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Analysis of Workforce Competency and Certification on Success in Construction Projects in Bali Province

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Abstract
Construction project success is strongly influenced by workforce competency, which can be demonstrated through certification. Despite regulatory requirements in Bali Province mandating certified competent labor for both large- and small-scale projects, limited research has examined the effect of workforce competency on project success when moderated by certification and grouped by project scale in Bali. This research aims to analyze the effect of construction workforce competency on construction project success and to examine this relationship when moderated by construction workforce certification. This study employs a quantitative approach with primary data collected through questionnaires distributed to 70 certified construction workers using purposive sampling, divided equally into large-scale and small-scale project groups. Data analysis was conducted using Structural Equation Modeling based on Partial Least Squares (SEM-PLS). The results indicate that, overall, construction workforce competency has a positive and significant effect on construction project success, with a t-statistic value of 3.834 and a p-value of 0.000. Based on the Multigroup Analysis (MGA), construction workforce competency continues to significantly influence construction project success in each group. There is no significant difference in the effect of workforce competency on construction project success between small-scale and large-scale construction projects, as indicated by a path coefficient difference of 0.166 and a p-value greater than 0.05 (0.283 > 0.05). Certification positively moderates the competency–success relationship (p = 0.013), with no significant difference in moderating effect between project scales (p = 0.452 > 0.05).
Keywords: *Competence; Certification; Project Success; Moderation; Multigroup Analysis (MGA).*

INTRODUCTION

The construction industry in Bali Province is currently experiencing rapid growth, with the need for public infrastructure, tourism support, and regional development continuing to increase (Suthanaya & Suwarningsih, 2023). However, the construction process is often plagued by problems that can lead to project delays. Delay factors in construction projects are grouped into seven categories: labor, materials, equipment, environment, management, finance, and others (Andi & Susandi, 2003). According to Wibawa (2021), labor is the dominant risk factor for construction project delays in the Denpasar area of Bali. Risks resulting from inexperienced labor result in low labor productivity, which impacts the quality and timeliness of work. The labor factor has the highest level of agreement as the most dominant cause of project delays, with the primary cause being labor expertise.

Construction workers are individuals who possess the skills, knowledge, and experience to carry out construction work (Johari & Neeraj Jha, 2021). Every construction worker needs to be certified as proof of their competence in that field. However, the reality on the ground regarding the number of construction workers (TKK) in Indonesia, based on data from the National Labor Force Survey (Sakernas, 2024), is known to have reached 8.76 million people. Of this number, only 4.86% of the construction workforce holds a work competency certificate (LPJK, 2024). This data aligns with the phenomenon in the field, where the majority of construction workers are

uncertified. Generally, the majority of skilled and expert workers have an elementary school education or below, and only a small portion have an academic background. This can cause problems, where workers who are not supported by technical knowledge and still rely on traditional skills tend to encounter obstacles in the era of global competition that demands high work dynamics, both in terms of technological capabilities and managerial business skills (Muzam, 2023).

Currently, many contractors in Bali still pay little attention to the importance of employing competent and specialized workers. Large contractors in Bali generally use certified workers solely to meet tender requirements (Wimalasena & Gunatilake, 2018). It is not uncommon for a single worker to hold more than one construction worker competency certification to simplify tender administration, but the reality on the ground does not align with the plan (Jackson, 2025). Take, for example, the Revitalization of the Thematic Market in Ubud, a major Bali project (Sholihah et al., 2026). The tender requirements required the contractor to provide certified workers, ranging from the Lead Expert level through the Implementation Manager position to the certified foreman level, according to their respective areas of expertise. The contractor, as the service provider, agreed to the contract for the handover of the work site and the personnel required in the tender. However, the actual deployment of these workers in the field was not realized. Another example is a contractor working on a villa construction project in Umalas, Badung. The tender process required the contractor to provide workers with at least a Level 6 Certificate in Building Implementation and one K3 expert. The approved budget proposal included two certified junior building construction experts and one junior construction safety and health expert (Abd Latib et al., 2016). However, the actual project did not meet the tender requirements, resulting in delays due to several tasks, such as redoing wall work, and accidents resulting in serious worker injuries (Alves-Dias & Coble, 2026).

Skilled and expert workers have standards that refer to the competency standards that have been set by the government using the Indonesian National Work Competency Standards (SKKNI) and the National Job Training System (Sislatkernas). Expertise and skills certification is required from an authorized institution in accordance with Law No. 2 of 2017 concerning Construction Services, which mandates that construction service providers are required to employ certified workers as proof guaranteeing that the workforce has competence.

Every construction project, whether large or small scale, in Bali Province requires the employment of competent workers. Workforce competence is essential during the construction project implementation process, as abilities are based on skills and knowledge, supported by work attitudes in implementing and executing instructions and work in the workplace that refer to established work requirements. According to Bastangka & Rafie (2023), workforce competence influences worker performance in construction projects. Competence also influences the accuracy of project costs, quality, and time. Based on validation tests, it was found that knowledge, expertise, and worker attitudes and behavior simultaneously influence project costs, quality, and time (Azis et al., 2016). To prove this competence, the workforce needs to be tested through certification. Obtaining an SKA (Expertise Certificate) can have a very positive impact on the

holder, especially in terms of the skills and abilities they possess after obtaining the Expertise Certificate (Hastomo & Pontan, 2022).

Government Regulation No. 14 of 2021 states that a Construction Worker (TKK) is any person possessing the skills, knowledge, and experience to perform work, as evidenced by holding a Work Competency Certificate (SKK). According to data from the Ministry of Public Works and Public Housing, there were 6,088 certified construction workers in Bali Province in 2022. This number decreased to 5,306 in 2023.

Previous research indicates that construction worker competence has a positive correlation with construction project success, including aspects of cost, quality, and time (Gajendran & Brewer, 2017). Furthermore, other studies highlight that worker certification can improve work standards and stakeholder confidence in project outcomes (Hussain et al., 2020). However, there has been no specific research on the impact of competence and certification on the success of large and small construction projects specifically in Bali Province (Pertiwi & Putra[1], 2026).

The Bali Provincial Government, through the Bali Provincial Public Works and Spatial Planning Agency, has implemented regulations stipulated in Law No. 2 of 2017 concerning Construction Services to address issues arising from incompetent workers. The implementation of Law No. 2 of 2017 is expected to optimize the results of construction project implementation and guarantee the rights of construction workers (Wiraantaka et al., 2024). The implementation of certification regulations, which require companies or construction service providers to employ certified workers in Bali Province, aims to improve construction project performance. Moreover, further analysis is needed to demonstrate that the competence and certification of skilled and expert workers can influence the performance of construction companies. Therefore, this study aims to determine the effect of labor certification as a moderating variable of labor competence on the performance of large and small construction project companies in Bali Province.

Based on the description of the background, this study formulates two main problems: first, how the competence of the construction workforce affects the success of construction projects for large and small contractors in Bali Province, and second, whether certification can strengthen the relationship between competence and construction project performance in large and small projects in Bali Province. Accordingly, this research aims to analyze the influence of construction workforce competence on project success and to examine the moderating effect of certification on the relationship between competence and project performance in both large and small-scale construction projects in Bali Province. The results of this research are expected to provide both theoretical and practical benefits: theoretically, to offer insights into the influence of certified workforce competence, enabling construction company management to recruit certified workers according to their expertise to optimize resources, time, and costs; and practically, to serve as a reference for agencies and various stakeholders in construction projects regarding the implementation of construction labor certification in accordance with Law No. 2 of 2017 to optimize human resources and improve construction project performance. To achieve these objectives, this study is limited to questionnaire distribution on small and large construction projects in Bali Province, involving certified workers including supervisors, implementers,

drafters, quantity surveyors, foremen, and other certified personnel directly involved in project implementation throughout Bali Province.

METHODS

This research was survey research conducted on small and large construction projects in Bali Province. The research location was determined based on the consideration that construction development in Bali Province is growing rapidly and that the province has implemented regulations requiring the hiring of certified workers.

To answer the research problems, data were collected through a questionnaire survey and classified into two types: primary data and secondary data. The study population was divided into two groups: the workforce employed in small construction projects and the workforce employed in large construction projects in Bali Province. The sampling technique used was non-probability sampling with a purposive sampling method, in which the selected samples were workers holding active construction worker certifications. Respondents who completed the questionnaire were workers directly involved in construction projects with a minimum of senior high school or vocational school education and an active construction worker certification. The sample size of 65 respondents was consistent with the guidance of Sugiyono (2019), which recommends a sample size between 30 and 500 respondents, who recommends a minimum of 30 respondents per group for a two-group quantitative study.

Data collection was carried out in three phases. In Phase I, a literature study was conducted based on previous research to gain a comprehensive understanding of construction workforce competence, performance, and certification, drawing from scientific journals, books, and relevant articles. Where the literature study was insufficient, exploratory research was conducted through brainstorming with relevant experts to support the research. In Phase II, variables, indicators, and factors related to competence, performance, and certification were identified and analyzed to compile the research questionnaire. In Phase III, the data obtained from respondents were collected and analyzed using the Structural Equation Modeling – Partial Least Squares (SEM-PLS) method to identify and test the relationships between the variables of workforce competence, project performance, and labor certification.

The research instrument was a questionnaire compiled based on literature review indicators covering three variables: Construction Workforce Competence (X), measured by knowledge, skills, and work attitudes; Construction Project Performance (Y), measured by cost, time, quality, occupational health and safety, and environmental performance; and Labor Certification (M) as a moderating variable, measured by workforce abilities. The questionnaire was divided into three parts: project data, respondent data, and indicators of competence's influence on performance as moderated by certification. It was distributed to 65 certified construction workers under direct researcher supervision to minimize errors, using a Likert scale for measurement. Before data collection, a pilot test was conducted to ensure the validity and reliability of the instrument.

The data obtained were processed through four systematic stages: editing, to verify the completeness of respondents' answers; coding, to group similar answers into categories; scoring,

to convert categorical data into quantitative values; and tabulating, to organize the processed data into tables for further analysis. The survey data were then analyzed using Multi-Group Analysis (MGA) with the aid of SmartPLS software to compare whether significant differences existed between the small and large contractor groups based on the path coefficients between variables in the model (Cheah et al., 2023; Amadea, 2024).

RESULTS AND DISCUSSION

Validity Test

Table 1. Results of the Validity Test of Construction Workforce Competency Indicators

Statement	r Table	r Count	Remarks
KP1	0,361	0,909	Valid
KP2	0,361	0,912	Valid
KP3	0,361	0,909	Valid
KP4	0,361	0,908	Valid
KP5	0,361	0,936	Valid
KP6	0,361	0,893	Valid
KP7	0,361	0,898	Valid
KP8	0,361	0,739	Valid
KK1	0,361	0,744	Valid
KK2	0,361	0,811	Valid
KK3	0,361	0,942	Valid
KK4	0,361	0,905	Valid
KK5	0,361	0,923	Valid
KK6	0,361	0,935	Valid
KK7	0,361	0,948	Valid
KK8	0,361	0,943	Valid
KK9	0,361	0,934	Valid
KK10	0,361	0,942	Valid
KSK1	0,361	0,939	Valid
KSK2	0,361	0,918	Valid
KSK3	0,361	0,936	Valid
KSK4	0,361	0,914	Valid
KSK5	0,361	0,927	Valid
KSK6	0,361	0,936	Valid
KSK7	0,361	0,951	Valid
KSK8	0,361	0,893	Valid
KSK9	0,361	0,902	Valid

Source: Processed by researchers from primary data using SPSS, 2025

Based on the results of the validity test presented in Table 1, all indicators in the 27 statements on labor competency given to 30 respondents showed a Pearson correlation value that was greater than the r-value of the table. The average correlation value for the labor competency questionnaire was 0.905, which exceeded the table r-value of 0.361. Thus, all statements are declared valid and can proceed to the reliability test stage.

Table 2. Results of Validity Test of Construction Project Performance Indicators

Statement	r Table	r Count	Remarks
KIN1	0,361	0,950	Valid
KIN2	0,361	0,611	Valid
KIN3	0,361	0,838	Valid
KIN4	0,361	0,893	Valid
KIN5	0,361	0,869	Valid
KIN6	0,361	0,794	Valid
KIN7	0,361	0,806	Valid
KIN8	0,361	0,750	Valid
KIN9	0,361	0,488	Valid
KIN10	0,361	0,624	Valid

Source: Processed by researchers from primary data using SPSS, 2025

Based on the results of the validity test presented in Table 2, all indicators in the 10 statements regarding the performance of the construction project given to the 30 respondents showed a Pearson correlation value that was greater than the r value of the table. The average correlation value for the construction project performance questionnaire was 0.762, which exceeded the table r-value by 0.361. Thus, all statements are declared valid and can proceed to the reliability test stage.

Table 3. Results of the Validity Test of Construction Labor Certification Indicators

Statement	r Table	r Count	Remarks
SER1	0,361	0,875	Valid
SER2	0,361	0,931	Valid
SER3	0,361	0,736	Valid
SER4	0,361	0,852	Valid
SER5	0,361	0,908	Valid
SER6	0,361	0,546	Valid
SER7	0,361	0,859	Valid
SER8	0,361	0,693	Valid
SER9	0,361	0,806	Valid
SER10	0,361	0,750	Valid

Source: Processed by researchers from primary data using SPSS, 2025

Based on the results of the validity test presented in Table 3, all indicators in the 10 statements regarding the certification of construction workers given to 30 respondents showed a Pearson correlation value that was greater than the r-value of the table. The average correlation value for the construction workforce certification questionnaire was 0.795, which exceeded the table r-value of 0.361. Thus, all statements are declared valid and can proceed to the reliability test stage.

Reliability Test

Table 4. Results of Construction Workforce Competency, Performance and Certification Reliability Test

No	Statement	Cronbach's Alpha	Number of Statements
1	Competencies	0,991	27
2	Performance	0,943	10
3	Certifications	0,952	10

Source: Processed by researchers from primary data using SPSS, 2025

Based on the reliability test results, the workforce competency variable, with 27 valid statements, yielded a Cronbach's Alpha value of 0.991. The construction project performance variable, with 10 valid statements, yielded a Cronbach's Alpha value of 0.943. The construction workforce certification variable, with 10 valid statements, yielded a Cronbach's Alpha value of 0.952.

All variables in this study had Cronbach's Alpha values above 0.70, indicating that the instrument met the criteria for high reliability. This indicates that the research instrument has good internal consistency and is reliable in measurement, as required in quantitative research (Nunnally, 1994, cited in Imam et al., 2023). Therefore, all statement items used in this study are deemed reliable and suitable for further analysis.

SEM-PLS (Structural Equation Model - Partial Least Square) Analysis

The stages in the SEM-PLS (Structural Equation Model - Partial Least Square) analysis in this study include measurement model evaluation, structural model evaluation, moderation effect testing and multi-group analysis. Data processing is carried out using SmartPLS v4.1 software.

Reflective Measurement Model Evaluation

1. Outer Model Evaluation Results

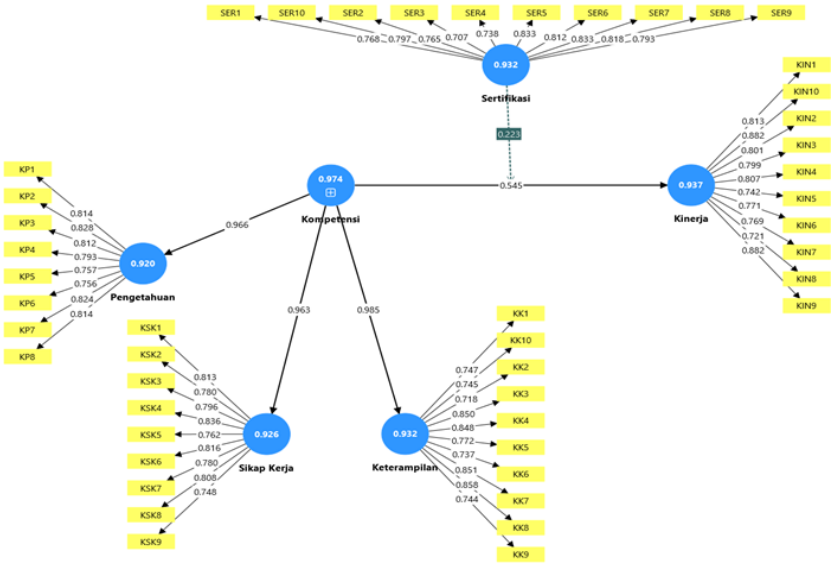

Figure 1. Model of Indicator Reliability Test Results
Source: Processed by researchers from primary data using SmartPLS v4.1 software, 2025

The results of the evaluation of the inner model in this study indicate a direct influence between the independent variable of competence and the dependent variable of Performance showing a positive relationship with a coefficient value of 0.545. Certification as a moderation variable in the relationship between competence and performance, shows a positive direction with a coefficient value of 0.223. All indicators in this study have an adequate contribution in explaining latent variables, without sacrificing the complexity and diversity of the constructs analyzed because the loading factor results ≥ 0.7.

Evaluation of the outer model explains the relationship between latent constructs and their respective indicators. Based on Figure 5.3, each indicator makes a significant contribution to the construct it represents, as can be seen in more detail in Table 5.5. Overall, the model structure developed in this study shows that the formation of latent variables is based on the contribution of strong, valid, and diverse indicators, thus supporting the overall validity and reliability of the model.

All indicators have a loading factor value above 0.70. These results indicate that all indicators used in this study have met the criteria for convergent validity. Thus, it can be concluded that these indicators are optimally able to accurately and consistently represent and measure the latent constructs they represent.

2. Internal Consistency Reliability Measurement

Table 5. Value Cronbach's Alpha, Composite Reliability dan Average Variance Extracted (AVE)

	Cronbach's Alpha	***Composite Reliability* (rho_a)**	***Composite Reliability* (rho_c)**	***Average Variance Extracted* (AVE)**
Competencies	0,974	0,974	0,975	0,594
a. Knowledge	0,920	0,921	0,934	0,640
b. Skills	0,932	0,934	0,943	0,622
c. Work attitude	0,926	0,927	0,939	0,630
Performance	0,937	0,940	0,947	0,640
Certifications	0,932	0,934	0,942	0,620

Source: Processed by researchers from primary data using SmartPLS v4.1 software, 2025

Based on the test results, all variables showed Cronbach's Alpha and composite reliability values > 0.7 (Hair et al., 2021), so it can be concluded that these variables have met adequate internal consistency criteria and the model has met reliability requirements so that it can be used in research models.

3. Convergent Validity

Convergent validity is evaluated through the Average Variance Extracted (AVE) value, which measures the average indicator variance successfully explained by the construct in question. AVE indicates the extent to which a construct is able to represent the variability of its measurement items. According to (Hair et al., 2021), the assessment of convergent validity in this study refers to a confirmatory approach, with an AVE value of ≥ 0.50 indicating that the construct is able to explain more than 50% of the indicator's variance. Based on the analysis results presented in Table 5.8, the AVE value obtained for the variable Workforce Competence is 0.594, Construction Project Performance is 0.640, and Construction Workforce Certification is 0.620. Thus, all variables in this study have met the criteria for convergent validity.

4. Discriminant Validity

Discriminant validity is a type of validity in research instrument testing that ensures that a construct or latent variable is empirically distinct from other constructs (Sugiyono, 2019). One method used to test discriminant validity is by examining the Heterotrait-Monotrait Ratio (HTMT) value. A construct is considered to meet the discriminant validity criteria if the HTMT value between constructs is below 0.90 (Hair et al., 2021).

All variable pairs showed values below 0.90, thus discriminant validity was declared met. The use of the HTMT value is currently recommended for reporting because it has a higher level of sensitivity in detecting discriminant validity issues than the Fornell-Larcker method and cross-loadings (Hair et al., 2021).

Evaluation of Structural Models (Inner Model)

The evaluation of the structural model includes several indicators, namely the R-Square value (R^2), Effect Size (f^2), Predictive Relevance (Q^2), and significance test (two-tailed). (Santosa, 2018)

1. R-Square

Table 6. R- Value Square

	R-square	R-square adjusted
Performance	0,538	0,522

Source: Processed by researchers from primary data using SmartPLS v4.1 software, 2025

The *R-square value* for the performance variable of 0.538 shows that there is a 53.8% variation in the dependent variable. The rest, which is 46.2%, is influenced by other factors outside the model. This value is in the medium category or shows moderate influence.

2. Effect Size f

Table 7. F-Square Value

	Performance
Performance	
Competencies	0,310
Certifications	0,058
Certification x Competency	0,099

Source: Processed by researchers from primary data using SmartPLS v4.1 software, 2025

Based on the results of the Effect Size (f^2) test shown in Table 7, it can be explained that competence with an F-square value of 0.310 has a great influence on the performance of construction projects. Meanwhile, certification with an F-square value of 0.058 has a small influence on the performance of construction projects. Meanwhile, certification moderates the relationship between competence and performance of construction projects with an F-square value of 0.099 which has a moderate effect on the performance of construction projects. So it can be concluded that the most dominant competencies affect performance, moderate interactions strengthen relationships, and weak certifications.

3. Q^2 Predictive Relevance

Table 8. Value Q-Square Predict

	Q^2predict	RMSE	IT IS
Performance	0,443	0,762	0,556

Source: Processed by researchers from primary data using SmartPLS v4.1 software, 2025

The Q^2 Predict table for the Performance variable shows a Q^2 Predict value of 0.443, RMSE 0.762, and MAE 0.556, indicating the predictive capability of the PLS-SEM model. The Q^2 Predict value, which is between 0.25 and 0.50, indicates a moderate level of predictive accuracy.

4. Significance and Relevance of the Path Coefficients (Two-Tailed) / Direct Effect Testing

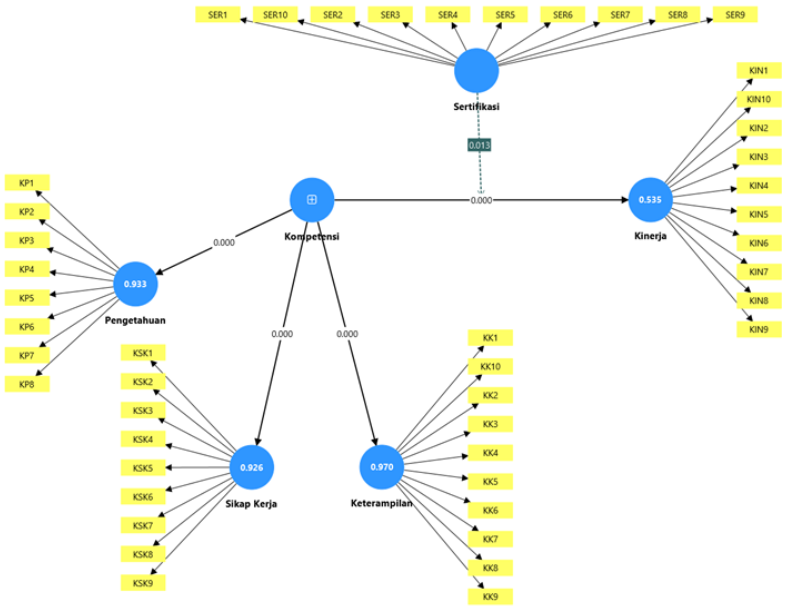

Figure 2. Bootstrapping Results

Source: Processed by researchers from primary data using SmartPLS v4.1 software, 2025

Table 9. Hypothesis Testing Results

	Original sample (O)	Sample mean (M)	Standard deviation (STDEV)	T statistics (|O/STDEV|)	P values
Competencies -> Performance	0,545	0,527	0,142	3,834	0,000
Performance > Certification	0,243	0,270	0,119	2,035	0,021
Certification x Competency -> Performance	0,223	0,207	0,099	2,239	0,013

Source: Processed by researchers from primary data using SmartPLS v4.1 software, 2025

Table 10. Hypothesis Testing Results on Large Construction Projects

	Original sample (O)	Sample mean (M)	Standard deviation (STDEV)	T statistics (|O/STDEV|)	P values
Competencies -> Performance	0,457	0,411	0,241	1,988	0,029
Performance > Certification	0,303	0,367	0,167	1,807	0,035
Certification x Competency -> Performance	0,218	0,180	0,119	1,983	0,033

Source: Processed by researchers from primary data using SmartPLS v4.1 software, 2025

Table 11. Hypothesis Testing Results on Small Construction Projects

	Original sample (O)	Sample mean (M)	Standard deviation (STDEV)	T statistics (|O/STDEV|)	P values
Competencies -> Performance	0,623	0,590	0,181	3,435	0,000
Performance > Certification	0,196	0,241	0,169	1,159	0,123
Certification x Competency -> Performance	0,190	0,157	0,160	1,189	0,117

Source: Processed by researchers from primary data using SmartPLS v4.1 software, 2025

Based on the results of the hypothesis test presented in Table 9, Table 10 and Table 11 can be concluded as follows:

a. Hypothesis 1: Labor competency (X) has a positive and significant effect on the performance of construction projects (Y).
   The value of the line coefficient (original sample) for the effect of construction labor competency on the performance of construction projects is 0.545 and shows a positive value. This indicates that the competence of the construction workforce has a positive effect on the performance of construction projects. The results of the t-statistical test were obtained at 3.834 with a p-value of 0.000. This hypothesis is acceptable because the t-statistical value is greater than the t-table value (3.834 > 1.96) and the p-value is smaller than 0.05 (0.000 < 0.05), which means that the competence of construction workers has a positive and significant effect on the performance of construction projects.
b. Hypothesis 2: Labor competence (X) has a positive and significant effect on the performance of construction projects (Y) in small construction projects.
   The value of the path coefficient (original sample) for the effect of the competence of construction labor on the performance of construction projects in small construction projects was 0.623 and showed a positive value. This indicates that the competence of the construction workforce has a positive effect on the performance of construction projects in small construction projects. The results of the t-statistical test were obtained at 3.435 with a p-value of 0.000. This hypothesis is acceptable because the t-value is greater than the t-table value (3.435> 1.96) and the p-value is smaller than 0.05 (0.000 < 0.05), which means that the competence of the construction workforce has a positive and significant effect on the performance of small construction projects.
c. Hypothesis 3: Labor competency (X) has a positive and significant effect on the performance of construction projects (Y) in large construction projects.
   The value of the path coefficient (original sample) for the effect of the competence of construction labor on the performance of construction projects in large construction projects is 0.457 and shows a positive value. This indicates that the competence of the construction workforce has a positive effect on the performance of construction projects in large construction projects. The results of the t-statistical test were obtained at 1.988 with a p-value of 0.029. This hypothesis is acceptable because the t-value is greater than the t-table value (1.988> 1.96) and the p-value is smaller than 0.05 (0.029 < 0.05), which means that the

competence of the construction workforce has a positive and significant effect on the performance of large construction projects.

d. Hypothesis 4: Labor certification (M) significantly moderates the influence of competency (X) on the performance of construction projects (Y).
   The value of the path coefficient (original sample) for the results of the moderation of construction labor certification on the relationship between the competence of construction labor and the performance of construction projects was 0.223 and showed a positive value. This shows that overall construction workforce certification moderates the relationship between construction workforce competencies and construction project performance in a positive direction. The results of the t-statistical test were obtained at 2.239 with a p-value of 0.013. This hypothesis is acceptable because the t-statistical value is greater than the t-table value (2.239 > 1.96) and the p-value is smaller than 0.05 (0.013 < 0.05), which means that the certification of construction labor moderates in a positive and significant direction the relationship between the competence of the construction workforce and the performance of the construction project.
e. Hypothesis 5: Labor certification (M) significantly moderates the effect of competency (X) on the performance of construction projects (Y) on small construction projects.
   The value of the path coefficient (original sample) for the results of the moderation of construction labor certification on the relationship between the competence of construction workers and the performance of construction projects was 0.190 and showed a positive value. This shows that the certification of construction labor moderates the relationship between the competence of the construction workforce and the performance of small construction projects in a positive direction. The results of the t-statistical test were obtained as 1.189 with a p-value of 0.117. This hypothesis is unacceptable because the t-value is smaller than the t-table value (1.189 < 1.96) and the p-value is greater than 0.05 (0.117 > 0.05), which means that the certification of construction labor moderates in a positive direction but is not significant to the relationship between construction labor competency and performance in small construction projects.
f. Hypothesis 6: Labor certification (M) significantly moderates the effect of competency (X) on the performance of construction projects (Y) on large construction projects.
   The value of the path coefficient (original sample) for the results of the moderation of construction labor certification on the relationship between the competence of construction labor and the performance of large construction projects was 0.218 and showed a positive value. This shows that the certification of construction workers moderates the relationship between the competence of the construction workforce and the performance of large construction projects in a positive direction. The results of the t-statistical test were obtained as 1.983 with a p-value of 0.033. This hypothesis is acceptable because the t-value is greater than the t-table value (2.983 > 1.96) and the p-value is smaller than 0.05 (0.033 < 0.05), which means that the certification of construction labor moderates in a positive and significant

direction the relationship between construction labor competency and performance in large construction projects.

5. Multigroup Analysis *(*MGA*)* Test Results

Multigroup Analysis (MGA) in PLS-SEM tests for differences in the significance of moderation effects between data groups. The results are judged from the p-value of the path coefficient comparison, if $p < 0.05$, a significant difference shows different moderation between groups, but if the path coefficient $p \geq 0.05$ t there is no difference, the moderator has a uniform effect. The following are the results of the MGA test: (Cheah et al., 2023)

Table 12. Test Results Multigroup Analysis

	Difference	**2-tailed p value**
Competencies -> Performance	0.166	0.283
Performance > Certification	0.107	0.326
Certification x Competency -> Performance	0.029	0.452

Source: Processed by researchers from primary data using SmartPLS v4.1 software, 2025

The Influence of Construction Workforce Competence on the Success of Construction Projects for Large and Small Contractors in Bali Province

Based on the findings of this study, overall, construction workforce competency has a positive and significant influence on construction project success, with a t-statistic of 3.834 and a p-value of 0.000. Construction workers with relevant knowledge and skills, along with a positive work attitude, can achieve project performance that meets cost, quality, time, occupational health and safety, and the environment. In terms of influencing competency, construction workforce skills, with a path coefficient of 0.970, were the most dominant factor. However, other factors, including knowledge (a path coefficient of 0.933) and work attitude (a path coefficient of 0.926), also contributed to construction workforce competency.

After categorizing large and small construction projects, construction workforce competency continued to influence project performance in each group. The difference in the path coefficient between small and large construction projects was 0.166. There is no significant difference between the influence of workforce competence on construction project performance in both small and large construction projects because the p-value is greater than 0.05 (0.283 > 0.05).

The results of this study are in accordance with the opinions of various previous studies, such as those stated by Pridani & Handayani (2025), regarding the Influence of Workforce Characteristics on the Success of Construction Projects, which stated that workforce competence has a significant influence on the success of construction projects. Another study by Putri et al. (2025), regarding the Correlation Between Human Resource Competence and Construction Project Success, stated that construction workforce competence significantly influences project success through factors such as experience, loyalty, and professional certification.

The Effect of Certification as a Moderator in the Relationship Between Competence and Construction Project Performance on Large and Small Construction Projects in Bali Province

The findings of this study indicate that, overall, construction worker certification can strengthen the relationship between competency and construction project performance. The path coefficient value is 0.223, indicating a positive value, and the t-statistic test results are 2.239 with a p-value of 0.013, indicating that certification can moderate the relationship between competency and construction project performance in a positive direction.

However, after categorizing large and small construction projects, differences are observed. Large construction projects have a higher t-statistic value of 1.983, while small projects have a t-statistic value of 1.189. The p-value for large construction projects is lower at 0.033, while small projects have a p-value of 0.117. The difference in the path coefficient values between small and large construction projects is 0.029. There is no significant difference between the influence of workforce certification as a moderating variable on the relationship between workforce competency and construction project performance in both small and large construction projects because the p-value is greater than 0.05 (0.452 > 0.05).

CONCLUSION

This study found that construction workforce competence, encompassing skills, knowledge, and work attitudes, had a positive and significant influence on construction project performance in both large and small construction projects in Bali Province, with no significant difference observed between the two project scales. Labor certification, as a moderating variable, further strengthened the relationship between workforce competence and project performance in both groups, again with no significant difference between large and small projects. These findings confirm that competence and certification are equally critical determinants of project success regardless of project scale. Future research could expand the scope beyond Bali Province to other regions in Indonesia to examine whether these findings hold across different regulatory environments and construction contexts, or could explore additional moderating variables, such as project complexity or contractor classification, to provide a more comprehensive understanding of the factors driving construction project performance.

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