



Development of Performance Assessment Tools for Supervision Consultants in Infrastructure Projects

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Abstract. The construction of toll roads requires supervision consultants capable of ensuring project quality, time, and cost performance, yet a structured and measurable assessment framework is lacking. This study develops a comprehensive performance assessment rubric for toll road supervision consultants using quantitative methods, including a literature review, a survey of 50 respondents, validation by six experts, and an application test by 12 evaluators. Data were analyzed using validity and reliability tests, Mann–Whitney U, AHP, TOPSIS, and ROC methods. The results identified 18 valid and reliable indicators grouped into three dimensions soft skills, technical skills, and project supervision. The most critical indicators were QA/QC (C=0.810), periodic reporting (0.782), and work volume management (0.711). Final dimension weights were 40% for technical skills, 30% for soft skills, and 30% for project supervision. Application of the rubric indicated consultants’ performance remained in the “Average” category, highlighting areas for measurable improvement in supervision practice.

Keywords: Assessment rubric, infrastructure performance, performance assessment system, supervisory consultant evaluation, toll road indicators.

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1. Introduction

Construction project performance is a quantitative indicator that reflects a country's ability to realize development plans into measurable physical results [1]. In infrastructure development, roads play a fundamental role as a transportation system that determines the efficiency of the movement of people, goods, and services, and affects regional connectivity, logistics costs, and economic competitiveness

[2], [3], [4], [5]. Various studies show that road infrastructure quality is positively correlated with socioeconomic development, regional expansion, and GDP growth [6], [7], [8].

Based on the Ministry of Public Works and Public Housing's Strategic Plan, the road infrastructure development targets in Indonesia until 2030 indicate a very large scale of development. This scale requires a construction quality control system that is not only administrative in nature but also based on measurable technical performance indicators during the construction process [9].

In road construction projects, particularly toll roads, supervision consultants have a technical function in ensuring that the work is carried out in accordance with design specifications, technical standards, and required construction methods. This role is crucial in determining the quality of the final road pavement, which is the largest cost component and the most critical structural element in the service life of a road. Ineffective supervision is often only identified through defects found during the Final Hand Over (FHO) stage or even after the road has been in operation for several years [10], [11].

Most of the damage to the toll road pavement that appeared after three years of operation shows that construction quality issues are often not adequately detected during the implementation phase. These findings indicate that the problem lies not only in construction methods or materials, but also in the effectiveness of the technical supervision process during the work. In other words, the failure of quality control in the field reflects the limitations of the consultant supervision performance evaluation system, which is currently not based on validated technical indicators [12].

Previous studies have discussed performance measurement in construction projects at a general level. Ibrahim et al. developed a KPI-based project performance measurement methodological framework that includes the dimensions of quality, safety, and stakeholder management [13]. Rarasati (2025) identified performance indicators for supervision consultants on toll road projects and developed an evaluation rubric [14]. Nova (2025) evaluated the performance of construction consultants using the IPA and SEM approaches, focusing on communication, quality control, and project management [15]. Although these studies have made important contributions to the measurement of construction performance, the approaches used are still generally evaluative in nature and have not integrated technical supervision indicators into a structured, statistically validated performance assessment system that can be directly operated by project owners.

The research gap lies in the unavailability of a performance assessment tool based on technical supervision indicators that has been developed through a process of critical indicator identification, statistical testing, and expert validation, and is specifically aimed at highway project supervision. Existing assessment systems tend to be administrative, subjective, and unable to represent the direct influence of supervision performance on the technical quality of pavement work.

This study proposes a technical innovation in the form of developing a Performance Assessment System in the form of an assessment rubric based on proven technical indicators for toll road project supervision consultants. The indicators were developed through a comprehensive literature review, professional respondent surveys, statistical analysis, and expert validation to reflect the supervision variables that truly affect the quality of road pavement construction.

This study aims to develop a technical indicator-based performance assessment system for supervision consultants in toll road construction projects. The research focuses on identifying supervision indicators that directly affect the technical quality of pavement work, then testing their validity and reliability through statistical analysis and expert validation. The validated indicators are then integrated into a structured and operational performance assessment rubric. Through this approach, the study produces an assessment tool that is able to directly link supervision practices in the field with the quality of construction results, so that it can be used by project owners as an objective basis for improving the effectiveness of supervision on toll road projects.

2. Methods

The research strategy was used to guide the process of collecting data relevant to the object, subject, variables, and research problems [16], [17]. This study applied a quantitative approach that was

conducted systematically, objectively, and logically [16], [17], and was supplemented with qualitative validation through Focus Group Discussions (FGD) with experts. The method design is formulated to produce a statistically tested and technically validated performance assessment system.

2.1 Sources and Stages of Data Collection

The data used consists of primary and secondary data. Primary data was obtained through three stages: (1). a questionnaire survey of 50 key respondents from PT X to test the indicators, (2). FGDs and structured interviews with six experts who had more than 10 years of experience in toll road projects (inclusion criteria: owner representative, site engineer, or senior supervisor), and (3). performance evaluation surveys by 12 experienced respondents to apply the rubric to PT Y's supervision consultants in three toll road projects.

Secondary data was collected from national and international scientific literature discussing the performance indicators of construction project supervision consultants.

2.2 Screening and Testing of Indicators

Initial indicators from the literature review were grouped based on similarity of meaning and screened using the Guttman scale, with a minimum threshold of appearance in three different references. The selected indicators were then tested for validity using Pearson's Correlation and reliability using Cronbach's Alpha with the help of SPSS software. The analysis continued with descriptive statistics, normality tests, and tests of differences in respondent perceptions using Mann–Whitney U.

2.3 Weighting and Ranking of Indicators (AHP, TOPSIS, ROC)

Indicator weighting and ranking were carried out using the Multi Criteria Decision Making (MCDM) approach through the integration of the AHP, TOPSIS, and ROC methods. In the AHP stage, a matrix of pairwise comparisons between dimensions and indicators was compiled based on expert assessments. The consistency of the assessments was tested using the Consistency Ratio ($CR \leq 0.1$) to ensure the logical validity of the weighting. The weights from the AHP results are used in the TOPSIS calculation to determine the order of importance of indicators based on their proximity to the ideal solution. Furthermore, ROC is used to simplify the weight distribution in the preparation of the assessment rubric.

2.4 Expert Validation and Rubric Design

The weighting and ranking results were re-verified through FGDs with six experts to ensure the technical suitability of the indicators. The validated indicators were then integrated into an operational performance assessment rubric designed as a structured evaluation tool for project owners.

2.5 Rubric Usage Test (Assessment Simulation)

The compiled rubric was then simulated through a usage test by 12 experienced evaluators to assess the actual performance of PT Y's supervision consultants on three toll road projects at PT X. This stage aimed to obtain an overview of actual performance based on the developed assessment system.

3. Results and Discussion

Variable X in this study represented a collection of performance evaluation indicators for supervision consultants, initially identified through a comprehensive literature review of multiple sources, yielding 107 preliminary indicators. To establish a more organized indicator framework and eliminate redundancies, we conducted a clustering analysis based on indicator characteristic similarities, resulting in 26 grouped indicators. Subsequently, an elimination process was performed using a Guttman scale, considering each indicator's frequency of appearance in reference literature. Indicators cited in at least three distinct literature sources were retained for meeting the minimum inclusion threshold. Following initial screening, additional relevant indicators were identified through further examination of professional manuals and regulatory documents pertaining to supervision consultants, culminating in a refined set of 18 core indicators. In accordance with [18], the indicators were regrouped into three categories of capabilities that must be possessed by construction project supervision consultants, namely Soft Skills, Technical Skills, and Project Supervision. The table below presents the performance evaluation indicators for road construction supervision consultants:

Table 1. Performance Evaluation Indicators for Supervision Consultants in Road Projects

Code	Indicators	Description	Source
Soft Skills			
X1.	Communication and coordination skills	The supervision consultant's ability to communicate and coordinate clearly and effectively with stakeholders.	[16], [17] [19], [20], [21] [22]
X2.	Leadership and managerial	The supervision consultant's ability to effectively lead the project team, motivate team members, and maintain productivity.	[17], [23], [24], [25] [22]
X3.	Problem and conflict management	The supervision consultant's ability to prevent and analyze conflicts and problems in depth, and provide implementable solutions.	[17], [25], [26], [27] [22]
Technical Skills			
X4.	Construction HSE (<i>Health, Safety, and Environment</i>)	The supervision consultant's ability to thoroughly implement Construction HSE at the project site.	[16], [17], [19]; [22]
X5.	Understanding of project administration and contract documents	The Supervision Consultant's ability to understand the project administration process and contract documents, both construction implementation contracts and supervision consultant work contracts and Terms of Reference (TOR).	[16], [26] [22]
X6.	Project time management and prioritization	The supervision consultant's ability to manage time effectively and establish work scheduling based on a priority scale.	[16], [17], [19], [28]
X7.	Construction technical skill capability	The Supervision consultant's ability to understand technical specifications, work execution methods, and understand the implementation of correct execution methods.	[17], [19], [23], [29], [30] [22]
X8.	Monitoring budget progress and absorption	The Supervision consultant's ability to monitor the progress of the work according to the time plan and monitor the absorption of costs that occur due to the realization of progress.	[17], [19] [22]

X9.	Capacity and quality of human resources of supervision consultants	Capacity, quality, and competence of supervision consultants in terms of meeting minimum educational qualifications, work experience, and certificates of expertise.	[19], [23], [24], [25], [28], [30] [22]
X10.	Information and Communication Technology	The Supervision consultant's ability to utilize information and communication technology in project management and coordination with stakeholders.	[17], [19] [22]
X11	Regular periodic reports	The supervision consultant's ability to prepare comprehensive and relevant periodic reports and deliver them to stakeholders on time.	[16], [19] [22]
Project Supervision			
X12.	Project supervision and inspection	The ability of the supervision consultant to supervise and inspect the work process in the field and ensure that all stages are carried out according to procedures.	[16], [17], [26], [29], [30]
X13.	Quality assurance and quality control	The supervising consultant's ability to ensure the quality of work and prevent quality defects during the work process (quality assurance) and be able to identify and recommend the correction of quality defects (quality control).	[16], [17], [19], [25], [26], [27] [22]
X14.	Archive and documentation management	The supervision consultant's ability to maintain and manage project archives and documents properly for easy access to information.	[19], [26], [29] [22]
X15.	Project planning	The supervision consultant's ability to develop a detailed and realistic work plan, including schedules and resources.	[17], [28], [30] [22]
X16.	Work volume management	The capacity of the supervision consultant to precisely assess and manage the amount of work in relation to the project's requirements.	[16], [17], [19] [22]
X17.	Ability to achieve project goals	The success and accomplishment of	[25], [27] [22]

		construction project goals for the project's and the company's profitability and continuity greatly depend on the supervision consultant's dedication to performing its duties.	
X18.	Project/field attendance	Commitment of the supervision consultant to be consistently present at the project site to conduct direct supervision of the work in progress.	[17], [19], [30] [22]

The previous table presented general performance indicators for supervision consultants in road construction projects. In the next stage, input was collected from main respondents to assess the importance of these 18 indicators when applied to toll road construction projects. The questionnaire was distributed to 50 respondents from PT X, selected based on their assignment history and documented work experience. Respondents rated each indicator using a 1–5 Likert scale, where the highest score indicated “extremely important.” Eligibility criteria required respondents to have at least five years of direct experience in toll road projects, involvement in at least two different projects with different supervision consultants, a minimum managerial-level position, and a Bachelor’s degree in Civil Engineering. The collected survey data were then subjected to statistical analysis.

3.1 Validity and Reliability Test

The validity test was conducted using the Pearson Correlation method. SPSS software is the main tool in analysing this validity and reliability test. An instrument is considered valid if the Pearson correlation value is greater than the r table value ($r_{xy} > r_{table}$) and the significance value is less than 5% (sig. 2-tailed value $< 5\%$). For the main survey respondents of 50 people ($N = 50$), the r table value is 0.279.

Data the results of the validity test with the help of SPSS software can be described as in the table below:

Table 2. Validity Test

Items Total Statistic				Items Total Statistic			
Indicators	Pearson Correlation	Sig. (2-tailed)	Dec.	Indicator	Pearson Correlation	Sig. (2-tailed)	Dec.
X1	0,427	0,002	Valid	X10	0,595	0,000	Valid
X2	0,607	0,000	Valid	X11	0,549	0,000	Valid
X3	0,565	0,000	Valid	X12	0,531	0,000	Valid
X4	0,443	0,001	Valid	X13	0,555	0,000	Valid
X5	0,385	0,006	Valid	X14	0,429	0,002	Valid
X6	0,573	0,000	Valid	X15	0,479	0,000	Valid
X7	0,464	0,001	Valid	X16	0,578	0,000	Valid
X8	0,435	0,002	Valid	X17	0,573	0,000	Valid
X9	0,418	0,003	Valid	X18	0,620	0,000	Valid

Every variable indicator has a Sig value, according to the calculation table of the validity test findings above. All 18 variable indicators are deemed legitimate since the Pearson Correlation value is higher than r table 0.279 and the 2-tailed is less than 0.05. The reliability test can be conducted once all variable indications have been deemed legitimate. With the use of SPSS software, the reliability test was conducted using the Cronbach's Alpha criteria as follows, and the results are shown in the table below.

Table 3. Reliability Test

<i>Cronbach's Alpha</i>	<i>N of Items</i>
0,819	18
0,819 ≥ 0,6 (Reliable)	

As shown in the table above, the Cronbach's Alpha value based on the calculation results is 0.819 from 18 indicators of the research variable. This value is greater than 0.60 so it can be concluded that all indicators in the survey questionnaire are declared reliable.

3.2 Descriptive Statistical Analysis

Based on the data obtained from respondents' answers, descriptive statistical analysis is carried out to determine the total number of responses from respondents' answers and the average of the respondents' rating scale on each indicator. This is done to determine the tendency of respondents to the level of importance of all indicators whether these indicators are considered important or not. The table below presents the results of the statistical analysis.

Table 4. Descriptive Statistical Analysis

Indicators	Descriptive Statistical			Indicator	Descriptive Statistical		
	N	Sum	Mean		N	Sum	Mean
X1	50	240	4,800	X10	50	216	4,320
X2	50	241	4,820	X11	50	224	4,480
X3	50	239	4,780	X12	50	239	4,780
X4	50	238	4,760	X13	50	245	4,900
X5	50	245	4,900	X14	50	224	4,480
X6	50	235	4,700	X15	50	217	4,340
X7	50	244	4,880	X16	50	240	4,800
X8	50	238	4,760	X17	50	237	4,740
X9	50	230	4,600	X18	50	237	4,740

According to the analysis's findings in the table above, among the 18 indicators, it is known that all indicators are considered important to be present in the performance of supervision consultants by respondents with mean values ranging from 4.32 to 4.9.

3.3 Normality Test

With the aid of SPSS software, a normality test is conducted to determine whether the data in this study is normally distributed. The data is deemed normally distributed if the significance value (Asymp. Sig.) is greater than 0.05; if it is less than 0.05, the data is deemed not normally distributed. This test employs the One-Sample Kolmogorov-Smirnov Test method with the following decision-making criteria. To choose the sophisticated statistical analysis technique that will be applied in the study, this normalcy test is crucial.

Table 5. Normality Test

Indicators	Test Statistic	Asymp. Sig. (2-tailed)	Description
X1	0,490	0,000	Non-normally distributed
X2	0,499	0,000	Non-normally distributed
X3	0,480	0,000	Non-normally distributed
X4	0,473	0,000	Non-normally distributed
X5	0,529	0,000	Non-normally distributed
X6	0,444	0,000	Non-normally distributed

X7	0,523	0,000	Non-normally distributed
X8	0,463	0,000	Non-normally distributed
X9	0,393	0,000	Non-normally distributed
X10	0,317	0,000	Non-normally distributed
X11	0,349	0,000	Non-normally distributed
X12	0,480	0,000	Non-normally distributed
X13	0,529	0,000	Non-normally distributed
X14	0,335	0,000	Non-normally distributed
X15	0,264	0,000	Non-normally distributed
X16	0,490	0,000	Non-normally distributed
X17	0,463	0,000	Non-normally distributed
X18	0,461	0,000	Non-normally distributed

3.4 Analysis of Differences in Perceptions between Respondent Groups

To further analyse whether there are significant differences in perceptions between the two groups of respondents from both criteria, it is necessary to conduct a comparative analysis between these groups. It is known from earlier research on the normality test using the Kolmogorov-Smirnov method that the data collected is not normally distributed, necessitating the use of non-parametric analysis techniques. The Mann-Whitney U analysis method is employed to examine variations in respondents' perceptions of the data. A nonparametric statistical test applied to two independent samples is the Mann-Whitney U test. The following table describes the analysis's findings:

Table 6. Mann-Whitney U Test

Indicators	Position Criteria		Formal Education Criteria	
	<i>Asymp. Sig. (2-tailed)</i>	Description	<i>Asymp. Sig. (2-tailed)</i>	Description
X1	0,475	Not Significant	0,264	Not Significant
X2	0,766	Not Significant	0,583	Not Significant
X3	0,783	Not Significant	0,508	Not Significant
X4	0,093	Not Significant	0,028	Significant
X5	0,341	Not Significant	0,167	Not Significant
X6	0,375	Not Significant	0,275	Not Significant
X7	0,035	Significant	0,582	Not Significant
X8	0,722	Not Significant	0,518	Not Significant
X9	0,114	Not Significant	0,209	Not Significant
X10	0,478	Not Significant	0,808	Not Significant
X11	0,423	Not Significant	0,627	Not Significant
X12	0,098	Not Significant	0,914	Not Significant
X13	0,341	Not Significant	0,167	Not Significant
X14	0,280	Not Significant	0,366	Not Significant
X15	0,157	Not Significant	0,518	Not Significant
X16	0,153	Not Significant	0,750	Not Significant
X17	0,280	Not Significant	0,964	Not Significant
X18	0,152	Not Significant	0,315	Not Significant
AVG	0,337	Not Significant	0,476	Not Significant

One indication, X7 in the respondent group based on position and indicator X4 in the respondent group based on formal education, is one that has differing perspectives among respondents for each set of respondents shown in the above table. Nonetheless, the mean significance value of Asymp.Sig (2-

tailed) for the position-based respondent group is 0.337, while the formal education-based respondent group's Asymp.Sig (2-tailed) value is 0.476, indicating that there is no significant difference between the two groups of respondents' perceptions.

The statistical analysis process has been conducted and has addressed Research Question 1 (RQ1), validating the 18 performance indicators for supervision consultants in toll road construction projects.

3.5 Indicator Ranking Analysis with TOPSIS and Weighting with ROC

Considering the findings of the descriptive statistical study, all indicators are between the ranges of important (scale 4) and very important (scale 5). Then a relative ranking analysis will be carried out with the MCDM method using the TOPSIS technique. The TOPSIS analysis results depict the importance level of each indicator in the performance evaluation of supervision consultants. The table below is the result of the TOPSIS analysis in the form of the relative closeness value (C) of each indicator based on its level of importance and then grouped based on the dimensions/groups of soft skills, technical skills, and project supervision indicator variables.

Table 7. TOPSIS Analysis

Indicators	C (Relative Closeness Value)	Rating
Soft Skills		
X1	0,494	2
X2	0,533	1
X3	0,455	3
Technical Skills		
X4	0,589	4
X5	0,704	2
X6	0,571	5
X7	0,689	3
X8	0,534	6
X9	0,531	7
X10	0,362	8
X11	0,782	1
Project Supervision		
X12	0,705	3
X13	0,810	1
X14	0,509	6
X15	0,374	7
X16	0,711	2
X17	0,638	5
X18	0,670	4

After ranking for each indicator, the next weighting is carried out with the ROC technique based on the order in the ranking of each indicator as in the table above. The weighting of each indicator is as shown in the following table:

Table 8. Weighting Analysis with ROC

Indicators	C (Relative Closeness Value)	Rating	Weight
Soft Skills			
X1	0,494	2	27.8%
X2	0,533	1	61.1%
X3	0,455	3	11.1%
Technical Skills			

X4	0,589	4	11.1%
X5	0,704	2	21.5%
X6	0,571	5	7.9%
X7	0,689	3	15.2%
X8	0,534	6	5.4%
X9	0,531	7	3.3%
X10	0,362	8	1.6%
X11	0,782	1	34.0%
Project Supervision			
X12	0,705	3	15.6%
X13	0,810	1	37.0%
X14	0,509	6	4.4%
X15	0,374	7	2.0%
X16	0,711	2	22.8%
X17	0,638	5	7.3%
X18	0,670	4	10.9%

3.6 Expert Validation and Recommendation

After conducting the ranking and weighting analysis for each indicator, a final validation was performed by six expert reviewers from PT X. The experts confirmed that the assigned ranks and weights for each indicator were suitable for assessing supervision consultants in toll road projects. However, they recommended refinements to the descriptions of indicators X5, X7, X8, and X10. Additionally, the reviewers suggested assigning weights to each indicator group as follows: 40% for technical skills, 30% for soft skills, and 30% for project supervision.

Technical skills were given the highest weight because this group represents the most critical competency for toll road supervision consultants. Without a strong grasp of technical aspects in toll road construction, the benefits of soft skills and project supervision would be negligible. The weighting of indicator groups aims to derive a comprehensive final assessment score.

Based on the final validation and expert recommendations, a finalized list of indicators and their respective weights was established, forming a robust assessment rubric for toll road supervision consultants. The table below displays the findings.

Table 9. Weighted Indicator List for Supervision Consultant Performance Evaluation in Toll Road Construction Projects

Code	Indicators	Description	Weight
Soft Skills			30%
X1.	Communication and coordination skills	The supervision consultant's ability to communicate and coordinate clearly and effectively with stakeholders.	27,8%
X2.	Leadership and managerial	The supervision consultant's ability to effectively lead the project team, motivate team members, and maintain productivity.	61,1%
X3.	Problem and conflict management	The supervision consultant's ability to prevent and analyze conflicts and problems in depth, and provide implementable solutions.	11,1%
Technical Skills			40%
X4.	Construction HSE (<i>Health,</i>	The supervision consultant is able to thoroughly implement Construction HSE at the project site.	11.1%

<i>Safety, and Environment</i>			
X5.	Understanding of project administration and contract documents	The supervision consultant's capability to understand project administration, contractual documentation, and legal contract aspects, encompassing both construction execution contracts and supervision consultant service agreements including their Terms of Reference (TOR)	21,5%
X6.	Project time management and prioritization	The supervising consultant's ability to manage time effectively and establish work scheduling based on a priority scale.	7,9%
X7.	Construction technical skill capability	The supervision consultant's expertise encompasses technical specification comprehension, working drawing accuracy analysis, execution method evaluation, and proper implementation of construction methodologies	15,2%
X8.	Monitoring budget progress and absorption	The supervision consultant's ability to supervise construction progress according to the planned schedule while monitoring budget expenditures associated with actual progress, then aligning these with the corporate Work Plan and Budget Framework	5,4%
X9.	Capacity and quality of human resources of supervision consultants	Capacity, quality, and competence of supervision consultants in terms of meeting minimum educational qualifications, work experience, and certificates of expertise.	3,3%
X10.	Information and Communication Technology	The supervision consultant's competency in utilizing information and communication technology for effective stakeholder communication, as well as their understanding of Building Information Modeling (BIM) implementation in project management	1,6%
X11.	Regular periodic reports	The supervision consultant's ability to prepare comprehensive and relevant periodic reports and deliver them to stakeholders on time.	34,0%
Project Supervision			30%
X12.	Project supervision and inspection	The ability of the supervision consultant to supervise and inspect the work process in the field and ensure that all stages are carried out according to procedures.	15,6%
X13.	Quality assurance and quality control	The supervising consultant's ability to ensure the quality of work and prevent quality defects during the work process (quality assurance) and be able to identify and recommend the correction of quality defects (quality control).	37,0%
X14.	Archive and documentation management	The supervision consultant's ability to maintain and manage project archives and documents properly for easy access to information.	4,4%
X15.	Project planning	The supervision consultant's ability to develop a detailed and realistic work plan, including schedules and resources.	2,0%

X16.	Work volume management	The supervision consultant's ability to analyze and control the volume of work accurately and relevant to the needs of the project.	22,8%
X17.	Ability to achieve project goals	For the construction project to succeed and meet its goals, as well as for the project's and the company's profitability and continuity, the oversight consultant's dedication to performing its duties is crucial.	7,3%
X18.	Project/field attendance	Commitment of the supervision consultant to be consistently present at the project site to conduct direct supervision of the work in progress.	10,9%

The list of indicators above can now be used as a performance assessment rubric for supervision consultants in toll road construction projects, incorporating specific evaluation criteria. Expert sources recommended the use of an interval scoring scale along with defined criteria for each interval. The experts also suggested definitions for each evaluation criterion and provided input on the acceptance criteria to describe the final assessment outcome. The evaluation criteria and acceptance criteria are presented in the table below:

Table 10. Scoring Interval, Description of Evaluation Criteria, and Acceptance Criteria

Scoring Interval	Criteria	Description of Evaluation Criteria	Acceptance Criteria
88 - 100	Excellent	The performance of the supervision consultant is excellent, demonstrating above-average capabilities with extensive professional experience.	Recommended to continue the current contract and to be selected for future projects.
75 - 87	Good	The performance of the supervision consultant is good, although there are some areas that require improvement; the consultant shows strong willingness for development.	Acceptable and recommended to continue the current contract and considered for future projects.
62 - 74	Average	The performance of the supervision consultant is average, and not yet optimal, but there is still willingness to improve and develop.	Acceptable for the current contract with close monitoring in coordination with the service provider's head office, and may still be considered for future projects with strict evaluation during the initial tender stage.
49 - 61	Poor	The performance of the supervision consultant is below average (Poor), and the consultant shows difficulty in accepting input for development.	The consultant should be returned to the service provider's head office for further coaching, not acceptable to continue the current contract, and not recommended for future projects.
< 49	Very Poor	The performance of the supervision consultant is so poor (very poor), and the consultant is	Unacceptable, immediate contract termination should be carried out in accordance with applicable

resistant to input for regulations, and the consultant should be blacklisted from future projects.

3.7 Performance Evaluation of Supervision Consultants in Toll Road Construction Projects

In this study, the author conducted a performance evaluation survey on one supervision consulting firm, "PT Y," which had previously supervised three toll road construction projects at PT X. The survey involved 12 respondents, who were part of the 50 primary survey respondents from PT X personnel. Respondents were asked to evaluate the supervision consultant using the available performance assessment rubric, assigning scores in multiples of 10, with ratings ranging from 10 to 100. The assessment results were then categorized into the scoring scale as previously described. The collected evaluation data were subjected to a reliability test to measure the consistency of the rubric across different users/respondents. The reliability test was performed using SPSS software, and the results are presented in the table below:

Table 11. Reliability Test

<i>Cronbach's Alpha</i>	<i>N of Items</i>
0,825	18
0,825 ≥ 0,6 (Reliable)	

Following the reliability test, the survey data were processed and analyzed using descriptive statistical analysis to obtain the mean score for each category: soft skills, technical skills, and project supervision. The results of the descriptive statistical analysis are presented in the following table:

Table 12. Summary of Supervision Consultant Assessment Results

Group of Indicators	Supervision Consultant in Project. A	Supervision Consultant in Project. B	Supervision Consultant in Project. C
<i>Soft Skills (30%)</i>	77,50	76,11	63,48
<i>Technical Skills (40%)</i>	67,02	61,61	68,08
<i>Project Supervision (30%)</i>	68,52	62,84	65,11
Total Score	70,61	66,33	65,82
Criteria	Average	Average	Average

Project B and Project C correspond to Projects 1 and 5, it can be assessed that the performance of the supervision consultant was not yet optimal and remained at the "Average" level. This is reflected in the supervision results, where more than 60% of defects occurred on the toll road pavement due to suboptimal supervision. An "Average" rating indicates that there is still willingness for development and performance improvement. According to the acceptance criteria, this supervision consultant may be accepted for the ongoing contract with strict evaluation in coordination with the service provider's head office and may still be considered for future projects with close evaluation at the beginning of the service provider's tender process.

4. Conclusion

This study produced a structured technical indicator-based performance appraisal system for supervision consultants on toll road projects. Through a process of literature screening, statistical testing, AHP weighting, TOPSIS ranking, ROC weight simplification, and FGD validation, 18 valid and reliable indicators were obtained, grouped into three dimensions: soft skills, technical skills, and project supervision. The integration of the MCDM method ensures that each indicator is not only important in terms of perception, but also has a consistent and logically verified quantitative weight ($CR \leq 0.1$). The

results of the usage test show that the rubric is able to identify the actual performance of consultants in a measurable manner in three toll road projects.

Practically, this system has the potential to be integrated into the company's internal evaluation mechanism as an operational evaluation tool that directly links field supervision practices with the quality of construction results. Thus, the assessment is no longer administrative in nature but is based on technical contributions to the quality of road pavement work. The limitation of this study lies in the use of indicators at the team level, which does not yet represent the differences in individual functions within the consultant structure. Further research is recommended to develop role-based indicators and integrate this system into a digital evaluation platform for more sustainable performance monitoring.

Declaration of AI and AI assisted technologies in the writing process

During the preparation of this work, the author(s) used ChatGPT to assist with paraphrasing and improving the clarity of the manuscript. After using this tool, the author(s) carefully reviewed and edited the content as needed and take full responsibility for the content of the publication.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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