Development of Lean Management Model with Target Value Delivery Approach and Cost Optimization Simulation to Improve Design-Build Contract Project Cost Performance of PT. X

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ABSTRACT : *The increasing adoption of the design and build contract method in the construction industry requires more effective and efficient management approaches to achieve optimal project performance. However, challenges in cost, quality, and time control still frequently occur, particularly in the form of cost overruns, which negatively impact overall project performance.*
This study aims to develop a Lean Management model integrated with the Target Value Delivery (TVD) approach and cost optimization simulation to improve project cost performance. The research employs a quantitative approach using descriptive and inferential statistical analyses, including validity and reliability tests, as well as regression analysis to identify relationships among research variables. Data were collected through questionnaires distributed to construction practitioners and project data analysis from PT. X as a case study. The results indicate that Lean Management, Target Value Delivery, and cost optimization simulation variables have a positive influence on project cost performance, both partially and simultaneously. Furthermore, the integration of these three approaches enhances the effectiveness of cost control through waste reduction, cost control from the design stage, and data-driven decision-making based on simulation. The developed model is expected to provide a solution for minimizing the risk of cost overruns in design and build projects.

KEYWORDS – *Lean Management, Target Value Delivery, Cost Optimization Simulation, Design and Build Contract, Project Cost Performance*

I. INTRODUCTION

Industrial building projects are characterized by high levels of complexity due to the integration of architectural, structural, mechanical, electrical, environmental, and operational requirements throughout the project lifecycle. In Indonesia, many industrial construction projects are delivered using the design-build method because it offers advantages in time efficiency, cost integration, and centralized responsibility between design and construction processes. However, despite these advantages, design-build projects remain highly vulnerable to cost overruns caused by uncertainties during both design and construction stages. Previous studies have identified several major factors contributing to cost overruns in design-build projects, including inaccurate early cost estimation, design changes, weak coordination between design and construction teams, inefficient project workflows, and inadequate cost control systems [1].

In addition, many construction projects still rely on conventional and manual cost management approaches, making it difficult to respond to dynamic changes in productivity, material prices, and project risks. The cost overrun phenomenon has also become a significant issue in Indonesian construction projects. According to data from PT. X, approximately 25% of design-build projects executed during the 2021–2026 period experienced cost overruns that negatively affected company profitability. At the national level, the construction sector contributes more than 9% to Indonesia's Gross Domestic Product (GDP), yet project inefficiencies and increasing construction costs continue to reduce industry competitiveness compared to other ASEAN countries.

The cost overrun phenomenon has also become a significant issue in Indonesian construction projects. According to data from PT. X, approximately 25% of design-build projects executed during the 2021–2026 period experienced cost overruns that negatively affected company profitability. At the national level, the construction sector contributes more than 9% to Indonesia's Gross Domestic Product (GDP), yet project inefficiencies and increasing construction costs continue to reduce industry competitiveness compared to other ASEAN countries.

To address these challenges, lean management has emerged as an important approach in improving construction project performance through waste reduction, process efficiency, and value creation. Furthermore, the Target Value Delivery (TVD) approach enables project teams to establish cost targets from the early design stage and collaboratively maintain project costs within the predefined budget. Several studies have shown that Lean Construction and TVD can improve project efficiency and cost performance. However, most previous studies have discussed these approaches separately, while research integrating Lean Management, TVD, and cost optimization simulation in design-build projects remains limited. Therefore, this study proposes an integrated Lean Management and Target Value Delivery (TVD) model supported by cost optimization simulation using Microsoft Excel and Building Information Modelling (BIM).

II. THEORETICAL BACKGROUND

2.1 Lean Management in Design-Build Construction Projects

Lean Management is a systematic approach aimed at reducing waste, minimizing errors, and optimizing resource utilization through continuous improvement processes [2]. In the construction industry, Lean Construction represents the adaptation of lean production principles into project-based construction environments. Lean has been recognized as one of the most influential managerial concepts globally due to its ability to improve operational efficiency and project performance [3].

The construction industry has long faced challenges related to low productivity, inefficient workflows, excessive waiting times, rework, design changes, and poor coordination among project stakeholders. A significant proportion of time, labor, and materials in construction activities do not generate value for the final product [4]. These non-value-added activities are categorized as waste within Lean Construction principles.

Several studies have demonstrated that Lean Management positively influences construction project performance, particularly in improving productivity, reducing delays, strengthening collaboration, and enhancing operational efficiency [5] - [7]. Therefore, Lean Management is increasingly considered an important strategy for improving cost and schedule performance in complex construction projects.

2.2 Target Value Delivery (TVD)

Target Value Delivery (TVD) is a cost management approach developed from the concept of Target Costing, which aims to ensure that project design and construction remain within predefined cost targets from the earliest project stages [8]. Unlike conventional approaches where project costs are estimated after the design process is completed, TVD treats cost as a primary design constraint throughout project development.

The integration of Lean Management and TVD creates a value-based project delivery approach that simultaneously focuses on process efficiency and cost control. Previous studies have shown that integrating Lean and TVD improves project collaboration, reduces rework, enhances productivity, and strengthens overall project cost performance [9], [3].

2.3 Cost Optimization Simulation

Cost optimization simulation is a quantitative approach used to model uncertainty in construction project cost estimation and evaluate potential cost outcomes under varying project conditions [10]. Traditional deterministic cost estimation methods generally rely on single-point estimates and often fail to represent actual project variability and risk. Therefore, probabilistic simulation approaches have become increasingly important in improving estimation accuracy and supporting more reliable project cost forecasting [11].

Several probability distributions are commonly used in construction cost simulation, including triangular distribution and uniform distribution. Uniform distribution is particularly useful during early project stages when historical data are limited and all values within a defined range are assumed to have equal probability of occurrence [10].

2.4 Relationship Between Lean Management, TVD, and Cost Performance

Previous studies have demonstrated that Lean Management significantly improves organizational and project performance by enhancing productivity, reducing waste, improving workflow reliability, and strengthening collaboration among project stakeholders [5], [7].

Similarly, Target Value Delivery (TVD) has been shown to improve cost control and design efficiency by integrating collaborative decision-making processes throughout project development [12].

Meanwhile, cost optimization simulation supports project performance improvement by enabling quantitative analysis of project uncertainties and alternative decision scenarios.

2.5 Conceptual Model

Furthermore, in this study, Target Value Delivery (TVD) and Cost Simulation are positioned as mediating variables in the relationship between Lean Management and construction project performance, particularly in design-build projects. The inclusion of these mediating variables is based on the limited number of studies that specifically examine the integration of Target Value Delivery and cost simulation approaches within the context of design-build construction projects. Therefore, a more comprehensive conceptual framework is required to address this existing research gap.

In addition, the selection of TVD and Cost Simulation as research variables is motivated by the increasing complexity and competitiveness of the construction industry. To improve project competitiveness and value creation, construction organizations are required to optimize project value from the earliest planning stages. TVD principles encourage collaborative decision-making and alignment between project design and target cost objectives, while Cost Simulation supports quantitative and predictive validation of project cost feasibility under uncertain project conditions.

The integration of Lean Management, TVD, and Cost Simulation is therefore expected to improve overall construction project performance, particularly in terms of cost efficiency, quality achievement, and schedule performance. Based on the theoretical discussions presented above, this study proposes an integrated conceptual model synthesizing Lean Management, Target Value Delivery, and Cost Simulation to improve the performance of design-build construction projects. The conceptual framework of this study is illustrated in Figure X.

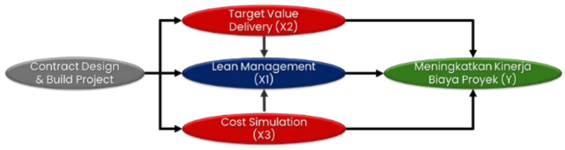

Figure 1. Model of Relationship

III. METHOD

This study employed a quantitative research approach to examine the relationships between Lean Management, Target Value Delivery (TVD), Cost Simulation, and Construction Project Performance in design-build projects.

Sample

The sample in this study consisted of construction professionals involved in design-build projects in Indonesia. Respondents were selected using purposive sampling based on the following criteria: (1) having experience in construction project implementation, (2) possessing involvement in Lean Management, Target Value Delivery, and Cost Simulation practices, and (3) having exposure to construction project performance evaluation.

The targeted respondents primarily included Project Managers, Site Engineering Managers, Lean Coordinators or Lean & Value Engineering Officers, procurement personnel, and logistics or equipment managers from state-owned construction enterprises (BUMN) within the Project Management Office (PMO) environment.

The determination of sample size referred to the rule of thumb for multiple linear regression analysis, which recommends a minimum sample size of 5–10 times the number of independent variables [13].
Since this study involved three independent variables, the minimum required sample ranged from 15 to 30 respondents. To ensure adequate statistical analysis using SPSS, this study employed 40 respondents, which exceeded the recommended minimum sample size.

Data Collection
Prior to questionnaire distribution, 91 indicators were validated by five construction experts. The validation to experts process involved two main stages: content validity and construct validity. Next, a pilot survey to 10 respondents was conducted to ensure the questionnaire was easy to understand and aligned with the research objectives. After pilot survey.
Following the pilot survey, the questionnaire was distributed to 40 employees of PT. X who met the required professional background and experience criteria. The respondents consisted of construction personnel involved in design-build project implementation and project management activities.
Respondents were asked to evaluate each statement using a five-point Likert scale ranging from 1 to 5, representing strongly disagree, disagree, neutral, agree, and strongly agree, respectively. The collected responses were subsequently analyzed using SPSS to evaluate the relationships between Lean Management, Target Value Delivery, Cost Simulation, and Construction Project Performance.

Data Analysis
The collected data were analyzed using Statistical Package for the Social Sciences (SPSS) to identify the relationships between the independent variables and the dependent variable. The analysis included correlation testing to examine the strength of the relationships between Lean Management (X1) and Construction Project Performance (Y), Target Value Delivery (X2) and Construction Project Performance (Y), as well as Cost Simulation (X3) and Construction Project Performance (Y).
In addition, the coefficient of determination (R-square) was used to evaluate the ability of the independent variables to explain the variation in Construction Project Performance. The R-square value indicates the proportion of variance in the dependent variable that can be explained by the regression model.
Furthermore, t-tests were conducted to evaluate the partial influence of each independent variable on project performance, while the F-test was performed to examine the simultaneous effect of Lean Management, Target Value Delivery, and Cost Simulation on Construction Project Performance. All statistical analyses were conducted using a significance level of 5%.

Instrument Development and Measurement
Based on literature review and expert validation that have been conducted, the dimensions and indicators that represent the variable with total 91 indicators, as follows:

Table 1. Research Variables, Dimensions and Indicators

Code	Variables, Dimensions and Indicators
X1	**Lean Management**
X1.1	**5S Management**
X1.1.1	Waste Sorting and Elimination
X1.1.2	Workplace Organization
X1.1.3	Workplace Cleanliness and Discipline
X1.1.4	Standardization
X1.2	**Just in time**
X1.2.1	Material Storage Control
X1.2.2	Material Flow
X1.2.3	Inventory Accuracy
X1.3	**Last Planner System**
X1.3.1	Collaborative Planning
X1.3.2	Lookahead Planning
X1.3.3	Plan Reliability Monitoring (PPC)
X1.3.4	Corrective Actions
X1.4	**Performance Indicator Measurement**
X1.4.1	Periodic Performance Evaluation
X1.4.2	Performance Improvement Program
X1.5	**Employee Suggestions**
X1.5.1	Continuous Improvement Participation
X1.5.2	Reward for Improvement Ideas
X1.6	**Daily huddle meeting**

X1.6.1	Daily Coordination Meetings
X1.6.2	Knowledge Sharing
X1.6.3	Problem Solving
X1.7	**Visual management**
X1.7.1	Target Visualization
X1.7.2	Information Transparency
X2	**Target Value Delivery**
X2.1	**Early Involvement of All Parties**
X2.1.1	Stakeholder Involvement
X2.1.2	Collaborative Design Decisions
X2.2	**Information Transparency**
X2.2.1	Information Openness
X2.2.2	Project Data Accessibility
X2.3	**Communication Mechanism**
X2.3.1	Target Coordination
X2.3.2	Communication Effectiveness
X2.4	**Data-Based Initial Estimation**
X2.4.1	Historical Estimation
X2.4.2	Risk-Based Targets
X2.5	**Alignment of Targets with Owner Requirements**
X2.5.1	Targets Based on Owner Value
X2.5.2	Targets as Design References
X2.6	**Alignment of Design with Target Cost**
X2.6.1	Design Evaluation
X2.6.2	Efficiency Alternatives
X2.7	**Achievement of Optimal Functionality**
X2.7.1	Value Optimization
X2.7.2	Function-Based Selection
X2.8	**Design Simulation and Validation**
X2.8.1	Cost Simulation
X2.8.2	Design Validation
X2.9	**Monitoring and Adjustment**
X2.9.1	Cost Monitoring
X2.9.2	Design Adjustment
X2.10	**Risk Sharing Mechanism**
X2.10.1	Risk Allocation
X2.10.2	Contractual Support
X2.11	**Support for TVD Implementation**
X2.11.1	Early Cost Targeting
X2.11.2	Contractual Collaboration
X2.12	**Value Engineering**
X2.12.1	Value Engineering
X3	**Cost Simulation and Optimization**
X3.1	**Frequency of Cost Simulation**
X3.1.1	Routine Simulation
X3.1.2	Simulation Updates
X3.1.3	Simulation Intensity
X3.1.4	Frequency Suitability
X3.2	**Accuracy of Cost Simulation**
X3.2.1	Estimation Accuracy
X3.2.2	Sensitivity to Design Changes
X3.2.3	Accuracy Evaluation
X3.2.4	Confidence in Results
X3.3	**Integration of Simulation with Design**
X3.3.1	Use of Simulation for Design Evaluation
X3.3.2	Integration of Simulation with Technical Decisions
X3.3.3	Simulation Updates During Design Changes
X3.3.4	Understanding Cost Impacts Through Simulation
X3.4	**Design–Cost Feedback Mechanism**
X3.4.1	Formal Feedback Flow
X3.4.2	Communication Procedures
X3.4.3	Simulation-Based Improvements
X3.4.4	Feedback Utilization
X3.5	**Multidisciplinary Involvement in Simulation**
X3.5.1	Multidisciplinary Participation
X3.5.2	Collaborative Forums
X3.5.3	Cross-Disciplinary Collaboration
X3.5.4	Team Consensus
X3.6	**Use of Simulation in Cost Control**
X3.6.1	Cost Control Tool
X3.6.2	Deviation Monitoring
X3.6.3	Cost Overrun Prevention
X3.6.4	Basis for Performance Evaluation
Y	**Cost Performance**

Y.1	**Optimization of Resource Utilization**
Y.1.1	Resource Efficiency
Y.1.2	Lean Implementation for Efficiency
Y.1.3	Technology Utilization
Y.1.4	Cost Saving Documentation
Y.2	**Ratio of Actual Cost to Output**
Y.2.1	Cost per Unit Output
Y.2.2	Cost–Output Ratio Evaluation
Y.2.3	Cost Benchmarking
Y.2.4	Operational Cost Control
Y.3	**Cost Deviation Control**
Y.3.1	Budget Compliance
Y.3.2	Deviation Reporting
Y.3.3	Budget Control Discipline
Y.3.4	Approval of Budget Changes
Y.4	**Discipline in Budget Utilization**
Y.4.1	Budget Allocation Compliance
Y.4.2	Variation Order Control
Y.4.3	Unexpected Cost Control
Y.4.4	Budget Reconciliation
Y.5	**Initial Estimation Accuracy**
Y.5.1	Alignment Between Estimated and Actual Costs
Y.5.2	Accuracy of Estimation Models
Y.5.3	Estimation Deviation Evaluation
Y.5.4	Risk-Based Estimation
Y.6	**Reliability of Estimation Methods**
Y.6.1	Consistency of Estimation Methods
Y.6.2	Use of Historical Data
Y.6.3	Estimation Verification
Y.6.4	Industry Standardization

IV. RESULT

Survey consisting of 91 indicator statements was distributed to determine respondents' perceptions, resulting in a representative sample of 40 respondents. Respondents were classified into three profile categories: job position, working experience, and educational background.

Respondents' profiles

A total of 40 valid responses were collected from construction practitioners working in PT. X, a construction company in Indonesia. The respondents consist of site engineers, site engineer managers, site operation managers and project managers with different levels of experience and educational backgrounds.

Based on working experience in construction projects, most respondents (60%) have 6-10 years of working experience, indicating they have sufficient knowledge in project planning, lean management and cost control. While the other respondents (35%) have over 10 years of working experience strengthening the reliability of the data.

Test of Sampling Adequacy

The sampling adequacy test is a statistical method used to ensure that the collected data are sufficient and appropriate for further analysis. The data are considered adequate if the KMO value is ≥ 0.5 and the significance value (Sig.) is < 0.05. This study utilized SPSS software with a confidence level of 95%.

Table 2 Test of Sampling Adequacy All Variables

Test of Sampling Adequacy X1			
Indicator	**KMO**	**Sig**	**Note**
X1	0.567	0.001	Adequate
Test of Sampling Adequacy X2			
Indikator	**KMO**	**Sig**	**Note**
X2	0.506	0.001	Adequate
Test of Sampling Adequacy X3			
Indikator	**KMO**	**Sig**	**Note**
X3	0.544	0.001	Adequate
Test of Sampling Adequacy Y			
Indikator	**KMO**	**Sig**	**Note**
Y	0.572	0.001	Adequate

Homogeneity Test

The homogeneity test was conducted based on the respondents' work experience categories. Since the test groups consisted of three or more groups, the homogeneity analysis was performed using the Kruskal Wallis H-Test. The data are considered homogeneous if the Asymp. Sig. value is > 0.05. Data processing was carried out using IBM SPSS Statistics software, with the following results:

Table 3 Homogenity Test All Variables

Test Statistic (Working Experience)				
Indicator	Kruskal-Wallis H	df	Assymp. Sig	Note
X1.1.1	1.246	2	0.536	Homogen
X1.1.2	0.643	2	0.725	Homogen
X1.1.3	1.112	2	0.573	Homogen
X1.1.4	0.237	2	0.888	Homogen
X1.2.1	5.217	2	0.074	Homogen
X1.2.2	0.283	2	0.868	Homogen
X1.2.3	0.283	2	0.868	Homogen
X1.3.1	0.746	2	0.689	Homogen
X1.3.2	0.66	2	0.719	Homogen
X1.3.3	4.445	2	0.108	Homogen
X1.3.4	5.217	2	0.074	Homogen
X1.4.1	0.457	2	0.796	Homogen
X1.4.2	4.726	2	0.094	Homogen
X1.5.1	1.075	2	0.584	Homogen
X1.5.2	1.075	2	0.584	Homogen
X1.6.1	2.138	2	0.343	Homogen
X1.6.2	0.363	2	0.834	Homogen
X1.6.3	4.388	2	0.111	Homogen
X1.7.1	1.636	2	0.441	Homogen
X1.7.2	2.753	2	0.252	Homogen

Test Statistic (Working Experience)				
Indicator	Kruskal-Wallis H	df	Assymp. Sig	Note
X2.1.1	1.721	2	0.423	Homogen
X2.1.2	4.665	2	0.097	Homogen
X2.2.1	4.204	2	0.122	Homogen
X2.3.1	2.535	2	0.282	Homogen
X2.4.1	2.48	2	0.289	Homogen
X2.4.2	1.697	2	0.428	Homogen
X2.5.1	0.341	2	0.843	Homogen
X2.6.1	1.994	2	0.369	Homogen
X2.6.2	2.121	2	0.346	Homogen
X2.7.1	1.567	2	0.457	Homogen
X2.7.2	4.149	2	0.126	Homogen
X2.8.1	2.172	2	0.337	Homogen
X2.8.2	4.229	2	0.121	Homogen
X2.9.1	2.247	2	0.325	Homogen
X2.9.2	2.826	2	0.243	Homogen
X2.10.1	1.962	2	0.375	Homogen
X2.10.2	2.87	2	0.238	Homogen
X2.11.1	3.283	2	0.194	Homogen
X2.11.2	1.752	2	0.416	Homogen
X2.12.1	0.568	2	0.753	Homogen

Test Statistic (Working Experience)				
Indicator	Kruskal-Wallis H	df	Assymp. Sig	Note
X3.1.1	3.106	2	0.212	Homogen
X3.1.2	2.938	2	0.23	Homogen
X3.1.3	2.993	2	0.224	Homogen
X3.1.4	2.599	2	0.273	Homogen
X3.2.1	4.128	2	0.127	Homogen
X3.2.2	3.439	2	0.179	Homogen
X3.2.3	3.214	2	0.2	Homogen
X3.2.4	3.623	2	0.163	Homogen
X3.3.1	3.088	2	0.214	Homogen
X3.3.2	2.861	2	0.239	Homogen
X3.3.3	3.461	2	0.177	Homogen
X3.3.4	3.355	2	0.187	Homogen
X3.4.1	1.093	2	0.579	Homogen
X3.4.2	1.56	2	0.458	Homogen
X3.4.3	1.208	2	0.546	Homogen
X3.4.4	4.842	2	0.089	Homogen
X3.5.1	2.391	2	0.303	Homogen
X3.5.2	3.178	2	0.204	Homogen
X3.5.3	3.075	2	0.215	Homogen
X3.5.4	4.478	2	0.107	Homogen
X3.6.1	2.375	2	0.305	Homogen
X3.6.2	2.732	2	0.255	Homogen
X3.6.3	1.7	2	0.427	Homogen
X3.6.4	3.166	2	0.205	Homogen

Test Statistic (Working Experience)

Indicator	Kruskal-Wallis H	df	Assymp. Sig	Note
Y.1.1	2.414	2	0.299	Homogen
Y.1.2	5.019	2	0.081	Homogen
Y.1.3	3.081	2	0.214	Homogen
Y.1.4	2.208	2	0.332	Homogen
Y.2.1	2.817	2	0.245	Homogen
Y.2.2	2.88	2	0.237	Homogen
Y.2.3	4.466	2	0.107	Homogen
Y.2.4	5.24	2	0.073	Homogen
Y.3.1	3.521	2	0.172	Homogen
Y.3.2	4.464	2	0.107	Homogen
Y.3.3	3.384	2	0.184	Homogen
Y.3.4	2.004	2	0.367	Homogen
Y.4.1	2.498	2	0.287	Homogen
Y.4.2	4.13	2	0.127	Homogen
Y.4.3	2.377	2	0.305	Homogen
Y.4.4	4.639	2	0.098	Homogen
Y.5.1	5.059	2	0.08	Homogen
Y.5.2	3.764	2	0.152	Homogen
Y.5.3	5.212	2	0.074	Homogen
Y.5.4	2.494	2	0.287	Homogen
Y.6.1	4.671	2	0.097	Homogen
Y.6.2	4.771	2	0.092	Homogen
Y.6.3	3.236	2	0.198	Homogen
Y.6.4	4.148	2	0.126	Homogen

Validity Test

The validity test aims to determine whether the instrument used is capable of measuring variables in accordance with its intended function. The results of the validity test indicate whether an instrument is considered valid and appropriate for use. In this validity testing, several components were applied: a) two-tailed test, b) 95% confidence level (5% significance level), c) N = 40, d) df = 3 – 1 = 2, and e) r-table = 0.312.

Table 4 Validity Test All Variables

Indicator Code	Validation Corelation > R Tabel = valid		
	Corelation	R Tabel	Conclusion
X1.1.1	0.527	0.312	Valid
X1.1.2	0.535	0.312	Valid
X1.1.3	0.57	0.312	Valid
X1.1.4	0.452	0.312	Valid
X1.2.1	0.634	0.312	Valid
X1.2.2	0.523	0.312	Valid
X1.2.3	0.653	0.312	Valid
X1.3.1	0.498	0.312	Valid
X1.3.2	0.635	0.312	Valid
X1.3.3	0.635	0.312	Valid
X1.3.4	0.644	0.312	Valid
X1.4.1	0.658	0.312	Valid
X1.4.2	0.653	0.312	Valid
X1.5.1	0.518	0.312	Valid
X1.5.2	0.466	0.312	Valid
X1.6.1	0.629	0.312	Valid
X1.6.2	0.619	0.312	Valid
X1.6.3	0.53	0.312	Valid
X1.7.1	0.649	0.312	Valid
X1.7.2	0.68	0.312	Valid
Indicator Code	Validation Corelation > R Tabel = valid		
	Corelation	R Tabel	Conclusion
X2.1.1	0.545	0.312	Valid
X2.1.2	0.612	0.312	Valid
X2.2.1	0.319	0.312	Valid
X2.3.1	0.554	0.312	Valid
X2.4.1	0.681	0.312	Valid
X2.4.2	0.493	0.312	Valid
X2.5.1	0.42	0.312	Valid
X2.6.1	0.64	0.312	Valid
X2.6.2	0.574	0.312	Valid
X2.7.1	0.533	0.312	Valid
X2.7.2	0.35	0.312	Valid
X2.8.1	0.463	0.312	Valid
X2.8.2	0.487	0.312	Valid
X2.9.1	0.517	0.312	Valid
X2.9.2	0.43	0.312	Valid
X2.10.1	0.395	0.312	Valid
X2.10.2	0.556	0.312	Valid
X2.11.1	0.453	0.312	Valid
X2.11.2	0.627	0.312	Valid
X2.12.1	0.688	0.312	Valid
	Validation		

Indicator Code	Corelation > R Tabel = valid		
	Corelation	R Tabel	Conclusion
X3.1.1	0.574	0.312	Valid
X3.1.2	0.507	0.312	Valid
X3.1.3	0.474	0.312	Valid
X3.1.4	0.449	0.312	Valid
X3.2.1	0.496	0.312	Valid
X3.2.2	0.608	0.312	Valid
X3.2.3	0.545	0.312	Valid
X3.2.4	0.59	0.312	Valid
X3.3.1	0.514	0.312	Valid
X3.3.2	0.362	0.312	Valid
X3.3.3	0.511	0.312	Valid
X3.3.4	0.377	0.312	Valid
X3.4.1	0.393	0.312	Valid
X3.4.2	0.462	0.312	Valid
X3.4.3	0.525	0.312	Valid
X3.4.4	0.506	0.312	Valid
X3.5.1	0.469	0.312	Valid
X3.5.2	0.359	0.312	Valid
X3.5.3	0.424	0.312	Valid
X3.5.4	0.462	0.312	Valid
X3.6.1	0.387	0.312	Valid
X3.6.2	0.6	0.312	Valid
X3.6.3	0.55	0.312	Valid
X3.6.4	0.688	0.312	Valid

Indicator Code	Validation Corelation > R Tabel = valid		
	Corelation	R Tabel	Conclusion
Y.1.1	0.64	0.312	Valid
Y.1.2	0.64	0.312	Valid
Y.1.3	0.336	0.312	Valid
Y.1.4	0.702	0.312	Valid
Y.2.1	0.493	0.312	Valid
Y.2.2	0.799	0.312	Valid
Y.2.3	0.505	0.312	Valid
Y.2.4	0.565	0.312	Valid
Y.3.1	0.392	0.312	Valid
Y.3.2	0.616	0.312	Valid
Y.3.3	0.63	0.312	Valid
Y.3.4	0.601	0.312	Valid
Y.4.1	0.613	0.312	Valid
Y.4.2	0.801	0.312	Valid
Y.4.3	0.662	0.312	Valid
Y.4.4	0.682	0.312	Valid
Y.5.1	0.673	0.312	Valid
Y.5.2	0.461	0.312	Valid
Y.5.3	0.346	0.312	Valid
Y.5.4	0.555	0.312	Valid
Y.6.1	0.625	0.312	Valid
Y.6.2	0.646	0.312	Valid
Y.6.3	0.702	0.312	Valid
Y.6.4	0.663	0.312	Valid

Reliability Test

In this study, a reliability test was conducted. According to Singarimbun (1989), the reliability test is performed to determine the consistency and dependability of a measuring instrument through the stability and consistency of the responses or data obtained. This study employed the Cronbach's Alpha method using SPSS software with the following criteria :

- ✓ Cronbach's Alpha value > 0.6 → reliable
- ✓ Cronbach's Alpha value < 0.6 → not reliable

Table 5 Reliability Test All Variables

Reliability Statistics (X1)	
Cronbach's Alpha	N of Item
0.914	20
Reliability Statistics (X2)	
Cronbach's Alpha	N of Item
0.825	20
Reliability Statistics (X3)	
Cronbach's Alpha	N of Item
0.859	24
Reliability Statistics (Y)	
Cronbach's Alpha	N of Item
0.916	24

Data Collection

The questionnaire was developed based on three independent variables, namely Lean Management (X1), Target Value Delivery (X2), and Cost Simulation and Optimization (X3), each represented by several indicators in the form of statement items. Respondents were asked to assess each statement by answering the following question: "To what extent does the statement influence project cost performance?" using a Likert scale.

The questionnaire data were subsequently processed by aggregating the scores of each indicator into mean values for each variable, resulting in the composite variables X1, X2, and X3. These composite values were then used as inputs for statistical analysis using SPSS.

Subsequently, the data were analyzed using SPSS to identify the relationships between each independent variable and the dependent variable. The analyses included correlation testing to examine the strength of the relationships between X1 and Y, X2 and Y, as well as X3 and Y. In addition, t-tests were conducted to determine the partial effect of each independent variable on project cost performance, while the F-test was performed to evaluate the simultaneous effect of all independent variables (X1, X2, and X3) on the dependent variable (Y).

Relationship Model Analysis

Based on the relationship analysis conducted using SPSS, the following relationships were obtained:

Table 6 Correlation Between X and Y Variable

Correlations (X1 -> Y)	
Pearson Correlation	0.662
Sig	< 0.001
N	40
Correlations (X2 -> Y)	
Pearson Correlation	0.496
Sig	0.001
N	40
Correlations (X3 -> Y)	
Pearson Correlation	0.69
Sig	< 0.001
N	40

Table 7 Correlation Between X2 and X3 to X1 Variable

Correlations (X2 -> X1)	
Pearson Correlation	0.62
Sig	< 0.001
N	40
Correlations (X3 -> X1)	
Pearson Correlation	0.725
Sig	< 0.001
N	40

Table 8 Model Summary

R Square	
R	0.729
R Square	0.532
Adjusted R Square	0.493

The Relationship Between Research Variables

a. The Lean Management variable (X1) demonstrates a positive and strong significant relationship with project cost performance (Y), with a Pearson correlation coefficient of 0.662.
b. The Target Value Delivery variable (X2) demonstrates a positive and moderate significant relationship with project cost performance (Y), with a Pearson correlation coefficient of 0.496.
c. The Cost Simulation and Optimization variable (X3) demonstrates a positive and strong significant relationship with project cost performance (Y), with a Pearson correlation coefficient of 0.690.
d. The Target Value Delivery variable (X2) demonstrates a positive and strong significant relationship with Lean Management (X1), with a Pearson correlation coefficient of 0.620.
e. The Cost Simulation and Optimization variable (X3) demonstrates a positive and strong significant relationship with Lean Management (X1), with a Pearson correlation coefficient of 0.725.

Meanwhile, the coefficient of determination (R^2) value of 0.493 indicates that 49.3% of the variation in the improvement of cost performance in design-build contract projects can be explained by the combination of Lean Management, Target Value Delivery, and Cost Simulation and Optimization. This value reflects a moderate level of predictive accuracy of the model.

V. Discussion

This section discusses the research findings by connecting SPSS results to theoretical background to answer the question of how the relationship model between Lean Management, Target Value Delivery, and Cost Simulation and Optimization to project cost performance.

The Importance of Cost Simulation

These findings confirm that project cost performance is influenced not only by field efficiency through Lean Management, but also by predictive capability through cost simulation. Based on the analysis results, Cost Simulation and Optimization was identified as the most dominant variable affecting project cost performance, as indicated by the highest correlation value among all variables.

The dominant role of cost simulation can be explained by its function in supporting data-driven decision making. While Lean Management focuses on process efficiency and Target Value Delivery emphasizes cost control through design alignment, cost simulation provides quantitative evaluation of design alternatives, work methods, and cost scenarios before implementation. This enables early identification of potential cost deviations and improves estimation accuracy, particularly during the tender and early planning phases.

Furthermore, cost simulation also strengthens the implementation of Lean Management and Target Value Delivery by providing a quantitative basis to ensure that project decisions are optimized from a cost perspective. Therefore, simulation not only acts as an independent factor, but also enhances the effectiveness of the other two approaches.

Interpretation of the R² Value

Meanwhile, based on the preliminary testing using the multiple linear regression model, the Adjusted R Square value obtained was 0.493, indicating that the independent variables in this study were able to explain 49.3% of the variation in the dependent variable, while the remaining variation was influenced by other factors outside the model. This value reflects a moderate level of explanatory capability of the model.

To evaluate the possibility of non-linear relationships among variables, further testing was conducted using several forms of non-linear regression models, namely logarithmic and polynomial models, with the following results:

Table 9 Logaritmic Model Analysis

Logaritmic Model	
R	0.723
R Square	0.523
Adjusted R Square	0.482

Table 10 Polynomial Model Analysis

Polynomial Model	
R	0.770
R Square	0.593
Adjusted R Square	0.517

The test results show that the logarithmic model produced an Adjusted R Square value of 0.480, while the polynomial model generated the highest Adjusted R Square value of 0.520. This indicates that the polynomial model has a slightly better explanatory capability compared to the linear model, suggesting the presence of a non-linear relationship tendency among the variables.

VI. Conclusion

This study provides a comprehensive analysis of the relationship model between Lean Management, Target Value Delivery (TVD), and Cost Simulation and Optimization in influencing project cost performance in Design and Build construction projects.

The results show that Lean Management has a positive and strong relationship with project cost performance, indicating that the implementation of lean principles can improve efficiency, reduce waste, and support better cost control during project execution. This finding is consistent with previous studies highlighting the contribution of Lean Management to construction project performance improvement.

Target Value Delivery (TVD) also demonstrates a positive relationship with project cost performance. The implementation of TVD encourages early stakeholder involvement, collaborative decision-making, and alignment between project design and target cost, which supports more effective cost management throughout the project lifecycle.

Among all variables, Cost Simulation and Optimization shows the strongest relationship with project cost performance. This indicates that simulation-based approaches play a crucial role in improving cost prediction accuracy and supporting data-driven decision-making. Through simulation, project teams are able to evaluate various design alternatives, optimize work methods, and identify potential cost deviations at an early stage of the project.

In addition, the findings indicate that Cost Simulation and Optimization strengthens the implementation of Lean Management and TVD by providing quantitative evaluation and predictive analysis. While Lean Management focuses on process efficiency and TVD emphasizes value-oriented cost control, simulation provides analytical support to ensure that project decisions are optimized from a cost-performance perspective.

Furthermore, the regression analysis results indicate that the proposed model has a moderate explanatory capability. The polynomial regression model produced a slightly higher Adjusted R Square value compared to the linear model, suggesting the possibility of non-linear relationships among the studied variables. This finding implies that project cost performance is influenced not only by direct linear interactions, but also by more complex relationships between Lean Management, TVD, and Cost Simulation and Optimization.

Contribution

1. One of the main contributions of this study is the development of an integrated relationship model combining Lean Management, Target Value Delivery (TVD), and Cost Simulation and Optimization to provide a more comprehensive understanding of project cost performance in Design and Build construction projects. Compared to previous studies that examined these variables separately, this study evaluates the interaction among the variables within a single conceptual framework.
2. This study provides empirical evidence that Lean Management has a positive and strong relationship with project cost performance. The findings support previous studies indicating that lean principles improve efficiency, reduce waste, enhance workflow reliability, and contribute to better project cost control in construction projects.
3. The study also confirms that Target Value Delivery (TVD) contributes positively to project cost performance through early stakeholder involvement, collaborative decision-making, and alignment between design and target cost. These findings support previous research emphasizing the importance of value-oriented project delivery approaches in improving construction project outcomes.
4. Furthermore, the results demonstrate that Cost Simulation and Optimization has the strongest relationship with project cost performance among the studied variables. This finding highlights the important role of simulation-based and data-driven approaches in improving cost estimation accuracy, evaluating design alternatives, and minimizing potential cost deviations during the early stages of the project.
5. The study also contributes methodologically by applying statistical analysis using SPSS, including Pearson Correlation, multiple linear regression, and non-linear regression models, to capture the relationships among variables. The findings from the polynomial regression model indicate the possibility of non-linear interactions among Lean Management, TVD, and Cost Simulation and Optimization in influencing project cost performance.

Research Limitations

This study has several limitations. The research was conducted as a case study at PT. X, therefore the findings mainly reflect the specific conditions of the company and may not be directly generalized to other organizations. In addition, the study involved only 40 respondents, which, although statistically sufficient for SPSS analysis, may not fully represent broader industry perspectives. Furthermore, the proposed integration model of Lean Management, Target Value Delivery (TVD), and Cost Simulation and Optimization has not yet been implemented in actual construction projects, as the study remains at a conceptual and perception-based stage, requiring further validation through real project applications or pilot studies.

Contribution to Future Research

Several recommendations for future research can be proposed. Future studies may expand the research scope by conducting comparative analyses across different public sector institutions. Further research may also incorporate moderating and mediating variables into the relationship model among variables. In addition, future studies are encouraged to implement the proposed integration model in pilot construction projects to further validate its effectiveness. Moreover, future research may focus on developing the integration of Lean Management, Target Value Delivery, and Cost Simulation and Optimization supported by Artificial Intelligence (AI) technologies.

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