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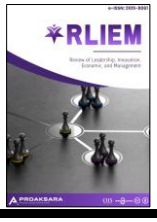

Evaluating Project Owner Satisfaction and Strategic Improvement Priorities in WIKA's Wosusokas Water Supply System Project

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ABSTRACT

Regional water supply system development is a national priority in Indonesia, yet project success is still commonly assessed through physical progress rather than the perceptions of the public agencies that commission the work. This study evaluates the satisfaction of the Ministry of Public Works as project owner with the project management performance of PT Wijaya Karya (Persero) Tbk. in the Wosusokas Regional Water Supply System (SPAM) Project, since 100% physical completion in Segments 2 and 4 does not by itself indicate that owner expectations were met. An ex post quantitative design was applied, with respondents comprising the Commitment Making Officer, work-unit representatives, and technical personnel from the owner's side. Data were gathered through importance–performance questionnaires, project documents, and expert judgment obtained in focused discussions, and analysed using the Customer Satisfaction Index (CSI), Importance–Performance Analysis (IPA), and the Analytic Hierarchy Process (AHP). The CSI reached 88.53%, indicating that the owner was satisfied. IPA nevertheless identified four priority attributes: system reliability after handover, handling of material and equipment delay risk, overall satisfaction, and the possibility of future cooperation. AHP ranked strengthening supply-chain risk management as the leading strategy, followed by digitalizing project reporting and communication, strengthening partnering with the owner, improving testing and after-handover procedures, and developing competence and K3/HSE culture. Owner satisfaction thus offers a basis for continuous improvement beyond physical progress.

Keywords: Analytic Hierarchy Process (AHP), Customer Satisfaction Index (CSI), Importance–Performance Analysis (IPA), Project Owner Satisfaction, SPAM Wosusokas

1. INTRODUCTION

The Water Supply System (*Sistem Penyediaan Air Minum* or SPAM) is a strategic public infrastructure that supports sustainable access to safe drinking water through planning, construction, operation, and maintenance of distribution networks. In Indonesia, SPAM development is strengthened by a regulatory framework that recognizes water as a basic public need and mandates the state to ensure its availability through sustainable management (Widiyastuti et al., 2025). The government has also introduced the National Safe Drinking Water Roadmap 2020–2030, which sets progressive targets for increasing access to safe drinking water and piped water services. As shown in Figure 1, the national safe drinking water access target is projected to increase from 11.80% in 2020 to 31.06% in 2024 and to continue rising toward 45% in 2030 (Kemenkes, 2021).

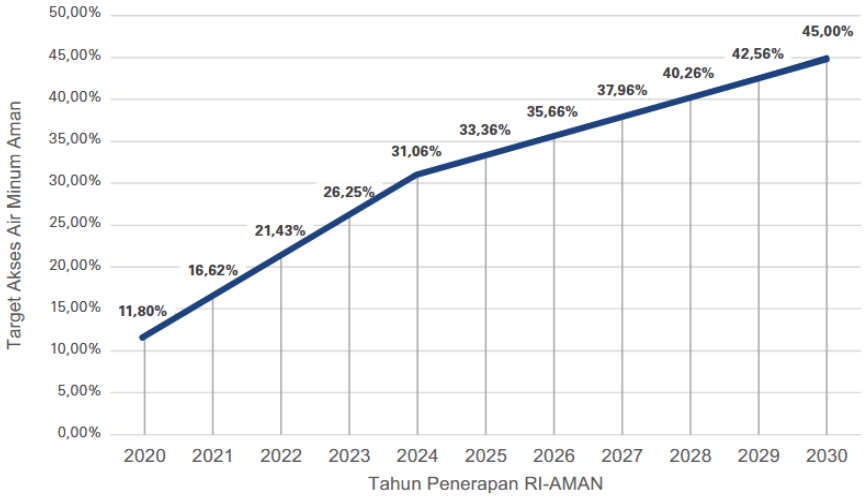

Figure 1. Target Coverage of Safe Drinking Water Access in Indonesia
Source: Kemenkes (2021)

The achievement of these targets requires effective implementation of regional SPAM projects, including the Wosusokas Regional SPAM Project, which is designed to serve Wonogiri, Sukoharjo, Surakarta, and Karanganyar. In this project, PT Wijaya Karya (Persero) Tbk. (WIKA) carried out the Main Distribution Network (Jaringan Distribusi Utama or JDU) and reservoir works for Segment 2 and Segment 4. Based on project-progress documentation, both segments reached full physical completion according to the planned progress, with no recorded deviation, indicating that the work had been completed in line with schedule and technical specifications (PT Wijaya Karya (Persero) Tbk., 2025). However, physical completion alone does not fully explain whether the Ministry of Public Works, as the project owner, perceives the contractor's project management performance as satisfactory.

The main research problem lies in the limited and non-standardized measurement of project owner satisfaction. The assessment previously available was mainly an internal contractor survey, which provided only a simple recap and did not sufficiently represent the broader perspective of owner-side units involved in supervision, decision-making, and strategic evaluation. This limitation may lead to a narrow interpretation of project success, making it difficult to identify performance gaps and formulate systematic improvement strategies. Previous studies have emphasized that project owner or customer satisfaction in construction is shaped by project performance dimensions such as time, cost, quality, safety, communication, human resources, risk management, trust, and contractor responsiveness (Astana et al., 2023; Li et al., 2023; Madeppungeng et al., 2020; Syamil et al., 2021). Nevertheless, studies on WIKA have generally focused on financial performance, vendor relationships, work-system improvement, and profitability, while empirical evaluation of project owner satisfaction in public SPAM infrastructure projects remains limited (Awatara et al., 2024; Putri & Maielyana, 2025; Firmansyah et al., 2022; Khorunisa & Hermuningsih, 2023).

Therefore, this study addresses the following research questions: how satisfied is the project owner with WIKA's project management performance in the Wosusokas Regional SPAM Project; which performance factors determine project owner satisfaction; and what improvement strategies should be prioritized to strengthen owner satisfaction in current and future projects. To answer these questions, this study integrates the Customer Satisfaction Index (CSI), Importance–Performance Analysis (IPA), and the Analytic Hierarchy Process (AHP). CSI is used to measure the overall level of satisfaction, IPA identifies priority attributes for improvement, and AHP ranks strategic alternatives based on expert judgment (Saaty, 2008; Usboko & Adi, 2020). Theoretically, this study contributes to project management literature by extending owner satisfaction analysis in the context of public water infrastructure projects. Practically, the findings provide WIKA and the Ministry of Public Works with a data-driven basis for improving project governance, strengthening contractor performance, and supporting continuous improvement in similar SPAM projects.

2. LITERATURE REVIEW

2.1. Project Performance and Project Owner Satisfaction

Project owner satisfaction in construction projects reflects the extent to which the contractor's performance meets the owner's expectations in technical, managerial, and relational aspects. In public infrastructure projects, satisfaction is not only determined by physical completion, but also by the quality of project delivery, communication, risk control, reliability of outcomes, and the potential for future cooperation. Previous studies show that project performance dimensions such as time, cost, quality, safety, communication, human resources, and risk management have a significant relationship with customer or owner satisfaction in construction projects (Astana et al., 2023; Madeppungeng et al., 2020; Syamil et al., 2021).

In the context of owner–contractor relationships, satisfaction is also influenced by trust, contractor capability, reputation, institutional certainty, and the quality of collaboration during project implementation. Trust and cooperation are important because construction projects involve uncertainty, contractual interdependence, and continuous coordination among stakeholders. Studies on construction relationships show that owner satisfaction is shaped not only by measurable project outputs, but also by the contractor's ability to communicate clearly, respond to problems, maintain integrity, and build a reliable working relationship (Kawesittisankhun & Pongpeng, 2020; Li et al., 2023).

2.2. Performance Dimensions in Construction Project Evaluation

Contractor performance in construction projects is generally evaluated through several interrelated dimensions, including time, cost, quality, safety, communication, risk management, and stakeholder satisfaction. These dimensions are widely used because they reflect both project outputs and the quality of the project management process (Kunkcu et al., 2022). Previous studies also show that schedule, cost, human resources, and risk are among the key project-performance factors that influence customer satisfaction in construction projects (Syamil et al., 2021). In public infrastructure projects, performance evaluation should not be limited to technical completion, because the owner also evaluates how the contractor manages coordination, uncertainty, documentation, and responsiveness during implementation (Astana et al., 2023; Madeppungeng et al., 2020).

In this study, contractor performance is grouped into eight dimensions: time performance, cost performance, quality and system reliability, K3/HSE, communication and coordination, risk management, trust and relationship, and overall satisfaction. The inclusion of quality and system reliability is relevant because water supply infrastructure requires not only completion according to specification, but also functional reliability after handover. Risk management is included because construction-project performance can be affected by material delays, equipment availability, technical uncertainty, and field coordination problems (Papanikolaou & Xenidis, 2020). Meanwhile, trust and relationship are included because owner satisfaction is also shaped by contractor capability, reputation, institutional trust, and the quality of owner–contractor cooperation (Kawesittisankhun & Pongpeng, 2020; Li et al., 2023). These dimensions are also consistent with previous SPAM-related research, which found that project work, delivery, measurement, and uncertainty influence satisfaction with contractor performance (Mukramin et al., 2024).

2.3. CSI, IPA, and AHP as an Integrated Evaluation Framework

The Customer Satisfaction Index (CSI) is used to measure the aggregate level of satisfaction by combining the importance and performance scores of each attribute. In construction-project evaluation, CSI is useful because it provides a standardized satisfaction score that reflects how far contractor performance meets owner expectations (Kärnä et al., 2009; Othman, 2015). However, CSI alone does not indicate which attributes should be improved first. Therefore, Importance–Performance Analysis (IPA) is commonly used to map each attribute into priority quadrants, so that decision makers can distinguish between attributes that must be improved, maintained, or monitored with lower urgency (Madeppungeng et al., 2020; Usboko & Adi, 2020).

The Analytic Hierarchy Process (AHP) complements CSI and IPA by translating the evaluation results into strategic priorities. AHP is relevant because it enables decision makers to compare several criteria and alternatives systematically through pairwise comparison and consistency testing (Saaty, 2008). In this study, CSI is used to measure the overall level of owner satisfaction, IPA is used to identify priority performance attributes, and AHP is used to rank improvement strategies based on expert judgment. This integrated framework allows the analysis to move from satisfaction measurement, to diagnostic mapping, and finally to

strategic prioritization. Such integration is appropriate for construction-project evaluation because it links owner perception, performance gaps, and managerial decision making into one coherent analytical process (Lee & Xue, 2021; Pak, 2013).

2.4. Previous Studies and Research Positioning

Previous studies on construction project performance and owner satisfaction fall into three streams: performance-satisfaction relationships across dimensions such as time, cost, quality, safety, human resources, and risk management; owner–contractor relationships involving trust, contractor capability, communication, and collaboration; and methodological approaches such as CSI, IPA, and decision-support methods for identifying improvement priorities. These studies form the basis for this research, while also showing that integrating CSI, IPA, and AHP in public SPAM infrastructure projects remains limited.

Table 1. Previous Studies on Project Performance, Owner Satisfaction, and Strategic Improvement

Study	Focus and Method	Key Finding	Relevance to This Study
Usboko and Adi (2020)	Contractor satisfaction toward owner-team performance using CSI and IPA	Financial processes, owner involvement, and empathy shape contractor satisfaction	Shows the relevance of CSI–IPA and provides a contrasting direction because the present study evaluates owner satisfaction toward the contractor
Li et al. (2023)	Owner trust motivation toward contractors using SEM	Capability, reputation, and institutional trust shape owner trust	Supports the inclusion of trust and relationship as a project-performance dimension
Astana et al. (2023)	Project performance and customer satisfaction in a public-sector project using factor analysis and SEM-PLS	Project performance significantly improves customer satisfaction	Confirms that owner satisfaction can be treated as a performance outcome in government projects
Papanikolaou and Xenidis (2020)	Risk-informed construction-project performance assessment	Project performance should be interpreted together with risk exposure	Justifies the central role of risk management in evaluating public-infrastructure projects
Kawesittisankhun and Pongpeng (2020)	Contractor multilevel strategies and owner/community satisfaction using SEM	Functional strategies such as safety, productivity, and communication affect satisfaction	Supports the managerial-strategy orientation of the present study
Syamil et al. (2021)	Project performance and customer satisfaction using regression	Schedule, cost, human resources, and risk influence customer satisfaction	Provides comparative evidence on the dominant dimensions of project performance
Mukramin et al. (2024)	SPAM-project customer satisfaction toward contractor performance	Project delivery, work domain, measurement, and uncertainty are influential	Offers a directly relevant SPAM-sector comparison for the present study
Madeppungeng et al. (2020)	Owner satisfaction toward contractor performance using CSI, IPA, and gap analysis	Time accuracy, contract scope, risk information, and quality assurance are important	Shows the usefulness of CSI and IPA but also reveals the need for a method to prioritize strategies, which is addressed here through AHP

Source: Authors' compilation

Based on Table 1, several research patterns can be identified. First, project performance is consistently positioned as an important determinant of customer or owner satisfaction in construction projects. Time, cost, quality, safety, communication, human resources, and risk management appear repeatedly as relevant dimensions in evaluating contractor performance (Astana et al. 2023; Madeppungeng et al. 2020; Syamil et al. 2021). Second, owner satisfaction is also shaped by relational factors, particularly trust, contractor capability, reputation, communication quality, and the ability to maintain cooperative working relationships (Kawesittisankhun & Pongpeng 2020; Li et al. 2024). Third, CSI and IPA have been widely used to measure satisfaction and map performance priorities, but these methods generally stop at diagnostic evaluation and do not always provide a structured ranking of strategic alternatives.

This study addresses that gap by evaluating the satisfaction of the Ministry of Public Works as project owner toward the project management performance of PT Wijaya Karya (Persero) Tbk. in the Wosusokas Regional SPAM Project. Unlike previous studies that mainly focus on satisfaction measurement or quadrant mapping, this study integrates CSI, IPA, and AHP in a single analytical framework. CSI measures the overall level of owner satisfaction, IPA identifies priority performance attributes, and AHP ranks improvement strategies based on expert judgment. Therefore, this study contributes to the literature by extending owner satisfaction evaluation in public water infrastructure projects and contributes practically by providing strategic improvement priorities for contractor performance in similar SPAM projects.

3. RESEARCH METHODS

3.1. Research Design

This study employed a quantitative explanatory design with an ex post approach, because the evaluation was conducted after the Wosusokas Regional Water Supply System (*Sistem Penyediaan Air Minum* or SPAM) Project, particularly the Main Distribution Network (*Jaringan Distribusi Utama* or JDU) Segment 2 and Segment 4, had reached full physical completion. The design was selected to measure the project owner's satisfaction with contractor performance, identify priority performance attributes, and formulate strategic improvement priorities for PT Wijaya Karya (Persero) Tbk. The use of an ex post approach is appropriate when the object being evaluated has already occurred and the researcher aims to assess outcomes based on available project experience and respondent perceptions (Creswell, 2013; Sugiyono, 2017).

The analytical framework integrates the Customer Satisfaction Index (CSI), Importance–Performance Analysis (IPA), and the Analytic Hierarchy Process (AHP). CSI was used to measure the aggregate level of owner satisfaction, IPA was used to map performance attributes into improvement-priority quadrants, and AHP was used to prioritize strategic alternatives through expert judgment. This integration is relevant because satisfaction evaluation should not stop at measurement, but should also provide a basis for managerial decision making and strategic improvement (Kärnä et al., 2009; Othman, 2015; Pak, 2013; Saaty, 2008).

3.2. Research Object, Respondents, and Expert Panel

The research object was the project management performance of PT Wijaya Karya (Persero) Tbk. in the Wosusokas Regional SPAM Project, specifically JDU Segment 2 and Segment 4. The respondents for the CSI and IPA analysis consisted of owner-side personnel from the Ministry of Public Works who were directly involved in project implementation, supervision, contract administration, and field evaluation. The total eligible population comprised ten personnel: the Head of the Regional Office (Kabalai), the Head of the Work Unit (Kasatker), the Commitment Making Officer (PPK), the technical implementer, the general administrative implementer, and field and project staff. Because this population was limited and could be clearly identified, all ten were included, so that the study used a total population approach or complete enumeration rather than sampling. This approach is suitable when the number of eligible respondents is small and each member has relevant knowledge of the evaluated object (Creswell, 2013; Sugiyono, 2017).

For the AHP stage, four experts were selected purposively based on their academic and practical competence in project management, SPAM infrastructure, construction supervision, and water distribution systems. Purposive expert selection is appropriate when the quality of judgment depends on the expertise and credibility of selected informants (Tongco, 2007). The expert panel was involved in validating the strategic alternatives and providing pairwise comparisons for AHP analysis.

Table 2. Research Respondents, Data Sources, and Analytical Procedures

Component	Description
Research object	Project management performance of PT Wijaya Karya (Persero) Tbk. in the Wosusokas Regional SPAM Project, JDU Segment 2 and Segment 4
Research approach	Quantitative explanatory design with an ex post approach
CSI–IPA respondents	Ten owner-side respondents from the Ministry of Public Works, consisting of Kabalai, Kasatker, PPK, technical implementer, general administrative implementer, and field/project staff
Sampling technique	Total population or complete enumeration because the relevant population was limited and directly involved in the project
AHP expert panel	Four experts consisting of two academics and two practitioners in project management, SPAM, and water distribution systems
Data collection	CSI–IPA questionnaire using a five-point Likert scale, project documents, and AHP expert assessment through focused discussion and pairwise comparison
Main variables	Contractor project management performance and project owner satisfaction
Performance dimensions	Time, cost, quality and system reliability, K3/HSE, communication and coordination, risk management, trust and relationship, and overall satisfaction
Analytical methods	Validity and reliability tests, CSI, IPA, and AHP
Research output	Satisfaction level, priority performance attributes, and ranked improvement strategies

Source: Authors' compilation

3.3. Data Collection and Instrument

Primary data were collected using an importance–performance questionnaire distributed to owner-side respondents. Each indicator was assessed twice: first, to measure the level of importance, and second, to measure the perceived performance of the contractor. A five-point Likert scale was used, ranging from very low to very high. The indicators were developed from project performance dimensions commonly used in construction-project evaluation, including time, cost, quality, safety, communication, risk management, and relational factors such as trust and cooperation (Kärnä et al., 2009; Othman, 2015; Astana et al., 2023).

Secondary data were obtained from project documents, including contracts, progress reports, minutes of technical meetings, and project completion documents. These documents were used to support the interpretation of the empirical findings and to confirm the completion status of the evaluated project. For AHP, data were collected through expert assessment using pairwise comparison. The criteria and alternatives used in AHP were formulated from the CSI and IPA results and refined through expert discussion.

3.4. Data Analysis

The data analysis was conducted in four stages. First, instrument quality was assessed through validity and reliability tests. Item validity was examined using item-total correlation, while reliability was measured using Cronbach's Alpha. An instrument is considered reliable when the alpha coefficient meets the acceptable threshold for applied research (Sugiyono, 2017; Putri et al., 2015). It should be noted that with a complete enumeration of ten respondents, the statistical power of item-total correlation testing is inherently limited, so the validity results are treated as an indication of internal coherence within this respondent group rather than as evidence of instrument validity generalisable beyond it.

Second, CSI was calculated to determine the aggregate satisfaction level of the project owner. The calculation involved the Mean Importance Score (MIS), Weight Factor (WF), Mean Satisfaction Score (MSS), and Weighted Score (WS). The CSI value was obtained by dividing the total weighted score by the maximum scale and multiplying it by 100 percent. CSI is useful because it provides a standardized satisfaction index that reflects both the importance and performance of each attribute (Kärnä et al., 2009; Othman, 2015; Kamaluddin et al., 2019)

Third, IPA was used to map each performance attribute into four quadrants based on the mean importance and mean performance scores. The four quadrants consist of concentrate here, keep up the good work, low priority, and possible overkill. This method enables the researcher to identify which attributes

require immediate improvement and which attributes should be maintained (Kamaluddin et al., 2019; Madeppungeng et al., 2020; Usboko & Adi, 2020).

Fourth, AHP was applied to prioritize improvement strategies. The AHP criteria were derived from the project performance dimensions and the CSI–IPA findings, while the strategic alternatives were formulated based on the priority attributes identified in IPA. Pairwise comparisons were conducted by the expert panel, followed by consistency testing using the Consistency Ratio (CR). A judgment is considered consistent when CR is equal to or below 0.10 (Saaty, 2008). The final output of this stage was a ranked list of strategic improvement priorities for strengthening owner satisfaction and contractor performance in similar SPAM projects.

4. RESULTS AND DISCUSSION

4.1. Research Results

The respondents in this study were representatives of the Ministry of Public Works as the project owner who were directly involved in the implementation, administration, supervision, and field evaluation of the Wosusokas Regional Water Supply System (*Sistem Penyediaan Air Minum* or SPAM) Project. The respondent composition included managerial, technical, administrative, and field-level representatives, thereby allowing the assessment to capture the owner's perception from both strategic and operational perspectives. Prior to the main analysis, the instrument was tested for validity and reliability. The results showed that all performance and importance items met the validity criteria, while the reliability test indicated strong internal consistency. Therefore, the instrument was considered adequate for further analysis using the Customer Satisfaction Index (CSI), Importance–Performance Analysis (IPA), and Analytic Hierarchy Process (AHP).

Table 3. Summary of Instrument Quality

Component	Result	Interpretation
Number of respondents	10	Owner-side respondents from the Ministry of Public Works
Number of performance attributes	24	All items valid
Number of importance attributes	24	All items valid
Cronbach's Alpha for performance	0.972	Very reliable
Cronbach's Alpha for importance	0.969	Very reliable

Source: Data analysis

The CSI calculation was used to measure the overall satisfaction level of the project owner with WIKA's project management performance. The calculation considered the Mean Importance Score (MIS), Weight Importance Factor (WIF), Mean Satisfaction Score (MSS), and Weighting Score (WS) for each performance attribute. Based on the calculation, the project owner's satisfaction was categorized as satisfied. This result indicates that WIKA's performance in the Wosusokas Regional SPAM Project was generally perceived as meeting the owner's expectations, although several attributes still required improvement to reach a higher satisfaction level. The CSI result is presented in Table 4.

Table 4. CSI Calculation of Contractor Project Management Performance

Attribute	MIS	WIF	MSS	WS
X1	4.40	4.16	4.40	18.32
X2	4.50	4.26	4.50	19.16
X3	4.50	4.26	4.50	19.16
X4	4.30	4.07	4.40	17.90
X5	4.40	4.16	4.50	18.73
X6	4.40	4.16	4.40	18.32
X7	4.50	4.26	4.50	19.16
X8	4.50	4.26	4.40	18.73
X9	4.40	4.16	4.40	18.32
X10	4.30	4.07	4.20	17.09
X11	4.50	4.26	4.50	19.16
X12	4.40	4.16	4.40	18.32
X13	4.60	4.35	4.70	20.45

Attribute	MIS	WIF	MSS	WS
X14	4.50	4.26	4.50	19.16
X15	4.30	4.07	4.50	18.31
X16	4.40	4.16	4.40	18.32
X17	4.30	4.07	4.30	17.49
X18	4.50	4.26	4.40	18.73
X19	4.30	4.07	4.40	17.90
X20	4.30	4.07	4.60	18.71
X21	4.20	3.97	4.30	17.09
X22	4.50	4.26	4.40	18.73
X23	4.20	3.97	4.20	16.69
X24	4.50	4.26	4.40	18.73
Total	**105.70**	**100.00**		**442.66**

Source: Data analysis

As shown in Table 4, the total Weighting Score across the twenty-four attributes was 442.66. The Customer Satisfaction Index was then obtained by dividing this total by the highest point on the measurement scale and converting the result into a percentage, as follows:

$$CSI = (\text{Total WS} \div HS) \times 100\% = (442.66 \div 5) \times 100\% = 88.53\%$$

where HS denotes the highest scale value used in the questionnaire, namely 5. The resulting index of 88.53% indicates that the project owner was satisfied with WIKA's project management performance in the Wosusokas Regional SPAM Project.

After the overall satisfaction level was obtained through CSI, the analysis was continued using IPA to identify which attributes should be prioritized for improvement. This step was necessary because CSI provides an aggregate satisfaction score, while IPA explains the relative position of each attribute based on its importance and performance. The IPA mapping used the average performance and importance scores as the crosshair points. The results are summarized in Table 5 and visualized in Figure 2.

Table 5. IPA Mapping of Contractor Project Management Performance Attributes

Quadrant	Attribute Code	Main Attribute Interpretation
Quadrant I – Concentrate Here	X8, X18, X22, X24	System reliability after handover, handling of material and equipment delay risk, overall satisfaction, and possibility of future cooperation
Quadrant II – Keep up the Good Work	X2, X3, X7, X11, X13, X14	Response to field changes, time management, technical quality, safety equipment, communication clarity, and response to clarification
Quadrant III – Low Priority	X1, X4, X6, X9, X10, X12, X16, X17, X19, X21, X23	Attributes that require gradual improvement but are not the main short-term priority
Quadrant IV – Possible Overkill	X5, X15, X20	Attributes with relatively high performance but lower relative importance

Source: Data analysis

The IPA Cartesian diagram confirms that four attributes were located in Quadrant I. These attributes represent the most urgent improvement areas because they were considered important by the project owner but had relatively lower performance than expected. In contrast, the attributes in Quadrant II indicate WIKA's strengths that should be maintained, particularly those related to responsiveness, schedule control, technical quality, safety readiness, and communication.

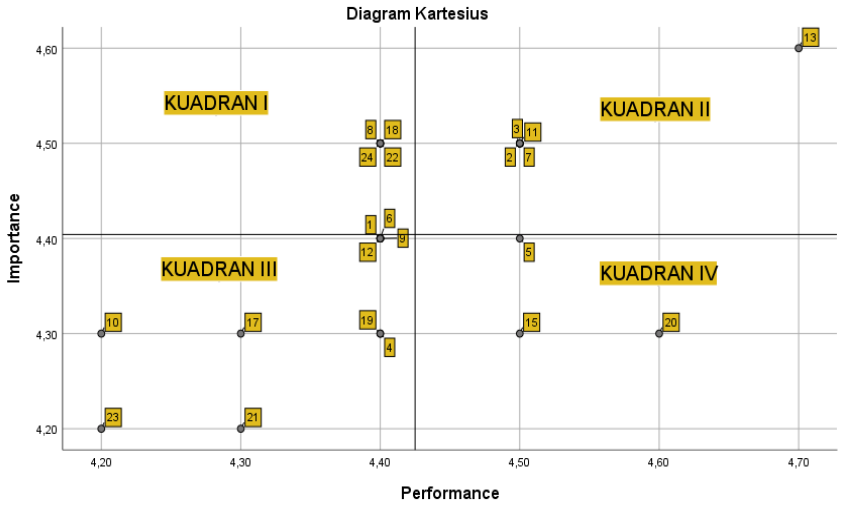

Figure 2. Importance–Performance Analysis Cartesian Diagram
Source: Data analysis

The IPA findings were then used as the basis for formulating the AHP hierarchy. The AHP stage was conducted through expert judgment involving academic and practitioner perspectives. The hierarchy consisted of the main goal, criteria, and strategic alternatives. The main goal was to determine improvement strategies for WIKA's project management performance in order to strengthen project owner satisfaction. The criteria consisted of time performance, cost performance, quality and system reliability, K3/HSE, communication and coordination, risk management, and trust and relationship with the project owner. The alternatives consisted of supply-chain risk management, testing–commissioning–after-service improvement, digital reporting and project communication, competence and K3/HSE culture development, and partnering with periodic evaluation.

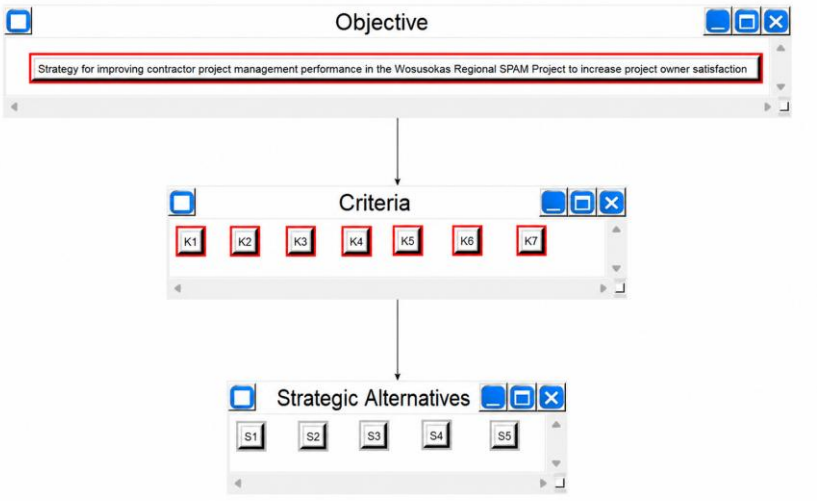

Figure 3. AHP Hierarchy for Strategy Prioritization
Source: Data analysis

After the hierarchy was established, the criteria were weighted based on expert pairwise comparisons. The results show that quality and system reliability became the most important criterion, followed by risk management, communication and coordination, and trust and relationship with the project owner. This result indicates that the owner's satisfaction in the Wosusokas SPAM Project was not determined only by completion of construction work, but also by whether the system was reliable after handover, whether risks were controlled, and whether communication and trust were maintained.

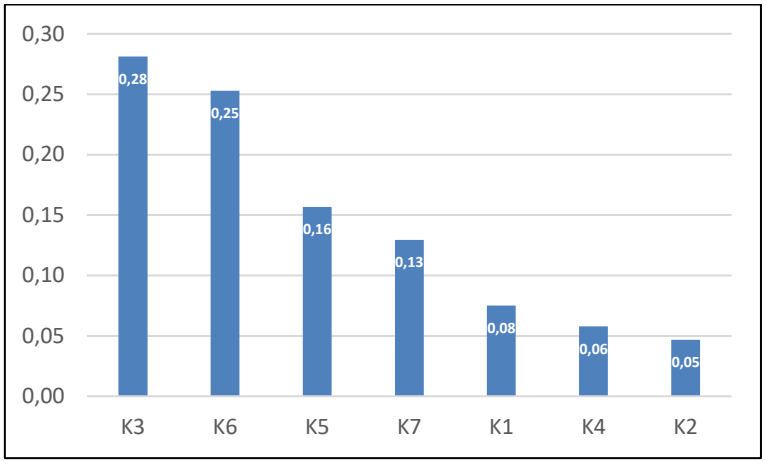

Figure 4. AHP Priority of Criteria toward the Main Goal
Source: Data analysis

The priority results for each criterion further clarify the strategic focus required by WIKA. For time performance and cost performance, supply-chain risk management became the dominant alternative, indicating that material and equipment availability has a strong relationship with schedule and cost control. These findings are shown in Figures 5 and 6.

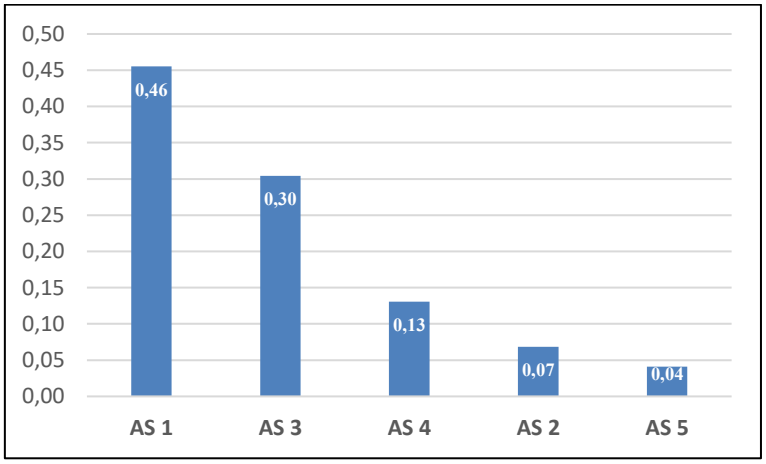

Figure 5. Priority of Strategic Alternatives toward K1: Time Performance
Source: Data analysis

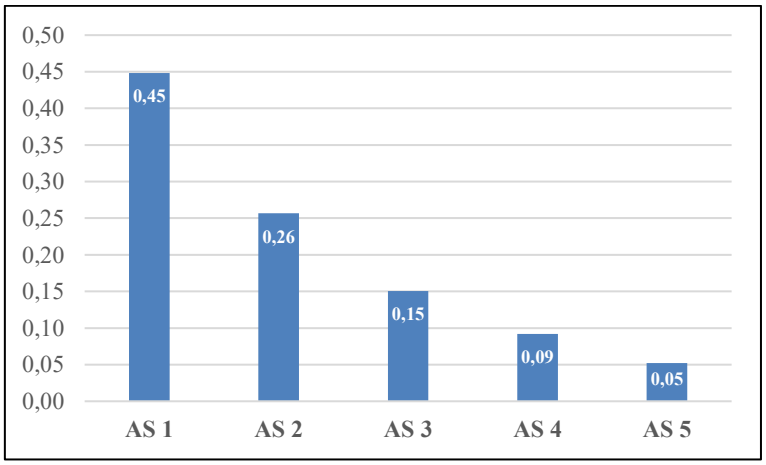

Figure 6. Priority of Strategic Alternatives toward K2: Cost Performance
Source: Data analysis

For quality and system reliability, the highest priority was improving testing, commissioning, and after-service procedures. This result is consistent with the IPA finding that system reliability after handover was located in Quadrant I. Meanwhile, for K3/HSE, competence development and strengthening safety culture became the main priority. These results are presented in Figures 7 and 8.

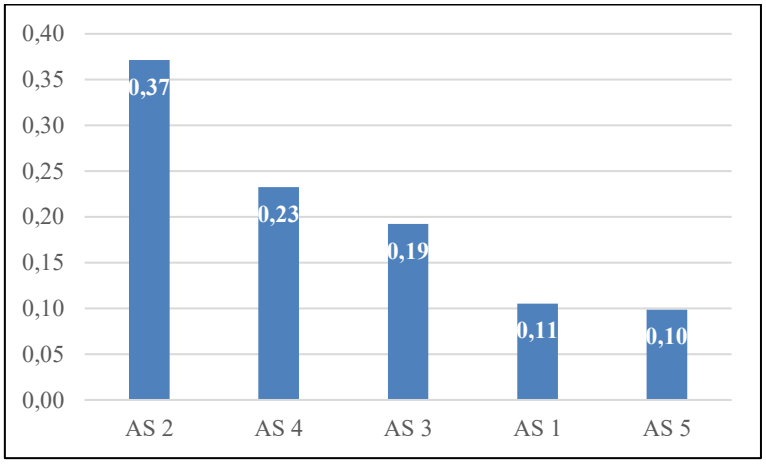

Figure 7. Priority of Strategic Alternatives toward K3: Quality and System Reliability
Source: Data analysis

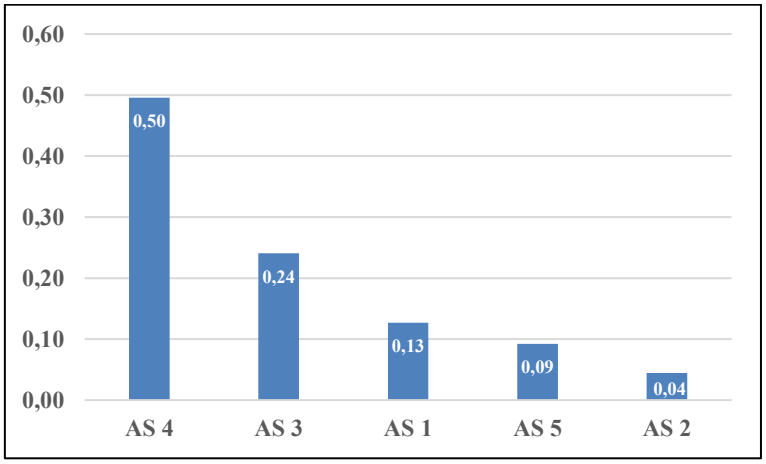

Figure 8. Priority of Strategic Alternatives toward K4: K3/HSE
Source: Data analysis

For communication and coordination, the dominant alternative was the digitalization of reporting, technical documentation, and project communication. For risk management, supply-chain risk management again became the strongest alternative, confirming that supply-chain disruption is one of the most critical risks in SPAM project delivery. For trust and relationship with the project owner, strengthening partnering and periodic evaluation with the Ministry of Public Works became the main priority. These results are presented in Figures 9, 10, and 11.

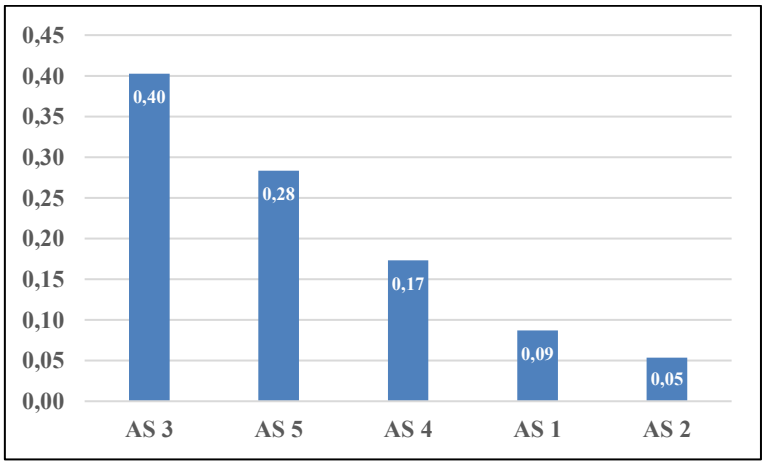

Figure 9. Priority of Strategic Alternatives toward K5: Communication and Coordination
Source: Data analysis

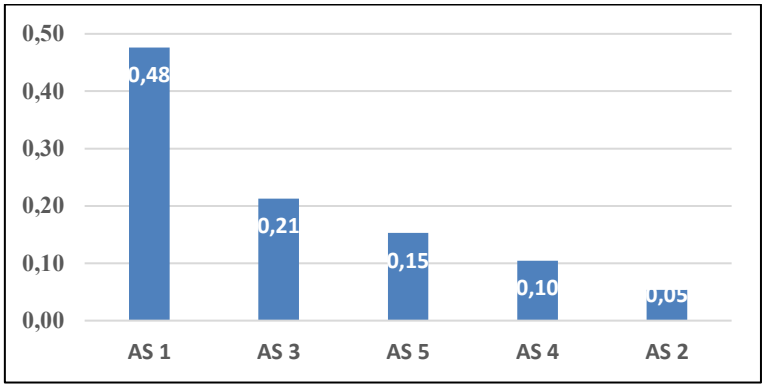

Figure 10. Priority of Strategic Alternatives toward K6: Risk Management

Source: Data analysis

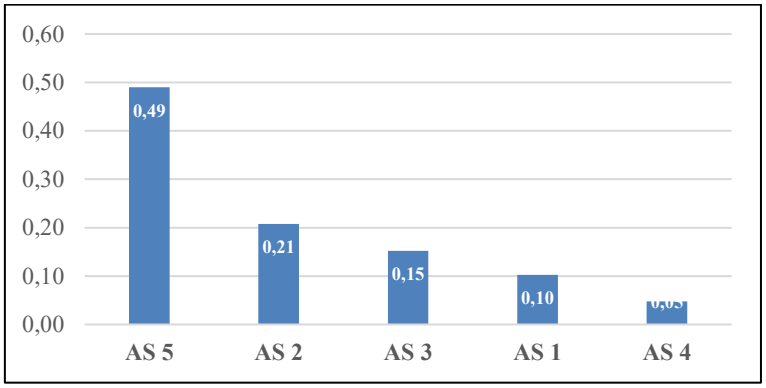

Figure 11. Priority of Strategic Alternatives toward K7: Trust and Relationship with the Project Owner

Source: Data analysis

The local priority results indicate that each criterion requires a different strategic emphasis. Therefore, the interpretation of AHP should not be limited to one overall strategy, but should also consider the most relevant strategy for each performance dimension. The summary of the local priorities is presented in Table 6.

Table 6. Summary of AHP Local Priorities by Criterion

Criterion	Main Strategic Priority	Interpretation
K1 Time performance	Supply-chain risk management	Schedule performance depends on material and equipment availability as well as timely risk response.
K2 Cost performance	Supply-chain risk management	Cost control is influenced by the ability to prevent procurement delays and emergency costs.
K3 Quality and system reliability	Testing, commissioning, and after-service improvement	Reliability after handover requires stronger technical assurance and post-handover support.
K4 K3/HSE	Competence and K3/HSE culture development	Safety performance depends on personnel competence, discipline, and safety culture.
K5 Communication and coordination	Digital reporting and project communication	Communication performance requires structured, traceable, and timely information flow.
K6 Risk management	Supply-chain risk management	Project risk control depends on early identification and mitigation of supply-chain disruptions.
K7 Trust and relationship	Partnering and periodic evaluation	Long-term trust requires formal dialogue, transparency, and regular evaluation with the owner.

Source: Data analysis

4.2. Discussions

The CSI result shows that WIKA's project management performance was generally perceived positively by the project owner. This finding confirms that project owner satisfaction in construction projects is closely related to the contractor's ability to manage technical and managerial dimensions such as time, cost, quality, safety, communication, and risk (Kärnä et al., 2009; Madeppungeng et al., 2020; Othman, 2015; Syamil et al., 2021). In this study, the strong contribution of communication clarity and responsiveness indicates that the owner values not only the physical output of the project, but also the way the contractor manages interaction, clarification, and coordination during project implementation.

Although the CSI result falls into the satisfied category, it also indicates that project completion does not automatically eliminate the need for further improvement. In construction project evaluation, satisfaction is multidimensional and includes the owner's perception of technical reliability, managerial responsiveness, relationship quality, and confidence in future cooperation (Kawesittisankhun & Pongpeng, 2020; Lehtiranta et al., 2012). Therefore, the remaining gap between satisfaction and the highest satisfaction level should be interpreted as an opportunity to strengthen WIKA's project governance and long-term relationship management with the Ministry of Public Works.

The IPA result provides a more specific explanation of this issue. Attributes located in Quadrant I represent critical improvement areas, namely system reliability after handover, handling of material and equipment delay risks, overall satisfaction with project results, and possibility of future cooperation. These findings indicate that the owner's evaluation goes beyond the construction phase. In SPAM projects, reliability after handover is particularly important because the infrastructure must function continuously and support public service delivery. Previous studies on construction and infrastructure projects also emphasize that quality assurance, defect handling, system reliability, and post-project service are important determinants of customer or owner satisfaction (Astana et al., 2023; Madeppungeng et al., 2020; Mukramin et al., 2024).

The placement of material and equipment delay risk in Quadrant I strengthens the relevance of risk management in public infrastructure projects. Papanikolaou and Xenidis (2020) argue that project performance should be assessed together with risk exposure because risk may simultaneously affect schedule, cost, quality, and safety outcomes. This is consistent with Syamil et al. (2021), who found that schedule, cost, human resources, and risk are important predictors of customer satisfaction in project settings. In the Wosusokas SPAM Project, this explains why supply-chain risk management became the dominant strategy under several AHP criteria, especially time, cost, and risk management.

The IPA results also show that future cooperation and overall satisfaction are important relational attributes. This finding is consistent with studies on owner–contractor relationships, which argue that trust, contractor capability, reputation, communication quality, and institutional certainty influence owner confidence and cooperation continuity (Drexler & Larson, 2000; Li et al., 2023; Li et al., 2024; Moree et al., 2013). Therefore, WIKA's improvement agenda should not only focus on technical correction, but also on relationship governance, structured evaluation forums, and transparent communication mechanisms with the Ministry of Public Works.

The AHP results strengthen the CSI and IPA findings by showing that the most important criteria were quality and system reliability, risk management, communication and coordination, and trust and relationship with the project owner. This pattern confirms that owner satisfaction in a public SPAM project is not dominated by the traditional project performance dimensions alone. Instead, satisfaction is shaped by the integration of technical reliability, risk control, communication governance, and long-term relational trust. This supports the view that construction project success should be assessed through multidimensional performance criteria rather than only through time, cost, and scope achievement (Astana et al., 2023; Haverila et al., 2020; Kunkcu et al., 2022).

The AHP local priority results also provide a coherent link between diagnosis and strategy. Supply-chain risk management became the main strategy for time, cost, and risk management because material and equipment delays can disrupt project sequencing, increase inefficiency, and create uncertainty in the delivery process. This is consistent with the risk-informed performance perspective, which emphasizes the importance of proactive risk identification and mitigation before risks become performance failures (Papanikolaou &

Xenidis, 2020). In practice, this means that WIKA should not treat procurement and supply-chain control as administrative support only, but as a core project management function.

For quality and system reliability, the priority given to testing, commissioning, and after-service improvement is consistent with the IPA result on system reliability after handover. This indicates that the owner expects stronger assurance that the SPAM system will remain functional after completion. Such assurance requires clear testing protocols, documented commissioning results, defect-list management, and post-handover technical support. Previous studies highlight that quality assurance and post-project responsiveness are important for maintaining owner satisfaction and reducing future complaints (Kärnä et al., 2012; Madeppungeng et al., 2020; Othman, 2015).

The priority of digital reporting and project communication under the communication and coordination criterion indicates that WIKA's existing communication strength should be institutionalized through a more traceable system. Digital documentation can improve transparency, clarify approval history, reduce information gaps, and support faster decision making. This is in line with studies emphasizing that communication quality, documentation, and structured coordination are important in improving project performance and stakeholder satisfaction (Haverila et al., 2020; Kamaluddin et al., 2019; Kawesittisankhun & Pongpeng, 2020).

Finally, the priority of partnering and periodic evaluation under the trust and relationship criterion confirms that owner satisfaction is also a relational outcome. Formal partnering mechanisms can reduce conflict, align expectations, and strengthen cooperation between the owner and contractor (Drexler & Larson, 2000; Moree, 2013). In the context of WIKA and the Ministry of Public Works, periodic evaluation forums may serve as a governance mechanism to discuss project progress, post-handover issues, corrective actions, and lessons learned. Overall, the integration of CSI, IPA, and AHP in this study demonstrates that owner satisfaction evaluation can be transformed from a descriptive post-project assessment into a strategic decision-making framework for contractor performance improvement.

4.3. Managerial Implications

The first managerial implication is that WIKA should institutionalize owner satisfaction measurement as part of its formal project evaluation system. The CSI and IPA results show that owner satisfaction cannot be assessed only through project completion status or internal contractor surveys. A standardized owner satisfaction instrument should be applied after project completion to capture the owner's perception of technical quality, risk control, communication, safety, and relationship quality. This would allow WIKA to identify improvement priorities more objectively and use the results as input for future project planning.

The second implication concerns supply-chain risk management. Since material and equipment delay risk appeared as a priority issue in IPA and became the dominant strategy in several AHP criteria, WIKA should strengthen its procurement and supply-chain governance. This can be implemented through project-specific risk registers, early identification of critical materials, alternative supplier mapping, procurement milestone monitoring, and escalation procedures when potential delays occur. These practices should be linked to project-level performance indicators so that supply-chain risk is monitored as part of core project control.

The third implication is the need to strengthen post-handover reliability governance. WIKA should develop standardized procedures for testing, commissioning, defect-list management, handover acceptance, and after-service response. These procedures are important because owner satisfaction in SPAM projects is strongly affected by the reliability of the delivered system after completion. By formalizing post-handover technical support, WIKA can reduce potential complaints, improve trust, and increase the owner's confidence in future cooperation.

The fourth implication relates to communication and relationship governance. WIKA should develop a digital reporting and documentation system that records progress reports, technical documents, clarification requests, meeting results, approval history, risk updates, and corrective actions. This system should be complemented by periodic partnering forums with the Ministry of Public Works to discuss progress, risks, post-handover issues, and lessons learned. Through this approach, communication becomes more transparent, traceable, and institutionalized, while the owner–contractor relationship becomes more stable and sustainable.

At the corporate level, the CSI–IPA–AHP framework can be adopted as a practical decision-support model for WIKA's future public infrastructure projects. CSI can measure the overall level of owner satisfaction, IPA can identify attributes requiring improvement, and AHP can determine which strategies should be prioritized. By embedding this framework into project governance, WIKA can strengthen contractor performance, improve competitiveness in similar SPAM projects, and build a more systematic basis for long-term cooperation with public-sector project owners.

5. CONCLUSIONS

This study concludes that the project owner's satisfaction with WIKA's project management performance in the Wosusokas Regional Water Supply System Project was generally positive, with the Customer Satisfaction Index reaching 88.53%, which places the owner's assessment in the satisfied category. The contractor was perceived as capable of meeting the owner's expectations in several core aspects of project delivery, particularly in responsiveness, schedule control, work quality, safety support, and communication clarity. However, the findings also show that project success cannot be interpreted solely from physical completion or contract fulfillment. Owner satisfaction is shaped by a broader set of technical, managerial, and relational factors, including system reliability after handover, risk handling, overall confidence in the project outcome, and the willingness to continue cooperation in future projects.

The integration of CSI, IPA, and AHP provides a structured evaluation framework that links satisfaction measurement, performance-gap diagnosis, and strategic prioritization. CSI shows the general level of owner satisfaction, IPA clarifies which performance attributes need to be maintained or improved, and AHP translates those findings into prioritized managerial strategies. The main strategic direction emerging from this study is the need to strengthen supply-chain risk management, improve testing and after-service procedures, digitalize reporting and project communication, develop competence and safety culture, and formalize partnering mechanisms with the Ministry of Public Works. These strategies indicate that WIKA should move from project completion orientation toward a more comprehensive owner-satisfaction governance model. Practically, the findings indicate that owner satisfaction evaluation should be institutionalized within WIKA's project management system rather than conducted as an informal post-project survey. For the Ministry of Public Works, the same framework offers a more transparent basis for contractor evaluation across similar SPAM projects. Theoretically, this study contributes to the project management literature by demonstrating how owner satisfaction in public water infrastructure can be evaluated through an integrated CSI–IPA–AHP framework.

This study is limited to the construction phase of the Wosusokas Regional SPAM Project and focuses on the perception of project-owner representatives rather than end users or post-handover operators. Therefore, the findings should be interpreted within the context of owner-side evaluation of contractor performance, not as a complete assessment of long-term service quality or public satisfaction with the water supply system. Future research may extend the analysis to the operation and maintenance phase, include the perspectives of operators and end users, compare several SPAM projects or contractors, and apply mixed methods to explore trust, communication, and partnering mechanisms more deeply. Such extensions would strengthen the theoretical and practical understanding of owner satisfaction as a strategic indicator of contractor competitiveness in public infrastructure projects.

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