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Factors Affecting Contractor Performance in Construction Projects

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Abstract— *Contractor performance in construction projects is a critical factor that directly influences overall project success. This p erformance is shaped by multiple variables, including variable of project management, variable of contractor experience, and variable of prevailing economic and environmental conditions. This study aims to identify and analyze the significant factors affecting contractor performanc e in construction settings. A quantitative research approach was employed, with data collected through surveys and structured interviews involving contractors and key stakeholders. The findings indicate that Project Scope Understanding (X1) with a hypothesis value of 2.355, Communica tion and Problem Solving (X4) with 2.703, and Human Resources Quality (X5) with 2.538 are statistically significant factors influencing contractor performance. These results underscore the importance of technical clarity, effective communication, and competent personnel in achieving o ptimal project outcomes. The study provides practical insights for contractors, project managers, and stakeholders in formulating strategies to enhance contractor performance and ensure the sustainable success of construction projects.*

Keywords— *Contractor performance, significant factors affecting, project management.*

I. INTRODUCTION

Construction projects are a series of time-limited, dynamic activities with varying intensities and constrained budgets. Problems may arise when not achieved, potentially leading to conflicts among stakeholders. Conflict is defined as a condition of incompatibility between values or objectives, either within individuals or in their interactions, which may impact work efficiency and productivity [1]. The construction services industry is one of the most dynamic sectors in Indonesia, involving owners, consultants, contractors, and others, and shows increasing trends annually [2]. Contractors are business entities that execute construction work based on jointly agreed terms and regulations. They may be individuals with legal status or corporate bodies actively involved in construction execution [3].

Contractor performance is an increasingly critical issue in today's competitive construction industry. Project success is now measured not only in terms of time and cost, but also final quality and stakeholder satisfaction. According to data from the Central Bureau of Statistics, Indonesia's construction sector contributes around 10% to the national Gross Domestic Product (GDP), underscoring the importance of contractor performance improvement for economic growth [4]. Various factors influence contractor performance, including project management, human resource quality, and external conditions such as weather and government regulations.

In this context, identifying and managing these influencing factors is essential. This study aims to further explore those factors and provide recommendations for best practices in construction project management.

II. LITERATURE REVIEW

2.1. Construction Project

A project is an activity undertaken within limited time and resources to achieve a predetermined outcome. In striving for this outcome, project activities are constrained by budget, schedule, and quality—commonly referred to as the "triple constraint." The term construction can be defined as the arrangement or composition of building elements, where each part is positioned according to its intended function. When discussing construction, one typically envisions high-rise buildings, bridges, dams, highways, irrigation structures, airports, and similar infrastructure [5].

A construction project is a sequence of coordinated activities aimed at producing a physical infrastructure. Given the inherent limitations in resources and time, effective and well-directed management is essential to ensure that the project's final objectives are successfully achieved [6].

2.2. Construction Management

Construction management is composed of two terms: "management" and "construction." The word management originally derives from the practice of training horses to lift their legs in a controlled manner, symbolizing coordination and discipline. Meanwhile, construction refers to the arrangement of building elements, in which the position and function of each part are aligned with its intended purpose [5]. Based on this understanding, construction management can be defined as a systematic effort carried out through a managerial process involving planning, execution, and control of project activities from inception to completion. This process entails the effective and efficient allocation of resources to achieve satisfactory outcomes aligned with predetermined project objectives.

Construction management also serves as a strategic framework that integrates technical knowledge, leadership, time management, and quality assurance to deliver infrastructure projects under complex and dynamic conditions. It requires a comprehensive approach that not only focuses on physical construction but also addresses contractual, financial, and human resource aspects that influence project performance [7].

2.3. Contractor Project

Project contractors are business entities contracted or hired to execute construction projects in accordance with the terms of a contract awarded by the project owner. In the implementation of construction projects, numerous tasks must be completed within the project's established duration. To manage this complexity, the main contractor often engages subcontractors as strategic partners to assist in completing specific tasks, thereby reducing the likelihood of performance deficiencies. In this context, a contractor can be defined as a company or organization that provides construction execution services and holds a formal agreement with the project owner [8], [9]. During execution, contractors typically collaborate with other firms to supply materials or perform specific portions of the construction work [10].

According to Law Number 2 of 2017 concerning Construction Services, a contractor is considered a service provider that delivers construction-related services.

A service provider is defined as any entity delivering construction services, while construction services, as stated in Article 1, are described as consultancy services and/or construction works. Construction works encompass all or part of activities that include building, operating, maintaining, dismantling, and reconstructing a structure [11].

Performance refers to the act of executing tasks and producing work outputs. In the context of construction, contractor performance is categorized into two dimensions: output-based and service-based. The output-based dimension includes aspects such as material quality, aesthetics, safety, and adequacy, while the service-based dimension covers punctuality, consistency, responsiveness, and security. Notably, nearly every year, many contractors underperform due to poor resource management and organizational limitations [12]. These performance issues highlight the importance of robust project governance and strategic resource allocation to meet the demands of increasingly complex construction environments.

2.4. Factors Affecting Consultant Performance Satisfaction

Several factors play a crucial role in influencing satisfaction with contractor performance in construction projects. Among these, the contractor's understanding of the project scope, effective project planning and management, and quality control are significant aspects that shape clients' positive perceptions of contractor performance [13]. These factors not only reflect technical competence but also indicate a contractor's commitment to meeting project expectations and professional standards.

Moreover, competence in problem-solving—especially in managing time, cost, and quality—stands out as a critical indicator in evaluating contractor performance. The ability to respond decisively in dynamic project conditions demonstrates sound managerial and operational capacity.

Equally important is the contractor's implementation of strategies to maximize human resources, which reflects a strong commitment and sense of responsibility for ensuring overall project success. Optimizing team capacity directly contributes to efficiency, productivity, and stakeholder satisfaction.

Based on this rationale, this study analyzes five main independent variables suspected to significantly influence the dependent variable, namely Satisfaction with Contractor Performance (Y).

These five variables include:

a) X1: Understanding of Scope Constructions
b) X2 Construction Planning and Control
c) X3 Quality and Performance Monitoring
d) X4 Communication and Problem Solving
e) X5 Human Resources

2.5. Conceptual Framework

To facilitate understanding of the directional relationships among the variables in this study, the researcher developed a conceptual framework as the basis for analyzing the influence of various factors on satisfaction with the performance of construction project supervisors.

This framework was constructed based on variables identified through theoretical review and aligned with the research objectives, which focus on analyzing the factors that affect satisfaction with supervisory consultant performance in construction projects.

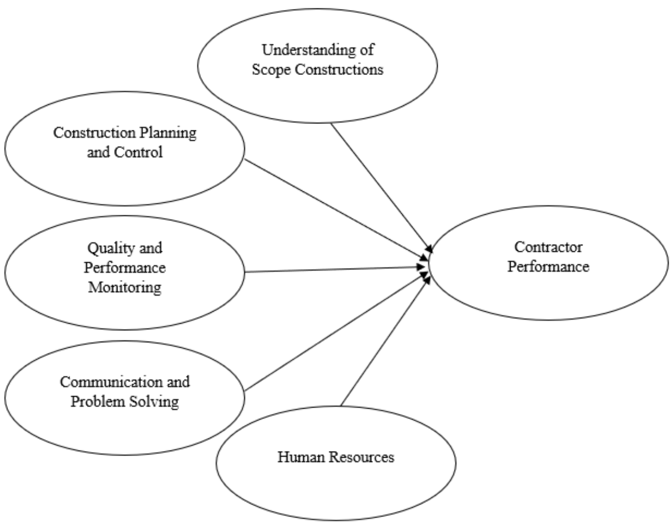

Fig. 1. Conceptual Framework

III. RESEARCH METHODOLOGY

This study employs a quantitative approach through direct field investigation. The primary data source consists of numerical-scale questionnaires used as the main measurement instrument [14], [15]. To complement the analysis, secondary data were also utilized, obtained from scholarly literature including books, academic journals, and other credible references.

The respondents in this research comprise all individuals directly involved in the construction of the ABC building project, totaling 20 participants. Data collection was conducted through the distribution of structured questionnaires designed to capture relevant variables [16], [17].

The collected data were analyzed using the Structural Equation Modeling (SEM) approach, with the Partial Least Squares (PLS) technique applied to test the previously formulated hypotheses. This analytical method was selected due to its suitability for small sample sizes and its ability to handle complex variable relationships within construction project contexts [18].

This study explores the influence of several independent variables on the dependent variable, namely contractor performance in construction projects [19]. The independent variables include: Project Scope Understanding (X1), Project Planning and Control (X2), Quality and Performance Monitoring (X3), Communication and Problem Solving (X4), and Human Resources (X5). Each variable represents a critical element of project execution, contributing to the overall effectiveness of construction outcomes. These dimensions reflect both technical and managerial competencies essential in delivering projects that time, cost, and quality expectations [20].

The dependent variable, Contractor Performance (Y), is assessed based on indicators such as timeliness, service quality, responsiveness, and stakeholder satisfaction. By examining the relationship between these variables, the study aims to identify which factors most significantly affect contractor success. The findings are expected to provide insights for construction managers and practitioners in improving operational strategies and enhancing project delivery standards.

The following is the operational definition of each research variable as follows:

1. Contractor Performance (Y) is measured through three main indicators: timeliness in completing work according to schedule (Y1), quality of work results in accordance with specifications (Y2), and efficiency in resource utilization during project execution (Y3). These three aspects reflect the extent to which the contractor is able to meet the project owner's expectations in terms of time, quality, and optimal resource management [21], [22].
2. The Project Scope Understanding phase (X1) involves several critical aspects. First, the contractor is expected to have a clear understanding of the scope of work as outlined in the contract (X1.1). Second, the contractor must consistently carry out tasks in accordance with the agreed project scope (X1.2). Lastly, the contractor should be capable of managing scope changes effectively and in compliance with established procedures (X1.3). These elements ensure that the contractor aligns with project objectives and responds adaptively to any adjustments.
3. The Project Planning and Control stage (X2) includes several important activities that reflect the contractor's ability to manage time and cost effectively. First, the contractor prepares a realistic and feasible project schedule (X2.1) and ensures that all work is completed according to the agreed timeline (X2.2). In addition, the contractor demonstrates the capability to accurately identify the project's critical path (X2.3), which is essential for prioritizing tasks and minimizing delays. Cost management is also addressed through the development of accurate and realistic cost estimates (X2.4), along with effective cost control aligned with the approved budget throughout the project's execution (X2.5). Together, these elements form the foundation for successful and efficient project delivery.
4. The Quality and Performance Monitoring aspect (X3) involves several essential practices carried out by the contractor to ensure project standards are consistently met. These include regular monitoring and reporting of project costs (X3.1), routine supervision of quality throughout the construction phase (X3.2), and the use of materials and equipment that comply with the required technical specifications (X3.3). Additionally, the contractor conducts periodic quality testing on completed work (X3.4), establishes a clear communication plan from the beginning of the project (X3.5), and utilizes communication tools that are effective and suited to the project's needs (X3.6). These efforts contribute significantly to maintaining performance standards and achieving project objectives [23], [24].
5. The Communication and Problem-Solving aspect (X4) reflects how effectively the contractor supports smooth project execution through various forms of engagement and coordination. This includes proactive communication that facilitates project continuity (X4.1) and active involvement of stakeholders in critical decision-making processes (X4.2). The contractor demonstrates professionalism in handling conflicts with stakeholders (X4.3) and responds to feedback promptly and appropriately (X4.4). Progress reports accurately reflect actual field conditions (X4.5), with minimal or no reporting errors or inconsistencies (X4.6). Furthermore, the contractor is capable of overcoming challenges such as weather, logistics, and technical issues, ensuring the project proceeds on schedule (X4.7) [25].
6. The Human Resources aspect (X5) focuses on the organization and deployment of competent personnel within the construction project. It includes ensuring that all key positions in the project organization are filled by qualified individuals (X5.1), that there are no overlaps or gaps in responsibilities within the project's organizational structure (X5.2), and that the contractor appoints key personnel—such as project managers, supervisors, and field implementers—according to the specific needs of the project (X5.3). This structured approach helps ensure smooth coordination and effective project execution [26].

IV. Result and Discussion

In utilizing the Partial Least Square (PLS) method for data analysis, the model testing process is divided into two main stages: the measurement model test and the structural model test. The measurement model, often referred to as the outer model, aims to assess the extent to which the indicators used can accurately represent the constructs or latent variables being studied. In the meanwhile, the inner model assesses the strength of the connections between the independent latent constructs and the dependent latent construct. The stages of the outer model testing for each respective model are described as follow:

4.1. Outer Model

1. Convergent Validity

One of the important stages in assessing the quality of indicators in the outer model is measuring convergent validity. This test is conducted by observing the loading factor value of each indicator toward the latent variable it represents. In order for an indicator to be declared as convergently valid, the resulting loading factor value must be greater than 0.5 [27].

This value indicates that the indicator has a sufficiently strong correlation with the construct being measured. If there is an indicator with a loading factor value below that threshold, then the indicator is considered less capable of adequately representing the construct and may be considered for removal from the model. The evaluation process is carried out gradually (iteratively), and the model continues to be refined until all retained indicators have loading factor values that meet the convergent validity criteria (> 0.5). After this stage is fulfilled, the analysis may proceed to other validity tests or to the evaluation of the structural model (inner model).

TABLE 1. Convergent Validity

Variable	Items	Sample	Result
Understanding of Scope Constructions (X1)	X1.1	0.980	Valid
	X1.2	0.599	Valid
	X1.3	0.491	Not Valid
Construction Planning and Control (X2)	X2.1	0.468	Not Valid
	X2.2	0.676	Valid
	X2.3	0.237	Not Valid
	X2.4	0.939	Valid
	X2.5	0.531	Not Valid
Quality and Performance Monitoring (X3)	X3.1	0.339	Not Valid
	X3.2	0.487	Not Valid
	X3.3	0.983	Valid
	X3.4	0.958	Valid
	X3.5	0.533	Not Valid
	X3.6	0.800	Valid
Communication and Problem Solving (X4)	X4.1	0.713	Valid
	X4.2	0.742	Valid
	X4.3	0.498	Not Valid
	X4.4	0.655	Valid
	X4.5	0.462	Not Valid
	X4.6	0.597	Valid
	X4.7	0.614	Valid
Human Resources (X5)	X5.1	0.833	Valid
	X5.2	0.397	Not Valid
	X5.3	0.916	Valid
Contractor Performance (Y)	Y1	0.523	Valid
	Y2	0.768	Valid
	Y3	0.519	Valid
	Y4	0.901	Valid

Source: PLS Processed Products

Based on Table 1, the results of the loading factor analysis for each indicator suggest that most indicators for each construct variable demonstrate an adequate level of convergent validity, as indicated by values above the threshold of 0.5.

For the variable Project Scope Understanding (X1), indicators X1.1 and X1.2 show loading factor values of 0.980 and 0.599, respectively. Since both values exceed the minimum threshold of 0.5, these indicators are considered suitable for measuring the X1 construct.

For the Project Planning and Control (X2) variable, two indicators—X2.2 and X2.4—record loading factor values of 0.676 and 0.939, respectively. Thus, both items can be deemed valid in representing the X2 construct.

Meanwhile, the Quality and Performance Monitoring (X3) variable consists of six indicators, with X3.3, X3.4, and X3.6 yielding loading factor values of 0.983, 0.958, and 0.800, respectively. All three indicators meet the criteria for convergent validity and are therefore acceptable for measuring X3.

For the variable Communication and Problem Solving (X4), four indicators passed the validity test: X4.1 (0.713), X4.2 (0.742), X4.4 (0.655), and X4.6 (0.597). Despite varying in magnitude, all indicators exceed the 0.5 threshold and thus meet the requirements for convergent validity.

The Human Resources (X5) variable is measured using three indicators, two of which—X5.1 and X5.3—achieved values of 0.833 and 0.916, indicating that both are valid for measuring the corresponding construct.

Finally, for the Contractor Performance (Y) variable, four indicators were tested. Three of them—Y1 (0.523), Y2 (0.768), and Y3 (0.519)—recorded values above 0.5 and can therefore be considered valid indicators of construct Y. Indicator Y4 even demonstrated a very strong correlation with a value of 0.901. Overall, all indicators with loading factors greater than 0.5 are acceptable and can be retained for subsequent analysis in the PLS modeling process.

2. Discriminant Validity

Discriminant validity testing is conducted to ensure that each indicator measures only the construct it is intended to represent and does not exhibit a stronger association with other constructs in the model.

One common method for evaluating discriminant validity is by analyzing cross-loading values, which refer to the correlations between each indicator and all latent variables in the model [28].

An indicator is considered to exhibit good discriminant validity if its correlation value is highest with its intended construct compared to its correlations with other constructs. In other words, the indicator should reflect its designated variable more strongly than it does any other variable within the mode

TABLE 2. Cross Loading

	(X1)	(X2)	(X3)	(X4)	(X5)	(Y)
X1.1	0.980	0.288	0.149	0.359	-0.035	0.138
X1.2	0.599	0.314	0.152	0.222	-0.099	0.034
X2.2	0.079	0.676	0.270	0.364	0.181	0.162
X2.4	0.370	0.939	0.191	0.568	0.156	0.346
X3.3	0.339	0.206	0.683	0.111	0.173	0.184
X3.5	0.085	0.285	0.958	0.413	0.500	0.573
X3.6	0.133	0.050	0.800	0.276	0.169	0.203
X4.1	0.128	0.536	0.343	0.713	0.175	0.347
X4.2	0.295	0.331	0.262	0.742	0.272	0.426
X4.4	0.182	0.399	0.124	0.655	0.167	0.350
X4.6	0.268	0.383	0.279	0.597	0.362	0.371
X4.7	0.301	0.338	0.234	0.614	0.266	0.523
X5.1	-0.050	0.101	0.399	0.156	0.883	0.768
X5.3	-0.045	0.234	0.363	0.502	0.916	0.901
Y1	0.301	0.338	0.234	0.614	0.266	0.523
Y2	-0.050	0.101	0.399	0.156	0.883	0.768
Y3	0.434	0.430	0.361	0.739	0.248	0.519
Y4	-0.045	0.234	0.363	0.502	0.916	0.901

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Source: PLS Processed Products

Based on the results presented in Table 2, all indicators demonstrate the highest correlation with their respective constructs. For instance, indicator X1.1 shows a loading value of 0.980 with the Project Scope Understanding (X1) variable, which is significantly higher than its correlations with other variables. A similar pattern is observed in other indicators, such as X2.4 with a loading of 0.939 on Project Planning and Control (X2), and X3.5 with a loading of 0.958 on Quality and Performance Monitoring (X3).

Additionally, indicators under the Communication and Problem-Solving (X4) construct—such as X4.2 and X4.7—consistently show the highest correlations with their own construct, at 0.742 and 0.614 respectively, compared to other variables in the model.

The Human Resources (X5) construct also exhibits strong internal consistency, with indicators X5.1 and X5.3 registering loading values of 0.883 and 0.916—both considerably higher than their correlations with other constructs. A similar observation applies to the Contractor Performance (Y) construct, where indicator Y4 records the highest loading value of 0.901, confirming its strong alignment with the intended variable.

Overall, these findings indicate that all indicators in the model possess good discriminant validity, as each indicator correlates more strongly with its own construct than with any other construct.

Therefore, no indicators need to be eliminated based on this test result, and the model is deemed ready to proceed to the next stage of evaluation

3. Composite Reliability

An important next step in evaluating the measurement model is to examine the composite reliability of each construct. This test aims to determine the extent to which the set of indicators consistently represents a latent variable. A construct is considered to have adequate reliability if its composite reliability value exceeds the threshold of 0.60. This value indicates the level of internal consistency among the indicators within a single construct.

TABLE 3. Composite Reliability

	Composite Reliability
Understanding of Scope Constructions (X1)	0.780
Construction Planning and Control (X2)	0.732
Quality and Performance Monitoring (X3)	0.685
Communication and Problem Solving (X4)	1.526
Human Resources (X5)	1.326
Contractor Performance (Y)	0.770

Source: PLS Processed Products

Based on the results presented in Table 3, all constructs in this study exhibit composite reliability values exceeding the minimum threshold, indicating satisfactory internal consistency among their respective indicators. For example, Project Scope Understanding (X1) achieved a reliability score of 0.780, Project Planning and Control (X2) scored 0.732, and Quality and Performance Monitoring (X3) reached 0.685. Notably, Communication and Problem-Solving (X4) and Human Resources (X5) displayed exceptionally high reliability values of 1.526 and 1.326, respectively, reflecting strong internal stability. The dependent variable, Contractor Performance (Y), also met the reliability criterion with a score of 0.770.

These results affirm that all variables meet the composite reliability standards, suggesting that the constructs used in the model are robust and dependable for continued analysis in the structural modeling phase

3. Cronbach Alpha

Following the reliability assessment using composite reliability values, a further evaluation was conducted by examining Cronbach's Alpha to ensure the internal consistency of each construct more comprehensively. This test provides an overview of how closely related and consistent the items within a given variable are in measuring the same construct. In general, a construct is considered to have acceptable reliability if its Cronbach's Alpha value exceeds 0.60, indicating that the indicators used within the construct demonstrate good internal consistency.

TABLE 4. Cronbach Alpha

	Cronbach Alpha
Understanding of Scope Constructions (X1)	0.766
Construction Planning and Control (X2)	0.641
Quality and Performance Monitoring (X3)	0.689
Communication and Problem Solving (X4)	0.600
Human Resources (X5)	0.784
Contractor Performance (Y)	0.553

Source: PLS Processed Products

Based on the results shown in Table 4, most constructs in the model meet the required reliability threshold. Constructs such as *Project Scope Understanding (X1)* and *Human Resources (X5)* demonstrate strong internal consistency, with Cronbach's Alpha values of 0.766 and 0.784, respectively. Likewise, *Quality and Performance Monitoring (X3)* and *Project Planning and Control (X2)* record acceptable reliability values of 0.689 and 0.641. Although *Communication and Problem-Solving (X4)* stands right at the minimum threshold with a value of 0.600, it is still considered reliable. However, the *Contractor Performance (Y)* construct shows a Cronbach's Alpha of 0.553, slightly below the recommended cut-off point, indicating relatively lower internal consistency that warrants careful interpretation in the subsequent analysis.

4. Average Variance Extracted (AVE)

The Average Variance Extracted (AVE) test is used to evaluate how well a latent variable explains the variance of its associated indicators. A high AVE value indicates strong internal correlation among indicators and sufficient discriminant validity of the construct. In general, an AVE value is considered acceptable if it exceeds the threshold of 0.50, meaning that more than half of the variance of the indicators can be explained by the latent construct being measured [27].

TABLE 5. AVE Value

	AVE
Understanding of Scope Constructions (X1)	0.766
Construction Planning and Control (X2)	0.641
Quality and Performance Monitoring (X3)	0.689
Communication and Problem Solving (X4)	0.600
Human Resources (X5)	0.784
Contractor Performance (Y)	0.553

Source: PLS Processed Products

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Referring to the results in Table 5, most constructs in the model meet the minimum threshold for Average Variance Extracted (AVE), indicating satisfactory discriminant validity. Constructs such as Project Scope Understanding (X1), Communication and Problem-Solving (X4), Human Resources (X5), and Contractor Performance (Y) recorded AVE values above 0.50, suggesting strong explanatory power of the latent constructs toward their indicators.

However, two constructs Project Planning and Control (X2) and Quality and Performance Monitoring (X3) have AVE values of 0.486 and 0.444, respectively, which fall below the acceptable threshold. This indicates that a significant portion of the indicator variance remains unexplained and calls for further review, particularly of indicators with limited contribution. In summary, while most constructs demonstrate adequate convergent validity, those below the standard may still be retained with caution and considered for refinement in future model development stages.

4.2. Inner Model

Structural model analysis in the Partial Least Squares (PLS) approach aims to evaluate the relationships between latent constructs. One key indicator of model strength is the R-Square (R^2) value of the endogenous latent variable, which shows how much of its variability is explained by the independent construct. Based on the guidelines presented by Ghozali (2014), the R^2 value in the context of a PLS model can be interpreted as follows:

- $R^2 \geq 0.67$ indicates a high (strong) predictive power,
- Around 0.33 reflects a moderate level of predictiveness,
- And around 0.19 suggests a low (weak) predictive capability.

TABLE 6. R-Square Valeu

	R Square	R Square Adjusted
Contractor Performance (Y)	0.959	0.948

Source: PLS Processed Products

Referring to the results presented in Table 6, it is known that the Contractor Performance (Y) construct obtained an R^2 value of 0.959, which indicates that 95.9% of the variability in variable Y can be explained by five independent constructs:

- Project Scope Understanding (X1),
- Project Planning and Control (X2),
- Quality and Performance Monitoring (X3),
- Communication and Problem-Solving (X4),
- Human Resources (X5).

Thus, the model demonstrates a very strong level of predictiveness and indicates that the exogenous variables contribute significantly in shaping the endogenous variable.

To assess the predictive relevance of the model, the Q-Square (Q^2) value is used, which is calculated using the following formula:

$= 1 – [(1 – R1)]$
$= 1 – [(1 – 0{,}959)]$
$= 1 – [(0{,}041)]$
$= 0{,}959$

The Q^2 value of 0.959, or 95.9%, indicates that the model possesses excellent predictive ability. This suggests that the information obtained from the model is sufficiently accurate in representing the actual observed.

Based on these results, it can be concluded that the structural model in this study possesses not only strong explanatory power but also excellent predictive relevance. This provides a solid foundation for proceeding to a more in-depth interpretation of the relationships among constructs through the examination of path coefficient significance.

4.3. Hypothesis Test

The PLS model in this study is designed to evaluate the influence of independent variables on Contractor Performance (Y) as the dependent variable.

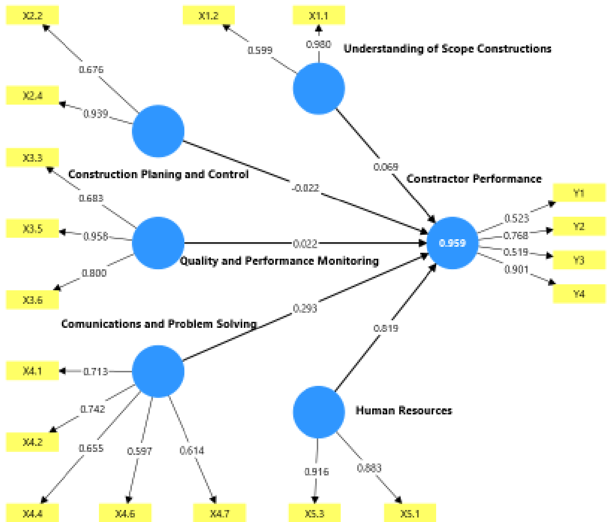

Figure 2. PLS Algorithm Models

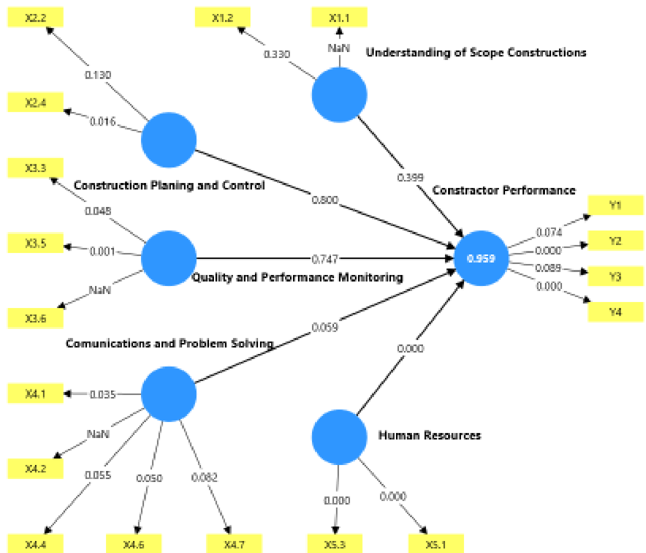

Figure 3. PLS Bootstrapping Models

The structural model diagram illustrates the inter relationships among the constructs, from which the following structural equation can be formulated based on the visual representation.

$$Y = -0{,}561X1 + 0{,}351X2 - 0{,}244X3 + 1{,}001X4 - 0{,}756X5$$

To determine whether the influence among variables is statistically significant, a t-test using the bootstrapping method was conducted. The reference t-table value used is 1.96, corresponding to a 5% significance level with a two-tailed test.

The hypothesis testing results based on Table 7 are explained as follows.

TABLE 7. Hypothesis Testing Results

Hypothesis	Original Sample (O)	T Statistics (|O/STDEV|)	Notes
X1 → Y	-0,561	2,355	Significant
X2 → Y	0,351	1,660	Not Significant
X3 → Y	-0,244	1,020	Not Significant
X4 → Y	1,001	2,703	Significant
X5 → Y	-0,756	2,538	Significant

Source: PLS Processed Products

1. *The Influence of Project Scope Understanding (X1) on Contractor Performance (Y)*

   The Project Scope Understanding (X1) variable has a negative coefficient value of -0.561 and a t-statistic of 2.355. Since the t-statistic exceeds the critical value of 1.96, X1 has a significant effect on contractor performance. This indicates that a low initial understanding of the work scope can significantly reduce contractor performance.
2. *The Influence of Project Planning and Control (X2) on Contractor Performance (Y)*

   The Project Planning and Control (X2) variable shows a positive coefficient value of 0.351; however, the t-statistic is only 1.660, which falls below the threshold of 1.96. Therefore, no significant effect is found between X2 and Y, even though the relationship is positive in direction
3. *The Influence of Quality and Performance Monitoring (X3) on Contractor Performance (Y)*

   For the Quality and Performance Monitoring (X3) variable, the regression coefficient is -0.244, and the t-statistic is recorded at 1.020. Since the t-value is below the critical threshold of 1.96, it can be concluded that the influence of X3 on Y is not statistically significant.
4. *The Influence of Communication and Problem-Solving (X4) on Contractor Performance (Y)*

   The Communication and Problem-Solving (X4) variable shows a positive coefficient of 1.001, with a t-statistic of 2.703. This indicates that X4 has a significant influence on Y. In other words, better communication and problem-solving on site will lead to a tangible improvement in contractor performance.
5. *The Influence of Human Resources (X5) on Contractor Performance (Y)*

   The Human Resources (X5) variable shows a negative effect of -0.756, with a t-statistic of 2.538. Since this exceeds the critical value of 1.96, the effect is considered statistically significant. This indicates that issues related to human resources can substantially reduce contractor performance.

V. Conclusion

The results of this study provide comprehensive insights into the key determinants of contractor performance in construction projects. Empirical analysis using the Partial Least Squares (PLS) approach confirms that three variables—Project Scope Understanding (X1), Communication and Problem-Solving (X4), and Human Resources (X5)—have a significant influence on Contractor Performance (Y). These findings highlight the critical importance of early clarity in project scope, effective on-site communication, and well-managed human capital in driving performance outcomes.

Conversely, the influence of Project Planning and Control (X2) and Quality and Performance Monitoring (X3) was found to be statistically insignificant, despite their conceptual relevance.

This suggests that while planning and monitoring are essential, their impact may be indirect or mediated by other factors such as communication and workforce responsiveness.

The strength of the structural model is further supported by its high explanatory power ($R^2 = 0.959$) and excellent predictive relevance ($Q^2 = 0.959$), indicating that the five independent variables collectively explain a substantial portion of the variability in contractor performance.

From a practical standpoint, these results offer actionable guidance for construction service providers. Enhancing workers' understanding of project scope, investing in structured communication strategies, and implementing regular, competency-based training programs can substantially improve overall performance and reduce execution risks.

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