JCE
JOURNAL OF CIVIL ENGINEERING
ISSN 2086 - 1206 E-ISSN 2579 - 9029

Factors Affecting Cost Performance Completion On Toll Road Projects With Turnkey Contracts

Muhammad F. A. Bakhri[a], I P. A. Wiguna[a]

Correspondence

[a]Civil Engineering Department, Sepuluh Nopember Institute of Technology , Surabaya 60111, Indonesia.

Corresponding author email adress: ferry.amirul08@gmail.com

Submitted : 07 February 2024
Revised : 18 November 2025
Accepted : 23 November 2025

Abstract

Currently, the implementation of turnkey contracts has recently gained significant attention due to several advantages, such as shorter construction durations, improved construction quality, and reduced overall project costs. However, compared to the traditional Design-Bid-Build (DBB) method, the higher degree of uncertainty in turnkey projects introduces substantial risks, particularly for contractors. Project success in the construction industry is commonly evaluated based on cost performance relative to the planned budget. This study aims to identify and analyze the key variables influencing cost performance in toll road projects delivered through turnkey contracts. A quantitative research approach was applied using Structural Equation Modeling (SEM) with Partial Least Squares (PLS).The study involved 60 respondents representing service providers, ranging from general managers to administrative staff, who were directly engaged in toll road projects using turnkey contracts. Data were collected through structured questionnaires and interviews. The results indicate that contract conditions have the most significant positive impact on cost performance, with a path coefficient of 0.421, influenced by the field conditions variable. Variations in contract conditions or Contract Change Orders (CCOs) were found to significantly affect cost performance. Therefore, identifying potential risks to field conditions and conducting detailed field investigations are critical to maintaining cost control and ensuring project success.

Keywords

Cost performance influence factors; Project toll; Turnkey contract; SEM-PLS

INTRODUCTION

At the construction project implementation stage, three key important aspects can be seen based on the timeliness of project completion, the accuracy of costs according to the budgeted plan, and the conformity of predetermined quality specifications. The implementation of projects with existing facilities that cannot be avoided and lack detail at the investigation site, this condition affects cost optimization [1]. If the implementation is not handled seriously, it can cause cost overrun [2].

In the implementation of a Turnkey contract, the Contractor must carry out everything from the project preparation stage, then carry out approvals, engineering design/planning processes, cost needs in carrying out costs to the risk of costs that occur, construction implementation, testing work commissioning and handover of work, until the project is ready to operate [3]. However, Compared to the Design-Bid-Build (DBB) method, more uncertainty in Turnkey contracts can make turnkey contract projects risky, especially for contractors [4]. The impact will cause cost overruns to all parties who carry out the Contract and can create a bad image for the construction industry.

The purpose of this study is to identify and analyze the Effect of turnkey contracts on the performance of completion costs on toll road projects.

RESEARCH SIGNIFICANCE

In using a turnkey contract arrangement, the contractor is required to handle all project phases from the project preparation stage, obtaining approval, engineering design, financing, construction, commissioning and handover of work, until the project is ready to operate [5]. The total project cost submitted by the contractor includes the risks that the contractor is likely to face [6]. While the turnkey approach offers various advantages and efficiencies, it also encourages project owners to adopt this type of contract. Consequently, the risks borne by the contractor become substantial and may hinder project completion if not properly assessed and mitigated during the project preparation stage.

A company's ability to accurately estimate project costs is a key factor in maximizing profitability. In project management, a contingency allocation must be carefully the contractor risks losing competitiveness, while an allocation that is too small may result in reduced profit margins. Therefore, contingency funds must be optimally determined [7].

Several studies have investigated the factors influencing cost performance, particularly the effect of contract changes, which often result in additional work items requiring adjustment [8]. Rework classifications have also identified rework as a major contributor to cost

overruns [9]. Changes in contract conditions generally govern three fundamental aspects of project implementation—cost, quality, and time [10].

Previous research to factors affecting the performance of completion costs on toll road projects with turnkey contracts has been carried out by several researchers using different variables and indicators; This study aims to identify and analyze the factors influencing the success of cost performance in the execution of construction projects using turnkey contracts. The study also explores with various new aspects used and looking for influences between various aspects that contribute to the successful implementation of turnkey contracts. The variables examined in this research include field conditions, planning and scheduling of work implementation, quality of work, contract conditions, and cost performance.

METHODOLOGY

To achieve research objectives and obtain valid results, that are in accordance with the purpose of conducting research and getting good results, it is necessary to have a research method. This chapter describes the research methods used, beginning with data collection and concluding with data analysis. The concepts in this study are quantitative research and confirmatory research. To find out what indicators affect the performance of toll road project completion costs and see how much influence they have on the use of Turnkey contracts.

The research sample used was taken from the perspective of service providers ranging from vice presidents, managers, and Research and Development (RnD) staff, with the number of respondents among 60 respondents, using SEM PLS. The technique of preparing questionnaires using the Likert scale is very agreeable to disagree strongly with values of 5 to 1. The Model concepts and hypotheses will be seen in Figure 1.

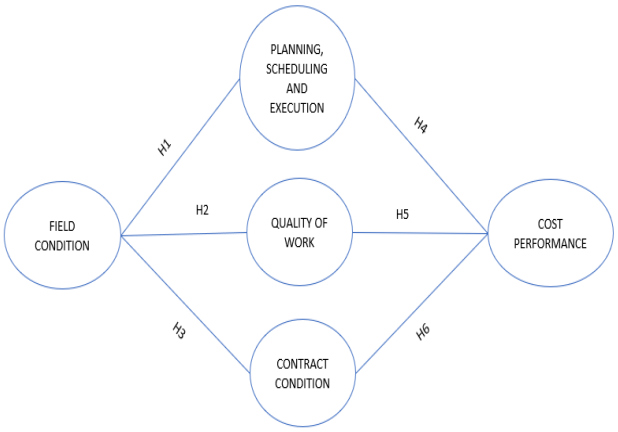

Figure 1: Model concepts and hypotheses

H1 = The Relationship of field conditions with planning, scheduling, and execution of work. (Haryono 2022, Ambadar 2021, sonderlun 2018)
H2 = The Relationship of field conditions with the quality of work. (Hamid 2019)
H3 = The Relationship of field conditions to contract conditions. (Jenifer2023)
H4 = The Relationship of planning, scheduling, and execution of work to cost performance (adhi et al 2020, erzaij 2020)
H5 = Relationship of work quality with cost performance (Chundawan et al., 2014)
H6 = Relationship of contract conditions with cost performance (Ambadar 2021, Hendy eka 2020, Maulana et al. 2016)

RESULTS AND DISCUSSIONS

The research sample used was taken from the perspective of service providers ranging from vice presidents, managers, and Research and Development (RnD) staff, with the number of respondents among 60 respondents.

A. DESCRIPTIVE ANALYSIS OF VARIABLE

Table 1 Descriptive Analysis of Field Conditions

Field Condition Indicators	Author
ROW problems are given to the design plan	1, 2
Weather Conditions	1,2,4
The Impact of Socialization on Citizens	1, 5
Existing Facility Data that is not awarded at tender	1,2,4
Material scarcity/material limitation	1, 5
Lack	1, 2, 3, 4, 6
field investigation of the drawing	1,2
Contractor experience that is not adequate in execution The Contract of turnkey	Additional indicator
Impact of natural disasters or forces Major	Additional indicator
The aanwijzing process has been clearly stated regarding the conditions in the field	Additional indicator
Tool malfunction	Additional indicator

Table 2 Descriptive Analysis of Planning Schedule and execution of work

Planning, scheduling, and execution indicators	Author
Poorly structured work sequence plan	1,2, 3, 5, 7,8
Inaccuracy in order time Materials, materials, and tools will affect project completion	1, 3, 6
Contractor competence affects project completion	1, 2, 3, 6
The financial ability of the Contractor is not good for sub-contractor payments	1,2
Labor and equipment productivity	
Work accident/safety	1,2,4
There is a postponement of work due to existing conditions	1,2

Lack of Contractor Communication with Service Users	1,2,4
Lack of Contractor to subcontractor communication	1,2
Incompetent subcontractors	1,2,4
Competence of Personnel in the field	Additional indicator
Work methods	Additional indicator

Table 3 Descriptive Analysis of Quality of Work

Quality of work indicators	**Author**
Plan Quality Goals Not Achieved	1, 3, 6
Quality control management	3
Material quality	1,2,4
Quality of work	1,2,4

Table 4 Descriptive Analysis of Quality of Work

Indicators of contract conditions	**Author**
Ambiguous Contract Conditions (Technical Specifications and Terms of Reference)	2, 3, 4, 5. 6
vagueness of Scope of work	2, 3, 5
Changes in the Scope of work at the time of implementation	1, 2, 3, 4, 5, 6
Details of supporting documents Contract containing terms of employment conditions	2, 3, 4, 5. 6

Table 5 Descriptive Analysis of Quality of Work

Cost performance indicators	**Author**
Additional Costs due to late work	6
Increased costs due to rework	1, 3
Exploration and inflation of prices of raw materials, tools, and workers	1, 3, 6, 7
Late payment	1, 2, 3, 5, 6

Based on tables 1 to 5 show how the indicators are arranged in this study; the indicators from previous studies are as follow by:

1. Haryono (2022) researched of Risk Identification Using Turnkey contracts in Transmission Construction Projects.
2. Ambadar (2021) researched of examines the factors causing construction disputes in brownfield EPC projects.
3. Erzaij (2020) researched of Nature and Causes of claims in Iraqi Turnkey projects.
4. Söderlund (2018) researched of Claim management in EPC-projects.
5. Shien dkk (2017) researched of Causes of contractors' claims in international engineering-procurement-construction projects.
6. Rajalekshmi (2015) researched of Causes of contractors' claims in international engineering-procurement- construction projects.
7. Maddeppungeng (2015) researched of identifies the risk factors that influence the construction stage of EPC projects on-time performance.
8. Jonathan et al. (2018) Comparison between PLS-SEM and factor analysis for identification of external influence factors of the project.

Then, a preliminary survey was conducted to determine the relevant conditions in the implementation of toll road projects with current turnkey contracts. These indicators are listed in Table 1 to Table 5

The average score of the research survey was from 60 respondents. Indicators of varying field conditions are as follows: Mapping of work to land acquisition shows the highest average value of 4.03. The variable indicators of planning, scheduling, and execution of work are the competence of the Contractor, which affects the completion of the project, and the method of work shows the highest average value of 3.95. The variable indicator of Quality of Work is the Quality of Materials, and Quality of Work shows the highest average value of 4.07. The variable indicator of the Conditions of the Contract is The change in the Scope of work at the time of execution, which showed the highest average value of 3.8. The variable indicator of cost performance is inflation and inflation of raw material, equipment, and worker prices, which shows the highest average value of 3.73.

B. ANALYSIS OUTER MODEL

Outer model evaluation is used to test research instrumentation in the form of validity and reliability tests as a measuring instrument consisting of convergent validity and composite reliability by making an outer model first (outer model).

1. Measurement of Variable Indicators

Testing on the outer model is convergent validity. To measure convergent validity, one must look at the value of each outer load. Outer loading is a value that describes the Relationship (correlation) between an indicator and its latent variable. The higher the external load, the more closely related it is to its latent indicators and variables. An outside loading value of > 0.7 is acceptable [15][11]. The following table shows the outer loading value of each indicator on the research variable. Outer loading results will be seen in Figure 2.

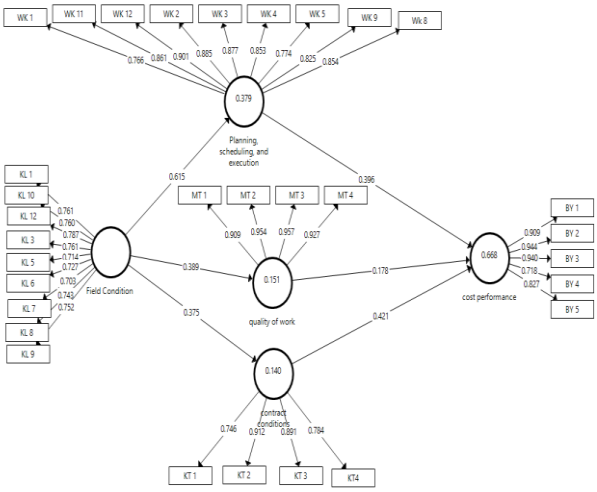

Figure 2 Outer loading results

Table 6 Outer Loading Values Field conditions

Field condition indicators	Outer loading
ROW problems are given to the design plan	0.761
The Impact of Socialization on Citizens	0.761
Material scarcity/material limitation	0.714
Lack of site detail in field investigation of images	0.727
Inadequate experience of contractors in the execution of *turnkey contracts*	0.703
Inadequate experience of contractors in the execution of *turnkey contracts*	0.743
Existing Facility Data not provided during the tender	0.752
The aanwijzing process has been clearly stated regarding the conditions in the field	0.760
Mapping of work toward land acquisition	0.787

Table 7 Outer Loading Values Planning Scheduling and execution of work

Planning, scheduling, and execution indicators	Outer loading
Poorly structured work sequence plan	0.766
Inaccuracy in order time Materials, materials, and tools will affect project completion	0.885
Contractor competence affects project completion	0.877
The financial ability of the Contractor is not good for sub-contractor payments	0.853
Labor and equipment productivity	0.774
Lack of Contractor Communication with Service Users	0.854
Lack of Contractor to subcontractor communication	0.825
Competence of Personnel in the field	0.861
Work methods	0.901

Table 8 Outer Loading Values Quality of Work

Quality indicators of work	Outer loading
Plan Quality Goals Not Achieved	0.909
Quality control management	0.954
Material quality	0.957
Quality of work	0.927

Table 9 Outer Loading Values of Contract Conditions

Contract Conditions Indicators	Outer loading
Ambiguous Contract Conditions (Technical Specifications and Terms of Reference)	0.746
vagueness of Scope of work	0.912
Changes in the Scope of work at the time of implementation	0.891
Details of supporting documents Contract containing terms of employment conditions	0.784

Table 10 Outer Loading Values Cost Performance Values

Cost performance indicators	Outer loading
Additional Costs due to late work	0.909
Increased costs due to rework	0.944
Exploration and inflation of prices of raw materials, tools, and workers	0.940
Late payment	0.718
Economic Conditions when the Global economy is affected	0.827

Based on Table 6 to Table 10 of the elimination results in the figure and table, it is known that all indicators have an outer loading value of > 0.7, which means that all indicators are maintained in the next analysis process. Indicator elimination states that in an analysis, a variable has at least one item (one indicator) in a model so that analysis can be continued for structural models [11].

2. Variabe Reliability Measurement

Table 11 Variable Reliability Measurement Values

Kode	Cronbac h's alpha	Composite Reliability	Description
BY	0.919	0.936	Reliable
KT	0.854	0.864	Reliable
KL	0.900	0.903	Reliable
MP	0.953	0.958	Reliable
WK	0.950	0.951	Reliable

Based on Table 11 results from composite reliability, the composite reliability value of each research variable is> 0.7. Thus, it can be concluded that each variable met the composite reliability criteria.

C. INNER MODEL EVALUATION

1. Coefficient Determination (R2)

Table 12 Coefficient Determination (R2)

Variable	R-Square	R-Square Adjusted	Description
Cost performance	0.668	0.651	Strong
Contract conditions	0.140	0.125	Weak
Quality of work	0.151	0.136	Weak
Planning, Scheduling and executing work	0.379	0.368	Medium

Based on Table 11 results from composite reliability, the composite reliability value of each research variable is>

0.7. Thus, it can be concluded that each variable met the composite reliability criteria Based on Table 13, the large R-Square value in the Cost Performance variable is 0.651; this indicates good influence / Strong. This means that field conditions have a 65.1% influence on cost performance.

Similarly, the endogenous variable of scheduling planning and implementation 0.368 shows that the indication of moderate influence means that field conditions have an effect of 36.8% on scheduling planning and implementation.

The R-Square values for contract conditions and work quality of 0.125 and 0.136 indicate that the indication of influence is weak, which means field conditions have an influence of 12.5% and 13.6% on contract conditions and quality of work.

2. Large Effect of Influence Between Variables – Variable Effect f-square (f2)

Table 13 Variable Effects of f-square (f2)

Variable	f-Square	Information
Contract Conditions -> Cost Performance	0.354	Big Effects
Field Conditions -> Contract Conditions	0.163	Medium Effect
Field Conditions -> Quality of Work	0.178	Medium Effect
Field Conditions -> planning, scheduling, and execution	0.609	Big Effects
Quality of Work -> Cost Performance	0.067	Small Effects
Planning, scheduling, and execution -> Cost performance	0.331	Big Effects

Based on Table 13, the Relationship between field condition variables with planning, scheduling, and implementation obtained an f-squared value of 0.609, then the Relationship between variables was declared to have a major effect, the Relationship between field condition variables and work quality obtained an f-squared value of 0.178. The Relationship between variables was declared to have a moderate effect; the Relationship between work quality variables and cost performance obtained an f-squared value of 0.067. The Relationship between variables is stated to have small Effect.

3. Path Coefficient of Direct Influence

Results of direct influence of hypotheses will be seen in Figure 3.

Table 14 Results of the Direct Influence hypothesis

Variable	Path coef.	T statistic	P value	inform
(H1) Contract Conditions -> Cost Performance	0.421	3.755	0.000	Significant
(H2) Field Conditions -> Contract Conditions	0.375	3.067	0.002	Significant
(H3) Field Conditions -> Quality of Work	0.389	2.550	0.017	Significant
(H4) Field Condition - > planning, scheduling, and execution	0.615	6.388	0.006	Significant
(H5) Quality of Work ->Cost Performance	0.178	1.438	0.160	No Significant
(H6) Planning, scheduling, and execution ->Cost performance	0.396	3.150	0.002	Significant

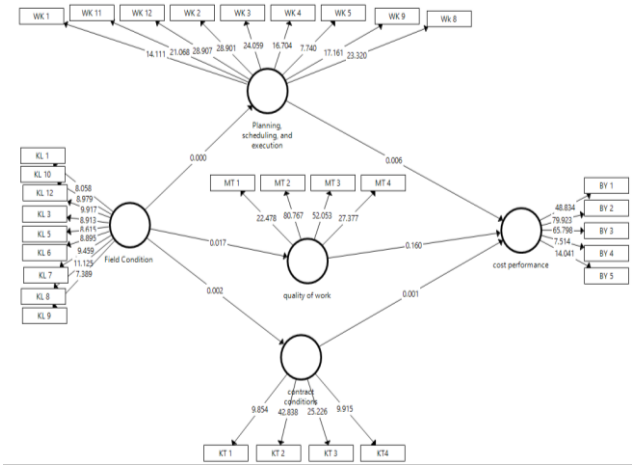

Figure 3 Results of direct influence of hypotheses

Based on Figure 3 and Table 14, the results of hypothesis testing on the coefficient of direct influence paths between constructs are obtained as follows.

a. The construct relationship of contract conditions to cost performance has a P-value of 0.001 (P-value < 5%), a t- statistic value of 3.755 (t-statistic > 1.96), and a path coefficient value of 0.486. It states that hypothesis 1 is accepted and has a positive influence on cost performance.
b. The construct relationship of field conditions with contract conditions has a positive effect shown by a P-value value of 0.002 (PValue < 5%), a t-statistic of 3.074 (t- statistic > 1.96), and a path coefficient value of 0.374. It states that hypothesis 2 is accepted and has a positive influence on the conditions of the Contract.
c. The construct relationship of field conditions to the quality of work has a significant positive effect shown by a P-Value value of 0.011 (P-Value < 5%), a t-statistic value of 2.550 (t-statistic > 1.96), and a path coefficient value of 0.396. This suggests that

hypothesis 3 is accepted and has a positive influence on the quality of work.

d. The construct relationship of field conditions with scheduling planning and implementation has a positive effect shown by a P-value value of 0.000 (PValue < 5%), a t-statistic value of 6.388 (t-statistics > 1.96), and a path coefficient value of 0.615. This suggests that hypothesis 4 is accepted and has a positive influence on scheduling, planning, and execution.
e. The construct Relationship of work quality construct to cost performance has a positive influence and no significant effect as shown by the P-Value value of 0.160 (P-Value > 5%), t-statistic value of 1.438 (t-statistic < 1.96), and path coefficient value of 0.178. This suggests that hypothesis 5 is rejected.
f. The construct relationship of scheduling planning and execution to cost performance has an significant value, where the P-Value value is 0.002 (P-Value < 5%), the t- statistic value is 3.150 (t-statistic < 1.96), and the path coefficient value is 0.443. This shows that hypothesis 6 is accepted and has a positive effect on cost performance.

4. Path Coefficient of indirect path

Table 15 Indirect Path

Variable	Path coef.	T statistics	P value	Inform
(H1) Field Conditions -> Contract Conditions -> Cost Performance	0.182	2.240	0.025	Significant
(H2) Field Conditions -> Planning, Scheduling, and Execution -> Cost Performance	0.273	2.853	0.004	Significant

Based on Table 15, the results of the indirect path coefficient analysis between constructs are summarized as follows :

a. The relationship between Field Conditions and Cost Performance shows a positive and significant indirect effect through the Contract Conditions construct. This is evidenced by a P-value of 0.025 (P < 0.05), a t-statistic of 2.240 (t > 1.96), and a path coefficient of 0.182. These results indicate that Field Conditions influence Cost Performance indirectly, with Contract Conditions playing a crucial mediating role in enhancing cost performance.
b. The relationship between Field Conditions and Cost Performance also exhibits a positive and Significant indirect effect through the Planning and Scheduling Implementation construct. This is shown by a P-value of 0.004 (P < 0.05), a t-statistic of 2.853 (t > 1.96), and a path coefficient of 0.273. This suggests that Field Conditions indirectly affect Cost Performance, emphasizing that effective Planning and Scheduling Implementation is a critical mediator influencing cost performance outcomes.

5. Managerial implications of each hypothesis

a. The Effect of field conditions on contract conditions

It is essential for construction stakeholders to remain attentive and proactive during the project initiation and planning phases when formulating contract documents and defining the project scope. Ensuring that detailed and accurate descriptions are clearly stated and mutually agreed upon by all parties can prevent ambiguity. reduce excessive scope changes, and minimize contractual disputes. Effective supervision and control of contract amendments are therefore necessary to maintain contractual stability and project consistency [12].

b. The influence of field conditions on the quality of work

Company management are critical role to identify and ensuring high quality work performance. Quality issues are the top priority. To strengthen site management, construction project should be quality control processes (materials) and procedures (SOPs) to maintance construction quality [13]. Improve the supervision mechanism of construction materials to ensure that materials will not be damaged during the procurement process and delivery to the site, and inspections should be conducted to verify material and workmanship quality, ensuring they do not affect subsequent work stages. A comprehensive quality management strategy and efficient quality control mechanisms are essential to enhance overall project quality.

c. The influence of field conditions on planning, scheduling, and implementation

Effective project management requires careful identification of field conditions when developing scheduling and implementation plans. many issues need to be challenges in the management of construction sites, such as environmental and personnel management, which affect the safe operation project. Project management specifically refers to the use of evaluation methods and criteria to carry out comprehensive and reasonable planning and work on a wide range of work productivity so as to achieve the goal of high-quality production and high efficiency [13].

d. The Effect of work quality on cost performance

Strategic management are practice in quality work to cost performance. Quality related costs arise both from efforts to improve quality and from losses associated with poor quality. Improvement in quality of work are followed increase in quality costs [14]. Therefore, implementing an efficient and effective Quality Management System (QMS) is crucial to ensure that quality improvements lead to optimal cost performance and do not result in unnecessary expenditures.

e. The Effect of construction planning, scheduling, and execution on cost performance

Company management is require to planning, scheduling, and implementing strategies to improve cost performance. Project delays frequently occur when work activities depend on one another without proper coordination, leading to idle time and potential cost overruns. Therefore, effective planning, scheduling, and evaluation should utilize project management software that allows for the integration and reuse of data from previous projects. Such digital tools enhance forecasting accuracy, improve workflow coordination, and support continuous improvement in cost management practices [15].

f. The Effect of contract conditions on cost performance

Company management to require in indentifying and managing contract term that influence cost performance. Contract terms establish a fundamental framework for effective cost management. A careful managerial strategy in designing and evaluating contract termprovisions can significantly impact a company's cost performance [16]. This has driven management's attention to cost monitoring, control, and flexibility required to maximize operational efficiency. Contract preparation and documentation from the early stages of a construction project are critical. Clear contract regulations, relevant agreements, and fair terms contribute to improved construction efficiency and effective project management.

CONCLUSIONS

Based on the results of data analysis and discussion conducted in this study on factors affecting cost performance in toll road projects using turnkey contracts, according to the perspective of service providers, various conclusions are obtained as follows:

1. From the results of factors that have a positive and significant influence on cost performance from service provider's perspective are planning, scheduling and implementation of work, as well as contract conditions. It can be seen from each relationship between constructs, the effect of contract condition variables on cost performance variables is 0.421 and the influence of scheduling planning & work implementation variables on cost performance variables is 0.396 with influencing variables (exogenous) are field condition variables.
2. The result that has the most positive and significant influence on cost performance on toll road projects with turnkey contracts is the contract condition of 0.421. Changes in contract conditions or CCO have a significant impact on cost performance and it is critical to look at potential risks in field conditions and detail in field investigations.

RECOMENDATIONS

Based on the results of the analysis and conclusions, the following recommendations are proposed:

1. Further research is needed related to other variables that can affect cost performance in toll road project work using turnkey contracts.
2. Further research is needed related to the variables of work quality, which should be more emphasized or more significant in the current study.
3. Empirical research from the perspective of service providers on the effect of field conditions on cost performance, using second-order Structural Equation Modeling (SEM), should be conducted to provide a more comprehensive understanding.

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