana: the case for a central agency. *National University of Singapore Omega, 25*(March), 415– 435.

Okuwoga, A. A. (1998). Cost-time performance of public sector housing projects in Nigeria. *Habitat International, 22*, 389-395. http://dx.doi.org/10.1016/S0197-3975(98)00014-9

Olaniyan, D. A., & Ojo, L.B., (2008). Staff training and development: A vital tool for organisational effectiveness. *European Journal of Scientific Study, 24*(3),1450–216. Available at: http://www.eurojournals.com/ejsr.htm.

Parker, D. W., Parsons, N., & Isharyanto, F. (2015). Inclusion of strategic management theories to project management. *International Journal of Managing Prpjects in Business, 8*(3), 552-573.

Pellizzari, M., & Fichen, A. (2017). A new measure of skill mismatch: Theory and evidence from PIAAC. *IZA Journal of Labor Economics, 6*(1).

Pheng, L., & Chuan, Q. (2006) Environmental factors and work performance of project managers in the construction industry. *International Journal of Project Management, 24*, 24-37. https://doi.org/10.1016/j.ijproman.2005.06.001

Prempah, E. O., (2014). *Assessment of productivity management practices on Ghanaian construction sites.* Kwame Nkrumah University of Science and Technology.

Quintini, G. (2011). *Over-qualified or under-skilled: A review of existing literature*, OECD Social, Employment and Migration Working Papers 121, OECD Publishing.

Qureshi, H., (2016). *Benefits of training and development in an organization.* Wikipedia, 1–5.

Reich, B. H., Gemino, A., & Sauer, C., Knowledge management and project-based knowledge in it projects: A model and preliminary empirical results. *International Journal of Project Management, 30*(6), 663-674. https://doi.org/10.1016/j.ijproman.2011.12.003

Relich, M., & Bzdyra, K. (2014). Estimating new product success with the use of intelligent systems. Foundations of Management, 6(2), 7-20. https://bibliotekanauki.pl

Rethinam, G. S., & Ismail, M. (2008). Constructs of quality of work life: A perspective of information and technology professionals. *European Journal of Social Sciences, 7*(1), 58-70

Risatti, H. (2007). *A theory of craft: Function and aesthetic expression.* Chapel Hill: The University of North Carolina Press.

Rugenyi, R. (2015). Assessment of the triple constraints in projects in Nairobi: The project managers - A perspective. *International Journal of Academic Study in Business and Social Sciences 5*(11). DOI:10.6007/IJARBSS/v5-i11/1889

Sala, G. (2011). Approaches to skills mismatch in the labour market: A literature review. *Revista de Sociologia,96*(4),1025-1045.

Saunders, M., Lewis, P., & Thornhill, A., (2012). *Study methods for business students 6th Edition.*, Pearson Education Limited.

Sekaran, U., & Bougie, R. (2016). *Study methods for business: A skill-building approach. 7th Ed.*, West Sussex: Wiley & Sons.

Shehata, M. E., & El-Gohary, K. M. (2012). Towards improving construction labor productivity and projects' performance. *Alexandria Engineering Journal, 50*(4), 321–330.

Sink, D. S. (1985). Productivity management: Planning, evaluation, control, and improvement. Wiley- Technology & Engineering.

Smith, J., Johnson, M., & Williams, A. (2019). Building trust in e-commerce: Exploring the influence of website design elements on initial trust formation. *Journal of Organizational and End User Computing (JOEUC), 31,* 52-72.

Smith, J. Q., Jones, M. R., & Brown, C. D. (2018). The future of work: Implications for managerial innovation and resource management. *Business Horizons, 61*, 1-12.

Sridarran, P., Keraminiyage, K., & Herszon, L. (2017). Improving the cost estimates of complex projects in the project-based industries. *Journal Built Environment Project and Asset Management, 7*(2).

Turner, J. R., & Xue, Y. (2018). On the success of megaprojects. *International Journal of Managing Projects in Business 11*(2). DOI:10.1108/IJMPB-06-2017-0062

United Nations International Strategy for Disaster Reduction (UNISDR). (2008). *Climate change and disaster risk reduction. Briefing Note 1*, September.

Van Wyngaard, C. J., Pretorius, J. H., & Pretorius, L. (2012). Theory of the triple constraint: A conceptual review. *IEEE International Conference on Industrial Engineering and Engineering Management*, 1991-1997.

Wang, Y., Goodrum, P. M., Haas, C. T., & Glover, R. W. (2008). Craft training issues in American industrial and commercial construction. *Journal of Construction Engineering and Management, 134*(10), 795–803.

Weichselgartner, J., & Pigeon, P. (2015). The role of knowledge in disaster risk reduction. *International Journal of Disaster Risk Science 6*(2):107-116 DOI:10.1007/s13753-015-0052-7

Wong, J. M. W., Chan, A. P. C., & Chiangn, Y. H. (2006). The changing construction labour market: A case of Hong Kong. *Journal of Engineering, Design and Technology, 4*(1), 1–17.

Xiao, H., & Proverbs, D. (2002). The performance of contractors in Japan, the UK and the USA: An evaluation of construction quality. *International Journal of Quality & Reliability Management, 19*(6), 672–687.

Yin, R. K. (2008). Case study Study: Design and methods. 4th Ed, Thousand Oaks: Sage Publications.

Zikmund, W. G. (2000). *Business Study methods. 6th Ed*, Fort Worth: The Dryden Press.

Zwikael, O., & Smyrk, J. (2014). Project governance: Balancing control and trust in dealing with risk. *International Journal of Project Management 33*(4).