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Indicators in the Performance Evaluation Rubric for Supervision Consultants in Toll Road Construction Projects

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Abstract

The construction of toll roads is a key government program aimed at enhancing public productivity and accelerating national economic growth. To ensure that toll road construction meets the desired quality, time, and cost objectives, the involvement of competent supervision consultants is essential. However, suboptimal performance of these consultants often leads to less-than-ideal project outcomes. This study aimed to analyse the performance evaluation indicators of supervision consultants and incorporate them into a comprehensive performance assessment rubric for supervision consultants in toll road construction projects. The research methodology combined literature review, questionnaire surveys, and expert interviews for data collection. Then, each indication is ranked and weighted using the Rank Order Centroid (ROC) and Technique for Order Preference by Similarity to Ideal Solution (TOPSIS) approaches. The results showed that respondents and experts identified 18 important indicators grouped into three categories soft skills, technical skills, and project supervision which can be used in a validated performance assessment rubric for evaluating supervision consultants in toll road construction projects.

Introduction

Construction projects serve as one of the most important indicators for a country to transform its vision and strategic goals from mere written plans to reality. A country's project performance is a measure that reflects the country's work efficiency and its ability to achieve its development aspirations (Alsuliman, 2019; Falcone, 2023; Permatasari et al.,et al., 2021; Denizer et al., 2013). Road infrastructure development is one of the main pillars in supporting economic growth and community welfare. Roads serve as transportation infrastructure that enables more efficient movement of people, goods, and services, thereby improving accessibility to different regions and accelerating regional economic development (Berk & Biçen, 2017; Kebede & Tiewei, 2021; Pheng Lau & SHing Hou, 2019).

Good road infrastructure facilitates smooth connectivity between urban and rural areas, reduces logistics costs, and promotes an increase in a country's global competitiveness (Elburz & Cubukcu, 2021; Li et al., 2018; Ondiege et al., 2013; Tzonevska, 2023; Rondinelli et al., 1998). This is supported by evidence that infrastructure development, especially road development, has a positive influence on socio-economic development, geographic dispersion, urban expansion, and community development (Klarenberg et al., 2018; Shi et al., 2019). Various studies show that increasing transportation infrastructure development can

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increase GDP growth (Ammar et al., 2022; Cigu et al., 2018; Farhadi, 2015; Achour & Belloumi, 2016).

Based on the Ministry of PUPR's Strategic Plan, Indonesia has a 2030 vision that is implemented in stages from 2017 to 2030. In this span, several transportation infrastructures will be achieved, which are listed in the following table (Ministry of PUPR, 2020).

Table 1. Road Infrastructure Development Targets in Indonesia

Year Range	Infrastructure Type			
	Steady Road Condition (%)	Toll Road Construction (km)	Non-toll road construction (km)	Bridge Construction (m)
2017-2019	94	824	1.320	39.000
2019-2024	97	1.500	2.500	60.000
2025-2030	99	2.000	3.000	70.000

Source: Ministry of PUPR (2020)

In road infrastructure development projects, supervision consultants play an important role throughout the construction supervision process. Their responsibilities include technical supervision during the construction process, supervising and monitoring the construction work so that it is carried out in accordance with applicable specifications, standards and regulations. Good supervision plays a role in ensuring the success of the project and the quality of the final road. The supervision consultant also acts as a liaison between the project owner and the contractor, ensuring that each stage of the work goes according to plan. The quality of construction work is highly dependent on the rigor and competence of the supervision consultant (Ding et al., 2017; Heston et al., 2024; Shi et al., 2014).

Supervision consultants play an important role in maintaining the quality of the final result of a road construction project. They are responsible for evaluating and supervising the entire construction process, from land preparation, pavement work, to finishing. When supervision is done well, the road construction results will have optimal quality and can last for the life of the plan. Conversely, weak supervision will negatively affect road quality, which in turn will affect the comfort and safety of road users. Good road quality also reduces the maintenance costs incurred by the government in the long run.

The role of the supervision consultant is crucial in ensuring that construction proceeds according to standards. Weak supervision can lead to negligence in ensuring compliance with technical specifications in the field. For example, material testing that is not carried out strictly can lead to the use of substandard materials (Marsinta, 2017; Kjesbu et al., 2017; Caudron et al., 2008). In addition, supervision of the quality of work must also be carried out intensely by supervision consultants. The quality of materials and construction techniques greatly affect the durability of the road. Errors in material selection, such as off-specification concrete mixes or inaccuracies in curing methods, can lead to premature deterioration such as transverse cracking. Research shows that poor quality control during the construction phase contributes to the appearance of defects, requiring additional costs for partial reconstruction (Marsinta, 2017; Chen & Lou, 2014; Banihashemi et al., 2024).

Seeing the importance of the role of supervision consultants, properly conducted supervision can be a preventive measure to minimize toll road damage in the post-construction phase or during operations, so that the losses incurred are not too large. Therefore, steps are needed to improve the quality of supervision through improving the performance of supervision consultants, with reference to the actual conditions of their performance in current road projects.

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This research focuses on the supervision aspect of toll road construction projects. Toll roads in Indonesia are generally categorized as expressways, with consistent geometric characteristics and uniform traffic flow along its length. These roads are designed to accommodate heavy traffic loads without being interrupted by level crossings. The poor implementation of supervision can be reflected in the number of defects identified during the project's Final Handover process.

Table 2. Tabulation of Percentage of FHO Defect Findings

Project	Finished Construction	FHO	Total Defect	Number of Pavement Defects	Percentage of Pavement Defects to Total Defects
Project 1	2018	2021	107	71	66,36%
Project 2	2018	2021	1333	635	47,64%
Project 3	2019	2023	82	28	34,15%
Project 4	2021	2024	328	179	54,57%
Project 5	2021	2024	527	361	68,50%

Source: PT Jasa Marga (Persero) Tbk. (2021-2024)

The majority of the faults that arise in the pavement part of the toll road come after three years of operation, according to the data that is currently available. This shows that the aspect of supervision of pavement work needs special attention, considering that this section is the main element of road infrastructure as a means of land transportation. From the observation of the cost structure of road construction in PT X company, pavement work is also known to be one of the largest cost components in the entire project. In this condition, the supervision consultant has a crucial role to ensure the final quality of the road construction project, with responsibilities covering all stages of construction from land preparation, pavement work process, to the final stage or finishing.

A method of assessment and evaluation of the work of supervision consultants is necessary to raise the standard of the construction supervision process. In order to guarantee the general calibre of road infrastructure projects, this assessment is crucial. It is required of supervision consultants to offer expert services that guarantee construction safety and quality while lowering potential risks and expenses throughout project execution. Therefore, there is a need for tested and validated assessment indicators that truly reflect the influence on the performance of supervision consultants. These indicators are then used as the main basis in the preparation of the performance assessment rubric. The rubric developed in this research is intended as a standard tool that can be used in assessing the performance of supervision consultants on toll road projects.

This study is motivated by the need to enhance supervision effectiveness in toll road construction projects, with particular focus on identifying performance evaluation indicators for supervision consultants. The research therefore aims to analyze critical performance evaluation indicators through comprehensive literature review, respondent surveys, statistical analysis, and expert validation. The rigorously analyzed indicators will be systematically incorporated into a practical performance evaluation rubric for project owners to optimize supervision consultants' contributions to toll road project quality outcomes. The primary benefit of this study lies in providing validated indicators for a practical and reliable evaluation rubric. This tool enables the development of supervision performance enhancement strategies, ultimately leading to more optimal and dependable outcomes in toll road construction projects.

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Methods

The research strategy was used to direct the process of collecting data that is relevant to the object, subject, variable, and problem under study (Sukmadinata, 2005). This research used a quantitative approach and is conducted systematically, objectively, and logically (Hardani et al., 2020). The strategies used in answering the first research question, namely "what are the performance evaluation indicators for supervision consultants in supervising toll road projects?" are literature studies, questionnaire surveys, validity and reliability tests, and statistical analysis. Meanwhile, to answer the second question, namely "how are the performance indicators of supervision consultants analysed so that they can be used in a performance evaluation rubric for supervision consultants in toll road construction projects?", a literature study approach and the Multi Criteria Decision Making (MCDM) method consisting of TOPSIS and ROC techniques were used. The final step is a qualitative approach to conduct final validation by interviewing expert sources

The data used consisted of primary and secondary data. Primary data was obtained through a survey in two stages: (1) Questionnaire survey to 50 main respondents from PT X (2) Interview survey with three expert respondents from PT X to obtain final validation. Meanwhile, secondary data was collected from scientific literature, both national and international, which discussed performance indicators of supervision consultants on road projects.

The initial indicators from the literature were analyzed using clustering and elimination method based on Guttman scale, to filter the indicators based on their frequency of occurrence. Furthermore, the selected indicators were asked for opinions from experienced respondents on toll road projects and the results were tested for validity using Pearson Correlation and tested for reliability with Cronbach's Alpha using SPSS software. In the second stage, descriptive statistical analysis and inferential statistical analysis (normality test and perception difference test between groups) followed. The third stage involved ranking and weighting the indicators through TOPSIS and ROC methods. After a series of tests and analyses were conducted using these various methods, the weighted and ranked indicators could be used in the development of a rubric for assessing supervision consultants on toll road projects.

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 Rounds & Segner (2011), 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:

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Table 3. 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.	Manoharan et al (2023); Rauf et al (2023); Apriani & Prasetia (2023); Wibowo et al., (2022); Kimingi & Olango., (2020) Rounds & Segner (2011)
X2.	Leadership and managerial	The supervision consultant's ability to effectively lead the project team, motivate team members, and maintain productivity.	Manoharan et al (2023); Yoneda et al (2023); Setyo et al., (2022); Abas et al., (2021) Rounds & Segner (2011)
X3.	Problem and conflict management	The supervision consultant's ability to prevent and analyze conflicts and problems in depth, and provide implementable solutions.	Manoharan et al (2023); Yoneda et al (2023); Astana et al (2023); Abas et al., (2021) Rounds & Segner (2011)
Technical Skills			
X4.	Construction HSE *(Health, Safety, and Environment*	The supervision consultant’s ability to thoroughly implement Construction HSE at the project site.	Manoharan et al., (2023); Rauf et al (2023); Apriani & Prasetia (2023); Rounds & Segner (2011)
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).	Astana et al (2023); Rauf et al., (2023) Rounds & Segner (2011)
X6.	Project time management and prioritization	The supervision consultant's ability to manage time effectively and establish work scheduling based on a priority scale.	Manoharan et al., (2023); Rauf et al., (2023); Apriani & Prasetia., (2023); Kimingi & Olango., (2020) Rounds & Segner (2011)
X7.	Construction technical skill capability	The Supervision consultant’s ability to understand technical	Manoharan et al., (2023); Apriani & Prasetia., (2023);

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		specifications, work execution methods, and understand the implementation of correct execution methods.	Wibowo (2022); Setyo et al (2022); Noor et al (2022); Rounds & Segner (2011)
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.	Manoharan et al., (2023); Apriani & Prasetia., (2023) Rounds & Segner (2011)
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.	Yoneda et al., (2023); Apriani & Prasetia., (2023); Wibowo et al., (2022) Setyo et al (2022); Abas et al., (2021); Kimingi & Olango., (2020) Rounds & Segner (2011)
X10.	Information and Communication Technology	The Supervision consultant's ability to utilize information and communication technology in project management and coordination with stakeholders.	Manoharan et al., (2023); Apriani & Prasetia., (2023) Rounds & Segner (2011)
X11	Regular periodic reports	The supervision consultant's ability to prepare comprehensive and relevant periodic reports and deliver them to stakeholders on time.	Rauf et al., (2023); Apriani & Prasetia., (2023) Rounds & Segner (2011)
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.	Manoharan et al., (2023); Rauf et al., (2023); Astana et al., (2023); Apriani & Prasetia., (2023); Wibowo et al., (2022); Noor et al., (2020) Rounds & Segner (2011)
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	Manoharan et al., (2023); Rauf et al., (2023); Yoneda et al., (2023); Astana et al., (2023); Apriani & Prasetia., (2023);

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		able to identify and recommend the correction of quality defects (quality control).	Abas et al., (2021) Rounds & Segner (2011)
X14.	Archive and documentation management	The supervision consultant's ability to maintain and manage project archives and documents properly for easy access to information.	Astana et al., (2023); Apriani & Prasetia., (2023); Noor et al., (2020) Rounds & Segner (2011)
X15.	Project planning	The supervision consultant's ability to develop a detailed and realistic work plan, including schedules and resources.	Manoharan et al., (2023); Wibowo et al., (2022); Kimingi & Olango., (2020) Rounds & Segner (2011)
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.	Manoharan et al., (2023); Rauf et al., (2023); Apriani & Prasetia., (2023) Rounds & Segner (2011)
X17.	Ability to achieve project goals	The success and accomplishment of 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.	Yoneda et al., (2023); Abas et al., (2021) Rounds & Segner (2011)
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.	Manoharan et al., (2023); Wibowo et al., (2022); Apriani & Prasetia., (2023) Rounds & Segner (2011)

The previous table only presented the general performance indicators of supervision consultants in road construction projects. The next stage involved gathering input from main respondents on the importance level of these 18 indicators when used to assess the performance of supervision consultants in toll road construction projects. The questionnaire was distributed to main respondents selected based on their assignment history and work experience recorded in PT X's historical data. Respondents assessed the importance level of each indicator using a 1-to-5 Likert scale, with the highest score representing "extremely important" in the evaluation. The author involved a total of 50 respondents in this survey, with the minimum criteria for respondents including: having direct experience in toll road construction projects and interacting with supervision consultants for at least five years, having been involved in at least two different construction projects or packages with different supervision consultants, holding a minimum position of manager equivalent, and having a minimum educational background of a Bachelor's degree in Civil Engineering. The survey data will subsequently undergo statistical analysis.

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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 (rxy> 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 4. 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 5. Reliability Test

Cronbach's Alpha	**N of Items**
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.

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 6. 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

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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.

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 7. 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

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 provides a description of the analysis's findings:

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Table 8. Mann-Whitney U Test

Indicators	Position Criteria		Formal Education Criteria	
	Asymp. Sig. (2-tailed)	Description	*Asymp. Sig. (2-tailed)*	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.

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 9. TOPSIS Analysis

Indicators	*C (Relative Closeness Value)*	Rating
Soft Skills		
X1	0,494	2
X2	0,533	1

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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 10. 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%

Expert Validation and Recommendation

After conducting the ranking and weighting analysis for each indicator, a final validation was performed by three expert reviewers from PT X. The experts confirmed that the assigned ranks and weights for each indicator were suitable for assessing supervision consultants in

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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 11. 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 *(Health, Safety, and Environment*	The supervision consultant is able to thoroughly implement Construction HSE at the project site.	11.1%
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	5.4%

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		associated with actual progress, then aligning these with the corporate Work Plan and Budget Framework	
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 Communicatio n 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 serve as a performance assessment rubric for toll road supervision consultants, incorporating specific evaluation criteria. The expert reviewers recommended adopting an interval scoring scale, defined as follows: 87–100 for "Very Good," 73–86 for "Good," 59–72 for "Fair," 45–58 for "Poor," and less than 45 for "Very Poor". For practical application, the assessment team may use a 10 to 100 rating scale for scoring.

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Conclusion

The research findings and analysis of the 18 indicators derived from literature review and validated by experienced respondents and expert sources confirm these as essential indicators for evaluating the performance of supervision consultants in toll road construction projects. These indicators are classified into three main categories: soft skills, technical skills, and project supervision. The study confirms that all indicators across these three categories can serve as the foundation for developing a performance assessment rubric, following preliminary ranking using the TOPSIS technique and weighting through the ROC method.

The implication of this study is that the assessment indicators can be developed into a standardized evaluation rubric within the company, serving as a practical tool for stakeholders - particularly project owners - to enhance accountability and supervision quality in the field. However, this research has limitations as the indicators used remain generalized for evaluating supervision consultants' performance at the team level. Therefore, it is recommended that future research develop more detailed indicators for each individual supervision consultant's position, function, and responsibilities - ranging from team leaders and engineers to supervisors. This approach would enable more in-depth and comprehensive performance evaluation, allowing for thorough assessment across all personnel task lines within the supervision consultant team.

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