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Development of A Risk-Based Pre-Tender Assessment Tool for Oil and Gas Construction Projects Using The Analytical Hierarchy Process

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ABSTRACT - The pre-tender stage is a critical decision point in oil and gas construction projects, particularly in capital-intensive, technically complex environments, where inappropriate project selection may increase financial, technical, operational, and regulatory risks. In practice, contractors often rely on subjective judgment in early project evaluation due to the limited availability of structured, quantitative decision-support tools. This study aims to develop a risk-based pre-tender assessment tool to support project selection decisions in oil and gas construction projects in Indonesia. The study integrates a literature review with a questionnaire-based survey involving 90 experienced construction practitioners occupying supervisory and managerial positions. Data were analyzed using descriptive statistics and the Analytical Hierarchy Process (AHP) to determine the relative priority weights of evaluation criteria and sub-criteria. The results indicate that all major criteria contribute significantly to pre-tender decision-making, with financial aspects obtaining the highest priority weight (22.9%), followed by commercial (20.1%), technical (19.4%), legal and social (19.3%), and marketing aspects (18.3%). At the sub-criteria level, expected profit margin, implementation risk, and project owner legality emerged as dominant evaluation factors. A case study application further demonstrates the practical applicability of the proposed framework, with the pipeline installation project achieving a higher feasibility score (7.48) than the oil storage terminal project (6.32). Sensitivity analysis also confirms that the ranking results remain stable under alternative weighting scenarios. The findings demonstrate that the proposed framework provides a structured, transparent, and risk-informed approach for evaluating project feasibility during the pre-tender stage. The study contributes by developing an integrated weighting-based decision-support framework specifically tailored to the characteristics and risk exposure of oil and gas construction projects, thereby supporting more objective and consistent contractor decision-making.

Keywords: oil and gas construction; pre-tender assessment; risk-based decision-making; analytical hierarchy process; decision-support tool .

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INTRODUCTION

Construction activities in developing countries, including Indonesia, have experienced steady growth over the past decade, particularly in sectors supporting strategic national development. A significant portion of this growth is associated with energy-related infrastructure, including oil and gas facilities such as processing plants, pipelines, and supporting onshore installations. This trend reflects the growing demand for complex industrial construction projects that require high levels of technical capability, capital investment, and regulatory compliance. The expansion of the Indonesian construction sector during the 2014–2025 period further indicates the growing involvement of contractors in projects characterized by elevated technical and operational complexity, particularly within the energy and oil and gas sectors.

Despite this positive development, oil and gas construction projects continue to present substantial challenges throughout their life cycle, especially during the pre-tender stage, where early technical and strategic decisions strongly influence project feasibility and overall project performance. In high-risk environments such as oil and gas facilities, inappropriate project selection at the pre-tender stage may result not only in financial losses but also in technical failures, schedule disruptions, contractual disputes, and increased operational and safety risks. One of the most critical challenges at this stage is selecting projects that are technically feasible and aligned with the contractor’s risk tolerance among multiple available opportunities (Ahlawat & Singh 2025). The absence of standard, quantitative, and objective assessment tools often leads contractors to commit to projects that do not adequately match their technical capabilities, financial capacity, or operational readiness, which, in extreme cases, may lead to severe financial distress or organizational failure (Tanaka et al., 2025). Therefore, early-stage decision-making in oil and gas construction projects requires structured, objective decision-support tools that integrate financial, technical, commercial, and regulatory risk considerations into project feasibility evaluation (Weng 2023). Effective project selection at the pre-tender stage consequently plays a fundamental role in improving organizational efficiency, competitiveness, and long-term sustainability (Adamu et al., 2025; Burinskienë & Daðkeviè 2023).

Oil and gas construction projects are inherently characterized by high levels of uncertainty and risk due to complex engineering systems, hazardous materials, strict safety requirements, large capital exposure, and stringent regulatory frameworks. As a result, risk-based evaluation approaches have been widely adopted in oil and gas projects to support technical decision-making under uncertain conditions (Teurupun et al., 2024). In practice, contractors must simultaneously evaluate multiple interrelated factors, including technical complexity, implementation risk, financial exposure, contractual structure, regulatory compliance, governance transparency, and strategic organizational objectives (Iastremska et al., 2023. These dimensions collectively represent major sources of project risk that may significantly affect project feasibility and contractor performance during project execution. However, project selection decisions at the pre-tender stage—particularly in capital-intensive oil and gas construction projects—often remain heavily

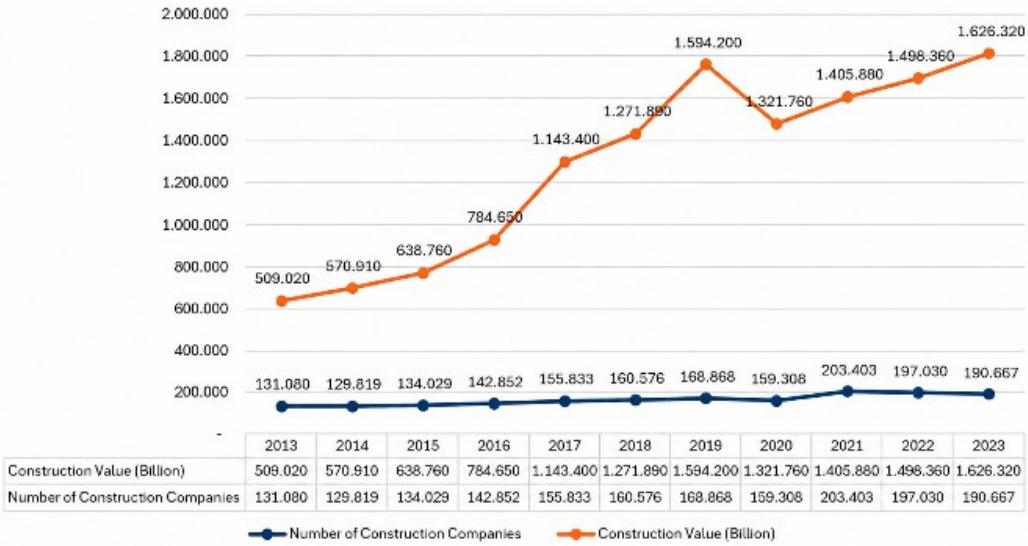

Figure 1. Value and number of indonesian construction companies. Source: Indonesian statistics book 2014–2025.

dependent on managerial intuition and subjective judgment. Such practices increase the likelihood of biased and inconsistent decisions, especially in highly uncertain and technically demanding environments (Hosseinkhani 2025). Without structured and quantitative assessment tools, contractors may undertake projects that are technically or economically unviable, thereby exposing the organization to excessive financial, operational, and safety-related risks (Aslam). These conditions highlight the importance of developing a structured risk-based assessment framework to support more transparent, objective, and reliable pre-tender decision-making in oil and gas construction projects.

Several previous studies have applied the Analytical Hierarchy Process (AHP) and other multi-criteria decision-making approaches in areas such as contractor selection, subcontractor evaluation, bid or no-bid decisions, investment prioritization, and general project selection. These studies demonstrate the effectiveness of AHP in supporting complex decision-making involving multiple evaluation criteria. However, most existing studies primarily focus on general construction management problems and do not specifically address the unique technical, financial, operational, and regulatory risk characteristics associated with oil and gas construction projects. Furthermore, previous studies generally do not provide an integrated, context-specific weighting framework explicitly designed for pre-tender assessment in oil and gas construction environments, particularly in the Indonesian construction industry.

This study, therefore, focuses on developing a risk-based pre-tender assessment tool for oil and gas construction projects in Indonesia. The proposed framework produces weighted values for a set of criteria and sub-criteria representing major financial, commercial, technical, marketing, legal, and operational risk dimensions relevant to pre-tender decision-making. Unlike previous studies that primarily emphasize investment selection, general project prioritization, or contractor evaluation, this research focuses on developing an integrated weighting-based framework tailored to pre-tender project feasibility assessment in oil and gas construction. The framework is intended to support contractors in evaluating project opportunities more systematically, consistently, and objectively before tender commitment.

Project selection is the process of evaluating and choosing projects based on multiple perspectives and decision criteria (Dong et al., 2022. An effective project selection process enables decision-makers to identify projects with higher probabilities of technical success, acceptable risk levels, and feasible requirements for cost, quality, and schedule (Krechowicz & Krechowicz 2024). In oil and gas construction environments, a structured selection process is particularly important because it supports the systematic identification and management of technical and operational risks while optimizing resource utilization and financial performance (Ansari et al., 2024). Previous studies have also applied multi-parameter and optimization-based approaches to evaluate the feasibility of oil and gas projects, particularly in capital-intensive environments (Iskandar & Kurihara 2025). The primary advantage of a risk-based project assessment model lies in its ability to transform subjective expert judgment into structured and quantitative information, reduce decision-making bias, and support technically sound project selection in complex and high-risk construction environments (Madanchian & Taherdoost 2025).

METHODOLOGY

This research was conducted to address the fundamental question of how to systematically identify and develop a risk-based pre-tender assessment tool for evaluating project selection criteria and sub-criteria in construction projects. The pre-tender stage is particularly critical in large-scale, capital-intensive construction environments, such as oil and gas infrastructure projects, where early technical and strategic decisions significantly influence project feasibility, financial exposure, implementation risk, and overall performance. In oil and gas construction environments, pre-tender decisions are closely associated with technical complexity, regulatory compliance, safety requirements, and the contractor's capability to manage engineering and operational risks. To achieve the research objective, a structured research framework was developed to determine accurate and consistent weights for project selection criteria using two complementary analytical approaches: descriptive analysis and the analytical hierarchy process (AHP) (Debnath et al., 2023).

Data collection was conducted by distributing a structured questionnaire via Google Forms. Respondents were selected purposively from contractor companies involved in construction project execution, including organizations operating in technically complex and high-risk environments typical of oil and gas infrastructure projects. The respondent selection criteria were designed to ensure data reliability and practical relevance by targeting individuals with adequate technical knowledge and decision-making experience. The selection requirements included a minimum education level of a diploma, a supervisory or managerial position, at least 5 years of professional experience, and direct involvement in at least 5 construction projects. These criteria ensured that respondents possessed sufficient technical understanding, managerial insight, and practical exposure to pre-tender evaluation processes, particularly in projects characterized by high uncertainty and stringent technical requirements. A total of 90 respondents successfully completed the questionnaire and were included in the analysis.

The relative importance of the identified criteria and sub-criteria was evaluated using the Saaty scale as the basis for pairwise comparison assessment within the Analytical Hierarchy Process framework. The Saaty scale ranges from 1 to 9, where 1 indicates equal importance between two criteria, while higher values indicate increasing relative importance. Pairwise comparison matrices were subsequently constructed to compare each criterion and sub-criterion systematically and to derive relative priority weights.

The analytical procedures employed in this study consisted of several sequential stages, including validity testing, reliability testing, descriptive analysis, and application of the AHP (Silva et al., 2025). Instrument validity was examined using product-moment correlation analysis to ensure that each criterion and sub-criterion accurately represented the intended assessment construct. Reliability testing was subsequently performed using Cronbach's Alpha coefficient to evaluate the internal consistency of respondents' assessments and confirm the stability of the collected data. Descriptive analysis was then conducted to determine the mode, mean, and initial weighting values for each criterion and sub-criterion, thereby providing an initial quantitative overview of respondents' perceptions regarding the relative importance of technical, financial, commercial, and regulatory risk factors in the pre-tender assessment process.

Following the descriptive analysis, the AHP method was applied to convert empirical pairwise comparison data into numerical priority values by constructing and normalizing pairwise comparison matrices. The normalized matrices were subsequently used to derive eigenvector-based priority weights representing the relative importance of each criterion and sub-criterion. In addition to generating weighting values, the AHP procedure was also used to evaluate the logical consistency of respondents' judgments.

Consistency evaluation was conducted by calculating the maximum eigenvalue (λmax), Consistency Index (CI), and Consistency Ratio (CR) for each comparison matrix. The Consistency Index was determined using the Equation 1:

$$CI = \frac{\lambda_{max} - n}{n - 1} \quad (1)$$

while the consistency ratio was calculated as:

$$CR = \frac{CI}{RI} \quad (2)$$

where λmax represents the maximum eigenvalue, n denotes the number of evaluated criteria, and RI refers to the Random Index value. The pairwise comparison results were considered acceptable if the resulting consistency ratio satisfied the standard AHP requirement of $CR \leq 0.10$. This procedure ensured that respondents' evaluations were logically coherent and free from significant inconsistencies that could compromise the reliability of the resulting priority weights.

The final stage of the AHP analysis produced relative priority weights for each criterion and sub-criterion, forming the quantitative foundation for the proposed risk-based pre-tender assessment tool for oil and gas construction projects (Adjorlolo et al., 2025). Consequently, the overall analytical process—from respondent selection and instrument validation to descriptive analysis and hierarchical weighting—contributes to the development of an objective, transparent, and measurable decision-support framework. The resulting model is intended to support more systematic and risk-informed pre-tender decision-making in construction environments characterized by high technical complexity, substantial investment requirements, and elevated operational risk, such as those commonly encountered in the oil and gas industry.

RESULT AND DISCUSSION

Literature review

Based on the results of the literature review and the application of a hierarchical process analysis approach, a structured set of criteria and sub-criteria was identified to form the foundation for developing a risk-based pre-tender assessment framework. The identification process was guided by prior studies on project selection, decision-support systems, and multi-criteria evaluation models, which emphasize the importance of structured, transparent, and measurable criteria to reduce subjectivity in early-stage decision-making. In the context of construction projects—particularly capital-intensive and high-risk environments such as oil and gas construction—the use of explicitly defined criteria and sub-criteria is essential to support technically sound and defensible pre-tender decisions.

The resulting variable hierarchy represents a comprehensive set of interrelated dimensions that influence project feasibility at the pre-tender stage. These dimensions are not limited to financial and commercial considerations but also incorporate technical capability, market positioning, and legal and social compliance. In oil and gas construction projects, these dimensions collectively determine a contractor's capacity to manage engineering complexity, regulatory obligations, and operational risks while maintaining acceptable financial performance.

From a risk-based decision-making perspective, these dimensions also represent major sources of project uncertainty during the pre-tender stage.

Financial aspects reflect liquidity and cash-flow exposure risks, technical aspects represent engineering and implementation risks, while legal and social aspects capture governance, contractual, and regulatory compliance risks. The integration of these dimensions enables contractors to evaluate project opportunities not only from a profitability perspective but also from the standpoint of overall project risk exposure.

Figure 2 illustrates the hierarchical structure of the variables used in the pre-tender assessment process, which comprises five main groups: Finance, Commercial, Technique, Marketing, and Law and Social. Each main group is further decomposed into sub-variables that function as priority assessment indicators within the decision-support framework. This hierarchical structure enables the systematic organization of complex technical, financial, and regulatory factors, allowing decision-makers to evaluate oil and gas construction project opportunities in a transparent, consistent, and measurable manner.

The Finance aspect focuses on indicators related to cash flow sustainability and financial exposure, including payment methods, payment systems, sources of funding, payment track records, and upfront costs incurred prior to contract signing. In oil and gas construction projects, these factors are closely linked to a contractor's ability to mobilize specialized equipment, comply with strict quality and safety requirements, and sustain operations throughout long project durations. Delayed payments or inadequate funding structures can significantly increase technical and operational risks in such environments. The Commercial aspect emphasizes the economic attractiveness of a project, covering expected profit margins, scope of work, nature of the contract, project duration, and the utilization of available company resources. These sub-criteria reflect the extent to which a project aligns with a contractor's strategic objectives and operational capacity, particularly in projects where contract structure and execution duration directly influence exposure to technical and financial risk.

The Technique aspect evaluates the contractor's technical readiness and the project's inherent complexity. This includes previous experience in similar projects, the level of implementation risk, land availability, project location, and the completeness and clarity of design documents. In oil and gas construction, technical considerations play a decisive role, as incomplete designs, difficult site conditions, or limited experience with similar facilities can significantly increase engineering risk, safety exposure, and the likelihood of cost and schedule overruns.

The Marketing aspect relates to external competitive and strategic considerations, such as the assessment system used to determine tender winners, contract targets, project turnover value, tender methods, and portfolio performance. These indicators reflect how participation in a particular oil and gas construction project contributes to market positioning, capability development, and the strengthening of a contractor's technical reputation within the industry.

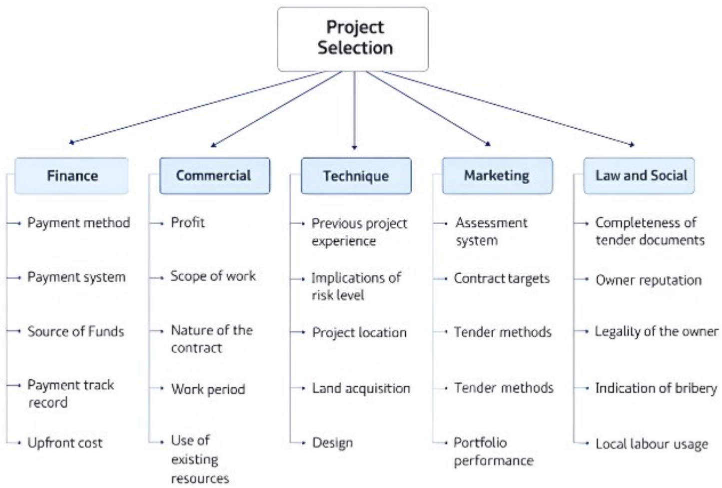

Figure 2. Variable hierarchy

Finally, the Law and Social aspect addresses regulatory compliance and social acceptability, including the completeness of tender documents, the project owner's reputation, the owner's legal status, indications related to governance practices, and the availability of local labor. In oil and gas construction projects, strict regulatory requirements and governance standards make legal and social factors critical for minimizing contractual disputes, ensuring ethical procurement processes, and maintaining operational continuity.

Together, these five groups and their associated sub-criteria form an integrated and risk-informed evaluation framework that supports systematic and measurable pre-tender assessment in oil and gas construction projects. The set of criteria and sub-criteria presented in Table 1 represents a structured framework for evaluating project feasibility at the pre-tender stage. By organizing financial, commercial, technical, marketing, and legal–social considerations into a hierarchical model, the proposed framework enables a comprehensive assessment of project opportunities while explicitly accounting for the technical complexity and risk characteristics of oil and gas construction environments. This structure ensures that both quantitative and qualitative factors are captured in a measurable manner, providing a robust analytical foundation for subsequent weighting, consistency testing, and priority determination. Based on this framework, the next stage of the analysis focuses on the characteristics of respondents whose assessments form the empirical basis for the evaluation process.

Table 1. Research variables

Code	Variables	Description
X1	**Finance**	
X1.1	Payment methods	Payment stage from the owners'
X1.2	Payment system	Payment facilities from owners'
X1.3	Source of funds	Project source of funding
X1.4	Payment track record	Payment reputation from owners'
X1.5	Costs incurred upfront	The amount of costs incurred before signing the contract
X2	**Commercial**	
X2.1	Margin/profit	Expected profit percentage
X2.2	Scope of work	The choices are construction only, design & build, etc.
X2.3	Nature of the contract	The choices are unit price, lump sum, etc.
X2.4	Project duration	Duration of the project
X2.5	Use of resources	Maximum utilization of the company resources
X3	**Technique**	
X3.1	Previous project experience	Experience in a similar project
X3.2	Risk level of implementation	Risk involved owing to the nature of the project
X3.3	Land availability	Land area that has been cleared
X3.4	Project location	Location of the project and accessibility
X3.5	Design	Completeness and clearness of drawing and specification
X4	**Marketing**	
X4.1	Assessment system	Winner determination process
X4.2	Contract targets	Project taking objectives
X4.3	Contract turnover value	Project value
X4.4	Tender method	Bidding method
X4.5	Portfolio performance	Increasing the company's capacity and reputation
X5	**Law and social**	
X5.1	Completeness of tender documents	Completeness & clearness of the tender documents
X5.2	Owner's reputation in fulfilling contracts	Owner's reputation based on previous collaboration experience with various parties
X5.3	Legality of the project owner	Identity & legal status of the owner
X5.4	Indications of bribery/GCG	Competitive process to win the tender
X5.5	Local labor location or source	Availability of unskilled labor in the region

Respondent profile

The respondent profile in this study is based on data collected from 90 respondents who successfully completed the questionnaire. Respondents were selected purposively to ensure that the data reflected informed and relevant perspectives on pre-tender decision-making in construction projects, particularly those characterized by high technical complexity and risk exposure, such as oil and gas construction projects. The distribution of respondents is categorized by education level, organizational position, work experience, and the number of construction projects in which they have been involved, as shown in Figures 3 and 4.

Figure 3 shows that the majority of respondents possess formal educational qualifications at the diploma and undergraduate levels and occupy supervisory or managerial positions within their respective organizations. These positions typically involve direct participation in technical evaluation, tender assessment, and early-stage decision-making processes. In the context of oil and gas construction projects, such roles require a combination of technical understanding and managerial judgment to evaluate project feasibility, risk exposure, and resource requirements. The respondents' educational background and professional roles, therefore, indicate an adequate level of competence to assess project selection criteria in a structured and objective manner.

Figure 4 illustrates that most respondents have substantial professional experience in the construction industry, with at least 5 years of experience, and have participated in multiple construction projects. A significant proportion of respondents reported involvement in more than five projects, indicating repeated exposure to pre-tender evaluation processes. This level of experience is particularly relevant in oil and gas construction environments, where project complexity, safety requirements, and regulatory constraints necessitate informed and cautious decision-making. The respondents' familiarity with such conditions strengthens the reliability of their assessments and supports the credibility of the collected data.

Figure 3. Distribution of respondents based on education level and position

Figure 4. Distribution of respondents based on work experience and the number of projects worked on

Overall, the respondent profile demonstrates that the data used in this study were obtained from practitioners with relevant educational backgrounds, professional responsibilities, and practical experience in construction projects. As a result, the responses provide a credible empirical foundation for subsequent analyses, including validity testing, reliability testing, descriptive analysis, and the hierarchical weighting of criteria and sub-criteria used in the development of the risk -based pre-tender assessment tool.

Validity test

The validity test was conducted to evaluate the extent to which the questionnaire items accurately measure the intended criteria and sub-criteria used in developing the risk-based pre-tender assessment tool. In the context of oil and gas construction projects—where early-stage decisions involve high technical, financial, and regulatory risks—it is essential that the assessment instrument reliably captures the relevant decision dimensions. Validity analysis was performed using SPSS 27 to examine corrected item–total correlation values for each variable.

With a total sample size of n = 90 respondents and a significance level of 5%, the critical r-value was determined to be 0.1726. A questionnaire item was considered valid if its corrected item–total correlation value exceeded this threshold. This approach ensures that each item contributes meaningfully to the overall construct measured by the assessment framework.

The results of the validity analysis indicate that all criteria and sub-criteria satisfy the validity requirements, as each variable demonstrates a corrected item–total correlation value greater than the critical r-value. This finding confirms that each questionnaire item can represent the construct it was designed to measure and is therefore suitable for inclusion in subsequent analyses.

Table 2. Validity value

Code	Scale mean if item deleted	Scale variance if item deleted	Corrected item–total correlation	Result
X1	767.09	18871.205	0.484	Valid
X1.1	767.71	18796.185	0.523	Valid
X1.2	767.47	18847.353	0.584	Valid
X1.3	767.91	18816.441	0.490	Valid
X1.4	767.82	18855.878	0.526	Valid
X1.5	769.02	18889.910	0.420	Valid
X2	767.98	18835.910	0.558	Valid
X2.1	767.13	18890.611	0.417	Valid
X2.2	768.33	18818.809	0.564	Valid
X2.3	768.27	18797.771	0.629	Valid
X2.4	768.62	18816.597	0.548	Valid
X2.5	768.78	18825.411	0.500	Valid
X3	768.22	18802.557	0.555	Valid
X3.1	768.11	18824.662	0.537	Valid
X3.2	767.60	18815.029	0.584	Valid
X3.3	768.24	18810.771	0.551	Valid
X3.4	768.98	18814.494	0.564	Valid
X3.5	768.40	18836.782	0.522	Valid
X4	768.56	18789.486	0.566	Valid
X4.1	768.51	18864.410	0.538	Valid
X4.2	768.29	18807.331	0.551	Valid
X4.3	767.96	18803.683	0.611	Valid
X4.4	768.67	18835.865	0.557	Valid
X4.5	768.44	18786.677	0.545	Valid
X5	768.24	18903.895	0.354	Valid
X5.1	767.76	18763.940	0.615	Valid
X5.2	767.73	18817.276	0.636	Valid
X5.3	767.18	18790.552	0.618	Valid
X5.4	768.60	18797.973	0.517	Valid
X5.5	769.13	18839.375	0.484	Valid

As presented in Table 2, the corrected item–total correlation values across all criteria and sub-criteria range from 0.354 to 0.636, indicating moderate to strong correlations between individual items and the overall measurement scale. The primary criteria—Finance (X1), Commercial (X2), Technique (X3), Marketing (X4), and Law and Social (X5)—all exhibit correlation values well above the minimum threshold, demonstrating that the main dimensions of the pre-tender assessment framework are statistically valid. Similarly, each sub-criterion within these primary categories also meets the validity criteria, reflecting internal coherence between the indicators and their respective constructs. These results confirm that the measurement instrument used in this study has adequate construct validity and can capture the key dimensions relevant to risk-based decision-making in oil and gas construction projects. Consequently, the validated criteria and sub-criteria provide a sound empirical foundation for further stages of analysis, including reliability testing, descriptive analysis, and the subsequent application of the Analytical Hierarchy Process (AHP).

Based on the validity test results presented in Table 2, all criteria and sub-criteria used in this study meet the required validity threshold and are therefore suitable for further analysis. Having established the validity of the measurement instrument, the next stage of the analysis proceeds with reliability testing to assess the internal consistency of the questionnaire data.

Reliability test

Reliability testing was conducted to assess the internal consistency of the questionnaire used to develop the risk-based pre-tender assessment tool. In oil and gas construction projects, where early-stage decisions involve complex technical, financial, and regulatory considerations, the reliability of the assessment instrument is critical to ensuring consistent, dependable evaluation outcomes. The reliability analysis was performed by calculating the Cronbach's Alpha coefficient using the SPSS 27 statistical software package. Cronbach's Alpha is widely used to measure the degree to which a set of items consistently reflects the underlying construct being assessed.

The results of the reliability test indicate a Cronbach's Alpha value of 0.973, demonstrating an exceptionally high level of internal consistency among the questionnaire items. This value exceeds the commonly accepted reliability threshold, confirming that the criteria and sub-criteria in the assessment framework are measured consistently and stably across respondents.

Table 3. Reliability value

Reliability statistics	
Cronbach's alpha	0.973
Number of items	35

As presented in Table 3, the reliability statistics are based on 35 questionnaire items, all of which contribute to the overall measurement of the pre-tender assessment criteria. The high Cronbach's Alpha value reflects strong coherence among the items and indicates that the instrument reliably captures the key dimensions relevant to risk-based decision-making in oil and gas construction projects.

The reliability test results confirm that the questionnaire instrument demonstrates high internal consistency and measurement stability. With the reliability requirements satisfactorily met, the analysis can proceed with a descriptive analysis to examine respondents' perceptions and determine the relative importance of each criterion and sub-criterion used in the development of the risk-based pre-tender assessment tool.

Descriptive analysis

The results of the descriptive analysis, which include the mode, mean, and weighting values, indicate that respondents generally perceive all criteria and sub-criteria as important in the context of risk-based pre-tender assessment. This perception is reflected in the predominance of responses in the higher-scale categories, particularly values 7 and 9, suggesting strong agreement on the relevance of the evaluated indicators. In oil and gas construction projects—where early-stage decisions are closely associated with technical feasibility, financial exposure, and regulatory compliance—such perceptions indicate a shared understanding of the multifaceted risks involved in pre-tender decision-making.

At the primary criterion level, Finance (X1) achieved the highest mean score of 7.31, with a corresponding weight of 22.9%, indicating that financial considerations are perceived as the most critical factor in pre-tender assessment. This finding is consistent with the characteristics of oil and gas construction projects, which are typically capital-intensive and require stable cash flow structures to support the procurement of specialized equipment, compliance with strict safety standards, and long project durations. The sub-criteria within X1—namely X1.1 (payment methods), X1.2 (payment system), X1.3 (source of funds), and X1.4 (payment track record)—all recorded mean values above 6.4, with weights ranging from 20.2% to 21.7%, demonstrating a consistent perception of high importance among respondents. Although X1.5 (costs incurred upfront) exhibited a relatively lower mean score of 5.38 and a weight of 16.7%, it remained within the medium-to-high importance category, indicating that upfront financial exposure is still a relevant consideration in pre-tender decision-making for oil and gas construction projects. The dominance of financial criteria indicates that contractors place significant emphasis on liquidity stability and payment certainty during pre-tender evaluation. In oil and gas construction environments, delayed payments and inadequate funding arrangements may disrupt procurement activities, equipment mobilization, subcontractor coordination, and overall project continuity. Consequently, financial exposure becomes a critical risk dimension influencing early project selection decisions.

For the Commercial criterion (X2), mean scores ranged from 5.78 to 7.27, with corresponding weights between 18.4% and 23.1%. Sub-criterion X2.1 (margin/profit) emerged as the most significant indicator within this group, with an average score of 7.27 and a weight of 23.1%, reflecting respondents' emphasis on expected profitability when evaluating project opportunities. In the context of oil and gas construction, adequate profit margins are closely linked to a contractor's ability to absorb technical risks, manage contractual complexity, and comply with stringent regulatory requirements. The remaining sub-criteria (X2.2 to X2.5) all recorded mean values above 6.0, indicating that scope of work, contract type, project duration, and resource utilization are collectively regarded as important determinants of commercial feasibility. The high importance assigned to commercial factors also reflects the need for contractors to maintain acceptable profitability margins as a buffer against technical uncertainty, contractual variation, and execution-related risks. In capital-intensive oil and gas projects, inadequate commercial arrangements may significantly reduce project attractiveness despite favorable technical conditions.

The Technique criterion (X3) displayed a similar pattern, with sub-criteria mean values ranging from 5.42 to 6.80. Among these, X3.2 (risk level of implementation) received the highest mean score of 6.80 and a weight of 22.2%, highlighting respondents' strong concern about the technical and operational risks inherent in construction projects. This concern is particularly relevant in oil and gas construction, where complex engineering systems, hazardous materials, and strict safety requirements significantly increase the risk of implementation. Other technical indicators, including previous project experience, land availability, project location, and design completeness, were also rated as important, reflecting the role of technical readiness and engineering clarity in ensuring successful project execution. The strong emphasis on implementation risk demonstrates that respondents recognize technical uncertainty as a primary risk driver in oil and gas construction projects. Complex engineering systems, hazardous operating environments, incomplete designs, and difficult site conditions may substantially increase the likelihood of construction delays, safety incidents, and cost overruns. Therefore, technical readiness becomes a critical component of risk-based pre-tender assessment.

The Marketing criterion (X4) showed a relatively stable distribution of scores, with mean values ranging from 5.73 to 6.44 and weights between 18.3% and 21.4%. Sub-criterion X4.3 (contract turnover value) recorded the highest average score in this group, at 6.44, with a weight of 21.4%, indicating that project scale and value are important considerations from a strategic and portfolio development perspective. Although X4.4 (tender method) recorded the lowest mean score within this group, it still reflected a relatively high level of importance in the overall pre-tender assessment process.

Finally, the Law and Social criterion (X5) exhibited relatively uniform respondent perceptions, with sub-criteria mean values ranging from 5.27 to 7.22. Sub-criterion X5.3 (legality of the project owner) emerged as the most prominent indicator, with an average score of 7.22 and a weight of 22.9%, underscoring the importance of legal certainty and regulatory compliance in oil and gas construction projects. In contrast, X5.5 (local labor availability) recorded the lowest mean score of 5.27 and a weight of 16.7%, yet it remained within the acceptable importance range, indicating that social considerations are relevant but secondary to legal and technical factors in this context. The prominence of legal and governance-related indicators highlights the importance of regulatory certainty and transparent procurement practices in oil and gas construction environments. Weak governance structures, unclear legal status, or contractual irregularities may expose contractors to disputes, compliance violations, and long-term operational risks. As a result, legal and social dimensions function as important safeguards in risk -based project selection.

Overall, the descriptive analysis results indicate that respondents place substantial importance on nearly all evaluated criteria and sub-criteria. The predominance of mean values above 6.0 suggests a shared perception that each indicator plays a meaningful role in pre-tender assessment. Moreover, the relatively balanced distribution of weights—ranging from approximately 16% to 23% —reflects a consistent and rational prioritization structure among respondents. These findings provide a strong empirical foundation for subsequent analyses, particularly for comparison with the results of the Analytical Hierarchy Process in the next stage of the study.

Analytical hierarchy process

The analytical hierarchy p(AHP) was applied using the average values obtained for each criterion and sub-criterion to determine their relative importance within the risk-based pre-tender assessment framework. In the context of oil and gas construction projects—where early-stage decisions involve complex technical systems, high capital exposure, and stringent regulatory requirements—AHP provides a structured mechanism for translating expert judgment into quantitative priority values. The analysis began with the construction of a pairwise comparison matrix, which represents the relative relationships among criteria based on respondents' judgments (Wang et al., 2024). In this process, each criterion was compared with all other criteria to generate comparative values reflecting their perceived importance in pre-tender decision-making.

These comparisons were conducted using the Saaty fundamental scale (1–9), which enables qualitative expert judgments to be expressed quantitatively. A value of 1 indicates equal importance between two criteria, while higher odd-numbered values (3, 5, 7, and 9) represent increasing levels of importance of one criterion over another. Intermediate even values (2, 4, 6, and 8) are used to express judgments that fall between two adjacent levels. The reciprocal of each value is applied when the direction of comparison is reversed, ensuring numerical consistency within the hierarchical structure.

Following the pairwise comparison stage, the resulting comparison matrices were normalized to form priority matrices, from which priority weights for each criterion and sub-criterion were derived. Eigenvalue calculations were subsequently performed to support the derivation of these weights and to evaluate the stability of respondents' assessments. The results indicate a relatively balanced distribution of importance across financial, commercial, technical, marketing, and legal–social aspects, suggesting that pre-tender decisions in oil and gas construction projects are influenced by multiple interrelated risk dimensions rather than a single dominant factor. The resulting priority weights serve as quantitative decision parameters that assist contractors in evaluating project attractiveness, feasibility of implementation, and overall risk exposure prior to tender commitment. By converting expert judgment into measurable weightings, the proposed framework supports more objective and transparent decision-making in early-stage project evaluation. To clarify the sequential application of the AHP method—from data collection and expert judgment to the generation of priority weights and ranking outcomes—the overall analytical framework is illustrated in Figure 5.

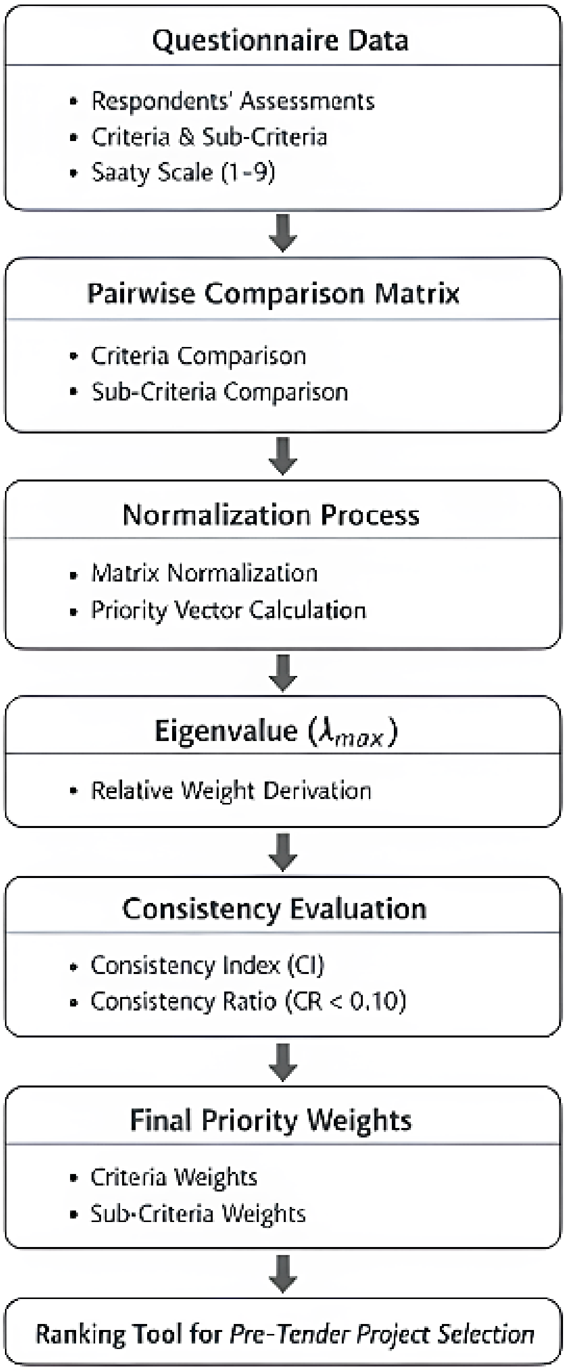

Figure 5. Analytical hierarchy process (AHP) framework for developing a ranking tool in pre-tender project selection.

As shown in Figure 5, the AHP procedure integrates questionnaire-based judgments, pairwise comparisons, normalization, eigenvalue computation, and consistency evaluation into a coherent analytical process. After the priority weights were obtained, a consistency test was conducted to assess the logical coherence of respondents' judgments (Hussein et al., 2025. Consistency was evaluated by calculating the Consistency Index (CI) and Consistency Ratio (CR) for each comparison matrix. The results show that the consistency ratios for both criteria and sub-criteria fall below the established tolerance limit of 0.10, indicating that respondents' pairwise comparisons are logically consistent and free from significant inconsistencies.

A recapitulation of the AHP analysis demonstrates that all criteria and sub-criteria possess clearly defined priority values and satisfy established AHP consistency standards (Masudin et al., 2024). With consistency ratios consistently below the accepted threshold, the AHP results are considered valid and reliable for supporting risk-based decision-making. Consequently, the ranking tool generated through this process is suitable for

Table 4. Comparison of the descriptive analysis and analytical hierarchy process value

Code	Questionnaire results		Descriptive analysis		Process hierarchy analysis	
	Mode	Mean	Mark	%	Mark	%
X1	9	7.31	0.229	22.9	0.229	22.9
X1.1	7	6.71	0.209	20.9	0.209	20.9
X1.2	7	6.96	0.217	21.7	0.217	21.7
X1.3	9	6.49	0.202	20.2	0.202	20.2
X1.4	7	6.58	0.205	20.5	0.205	20.5
X1.5	5	5.38	0.167	16.7	0.167	16.7
X2	7	6.42	0.201	20.1	0.201	20.1
X2.1	9	7.27	0.231	23.1	0.231	23.1
X2.2	7	6.07	0.193	19.3	0.193	19.3
X2.3	7	6.13	0.195	19.5	0.195	19.5
X2.4	7	5.78	0.184	18.4	0.184	18.4
X2.5	7	6.22	0.198	19.8	0.197	19.7
X3	7	6.18	0.194	19.4	0.194	19.4
X3.1	7	6.29	0.205	20.5	0.205	20.5
X3.2	7	6.80	0.222	22.2	0.222	22.2
X3.3	7	6.16	0.201	20.1	0.201	20.1
X3.4	5	5.42	0.177	17.7	0.177	17.7
X3.5	7	6.00	0.196	19.6	0.195	19.5
X4	7	5.84	0.183	18.3	0.183	18.3
X4.1	7	5.89	0.195	19.5	0.195	19.5
X4.2	7	6.11	0.203	20.3	0.203	20.3
X4.3	7	6.44	0.214	21.4	0.214	21.4
X4.4	7	5.73	0.190	19.0	0.190	19.0
X4.5	7	5.96	0.198	19.8	0.198	19.8
X5	7	6.16	0.193	19.3	0.193	19.3
X5.1	9	6.64	0.210	21.0	0.210	21.0
X5.2	7	6.67	0.211	21.1	0.211	21.1
X5.3	9	7.22	0.229	22.9	0.228	22.8
X5.4	7	5.80	0.184	18.4	0.184	18.4
X5.5	5	5.27	0.167	16.7	0.167	16.7

use as a core component of the pre-tender assessment model for oil and gas construction projects, providing structured, quantitative guidance for evaluating project feasibility under conditions of high technical complexity and risk.

Comparison of descriptive analysis results with process hierarchy analysis

The comparison between the descriptive analysis results and the AHP outcomes is presented in Table 4. This comparison was conducted to evaluate the consistency between respondents' direct assessments—reflected through descriptive statistics—and the priority weights generated through the hierarchical decision-making process. In the context of oil and gas construction projects, such consistency is essential to ensure that the proposed risk-based pre-tender assessment tool yields stable, reliable priority values across different analytical approaches.

As shown in Table 4, the results obtained from the descriptive analysis and the AHP method are highly consistent across almost all criteria and sub-criteria. The deviation between the two approaches is negligible, with differences of up to 0.0% for most indicators. This high level of consistency indicates that respondents' perceptions—captured through mode and mean values—are closely aligned with the priority weights generated through the AHP procedure. Consequently, the resulting importance weights can be regarded as stable and reliable for use in risk-based pre-tender assessment.

Several sub-criteria, such as X2.5, X3.5, and X5.3, exhibit very small deviations of approximately 0.1% between the two methods. These minor differences remain well within acceptable limits and do not affect the overall robustness or applicability of the proposed assessment framework. The observed deviations are primarily attributable to rounding effects during data processing rather than inconsistencies in respondents' judgments. Overall, these findings confirm that both analytical approaches yield consistent and mutually reinforcing results, providing a strong quantitative basis for interpretation and decision-making. To further illustrate the alignment between descriptive analysis and hierarchical process analysis, the comparison of priority values for all criteria and sub-criteria is visualized in Figure 6.

As shown in Figure 6, the priority scores generated by descriptive analysis and AHP are nearly identical across all evaluated criteria and sub -criteria. Each indicator assessed using the questionnaire's mode and mean values yields priority scores that closely match those obtained through the hierarchical process analysis (Fernández Ocamica et al., 2025). At the primary criterion level, both methods demonstrate complete consistency in determining the priority order, resulting in no meaningful differences between them.

This consistency is also evident at the sub-criterion level across financial, commercial, technical, marketing, and legal–social aspects. Only minimal differences are observed for a small number of sub-criteria, and these differences are statistically insignificant. As such, they do not influence the overall interpretation of the results or the validity of the ranking tool. The close agreement between the two analytical methods indicates that respondents' assessments are coherent and systematically structured.

Overall, the strong alignment between descriptive analysis and AHP results confirms the stability and reliability of the collected data. The consistency observed across both analytical approaches indicates that respondents share coherent perceptions regarding the relative importance of the evaluated criteria and sub-criteria, thereby strengthening the validity of the proposed risk-based pre-tender assessment framework. The strong alignment between the two methods demonstrates that respondents share a uniform perception of the relative importance of each criterion and sub-criterion (Fang et al., 2025). Therefore, the assessment results generated in this study can be confidently used as a valid quantitative foundation for the development and application of a risk-based pre-tender assessment model for oil and gas construction projects.

Having established the consistency and stability of the weighting results obtained from both descriptive analysis and the Analytical Hierarchy

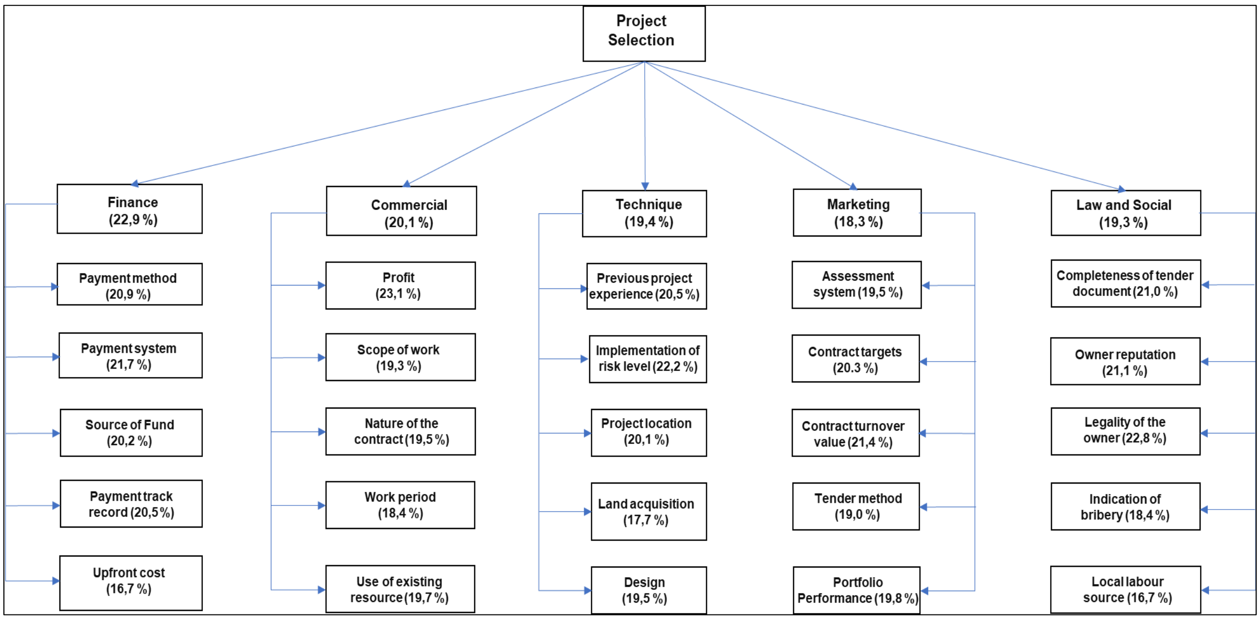

Figure 6. Results of rating tools analysis of criteria and sub-criteria

Process, the next step is to demonstrate the practical applicability of the proposed risk-based pre-tender assessment model. To achieve this objective, the model is applied to evaluate representative oil and gas construction project opportunities using a case-study approach.

Case study application of the risk-based pre-tender assessment tool

Having established the consistency and stability of the weighting results obtained from both descriptive analysis and the Analytical Hierarchy Process (AHP), the next step is to demonstrate the practical applicability of the proposed risk-based pre-tender assessment model. While the previous sections establish the methodological validity of the weighting structure, a practical demonstration is necessary to verify whether the model can effectively support real decision-making scenarios encountered by contractors during the pre-tender stage of oil and gas construction projects.

To illustrate the operational use of the proposed framework, a case study approach was employed by evaluating two representative project opportunities commonly encountered in oil and gas construction environments. The selected projects consist of Project A. Pipeline Installation and Project B. Oil Storage Terminal Development. These projects were selected because they represent typical infrastructure investments in upstream and midstream oil and gas development activities.

Project A involves installing an onshore pipeline to transport processed gas from a production facility to a regional distribution hub. Pipeline construction projects generally require specialized welding expertise, strict safety management, and coordination with multiple stakeholders along the pipeline corridor. However, compared with other oil and gas infrastructure projects, pipeline installation often exhibits relatively well-defined engineering specifications and moderate implementation complexity.

Project B involves the development of a new oil storage terminal comprising storage tanks, loading facilities, mechanical systems, and supporting infrastructure. Such projects typically require extensive foundation work, higher capital investment, and stricter regulatory compliance for environmental protection and industrial safety. Consequently, oil storage terminal projects often present higher financial exposure and greater technical uncertainty during the early pre-tender evaluation stage.

The practical evaluation of these project alternatives follows the structured decision-support process proposed in this study. The framework integrates project information assessment, AHP-based criteria weighting, and a weighted scoring mechanism to generate an overall project feasibility score. The overall analytical flow used in this decision-support process is illustrated in Figure 7.

Figure 7 illustrates the operational sequence of the proposed assessment model. The process begins with identifying potential project opportunities and collecting relevant pre-tender information, including technical specifications, financial arrangements, and contractual conditions. The collected information is subsequently evaluated using the five criteria groups identified in this study: finance, commercial, technical, marketing, and law and social aspects. The Analytical Hierarchy Process provides relative priority weights for each criterion, while expert judgment assigns performance ratings to individual project alternatives. These ratings are then combined with the AHP weights through a weighted scoring model to generate a final project feasibility score.

Based on this evaluation framework, each project alternative was assessed using the criteria and sub-criteria weights derived from the AHP analysis. Expert assessments were used to assign performance ratings to each project on a scale of 1 to 9, where higher values indicate more favorable project conditions from a contractor's perspective.

The detailed evaluation results across all criteria and sub-criteria are summarized in Table 5, which presents the expert ratings for Project A and Project B, along with the corresponding AHP priority weights.

Table 5 demonstrates how the proposed assessment framework captures variations in project feasibility across multiple decision dimensions. The ratings assigned to Project A indicate relatively favorable financial conditions, strong compatibility with the contractor's technical capabilities, and acceptable implementation risk. Conversely, Project B receives comparatively lower ratings in several financial and technical indicators due to higher capital requirements and greater engineering complexity. These differences reflect the inherent characteristics of the two project types and illustrate how the model differentiates between project alternatives based on multiple evaluation factors.

To obtain the overall feasibility score for each project, the weighted scoring model was applied by multiplying each project rating by the corresponding AHP priority weight and summing the results across all criteria. The project scoring formulation used in this study is expressed as: Project Score = Σ (Weight $\times$ Rating)

The aggregated evaluation results for both project alternatives are presented in Table 6.

Table 6. Aggregated feasibility scores of the evaluated project alternatives.

Project	Total weighted score
Project A. Pipeline installation	7.48
Project B. Oil storage terminal	6.32

The results indicate that Project A. Pipeline Installation achieved a higher overall feasibility score compared with Project B. Oil Storage Terminal Development. This outcome suggests that Project A presents a more balanced combination of financial feasibility, technical readiness, and manageable implementation risk from the contractor's perspective. Although Project B offers strategic value and potential portfolio benefits, its higher capital exposure and greater technical complexity reduce its attractiveness during the early pre-tender decision stage. This result indicates that projects with lower implementation uncertainty, more manageable financial exposure, and stronger technical compatibility tend to achieve higher feasibility scores within the proposed framework. The findings further demonstrate that the assessment model does not merely prioritize project value, but also evaluates the balance between project opportunity and associated risk exposure.

The case study results therefore demonstrate that the proposed risk-based assessment framework can function as a practical decision-support tool for evaluating competing project opportunities. By integrating systematically derived criteria weights with expert-based project ratings, the model

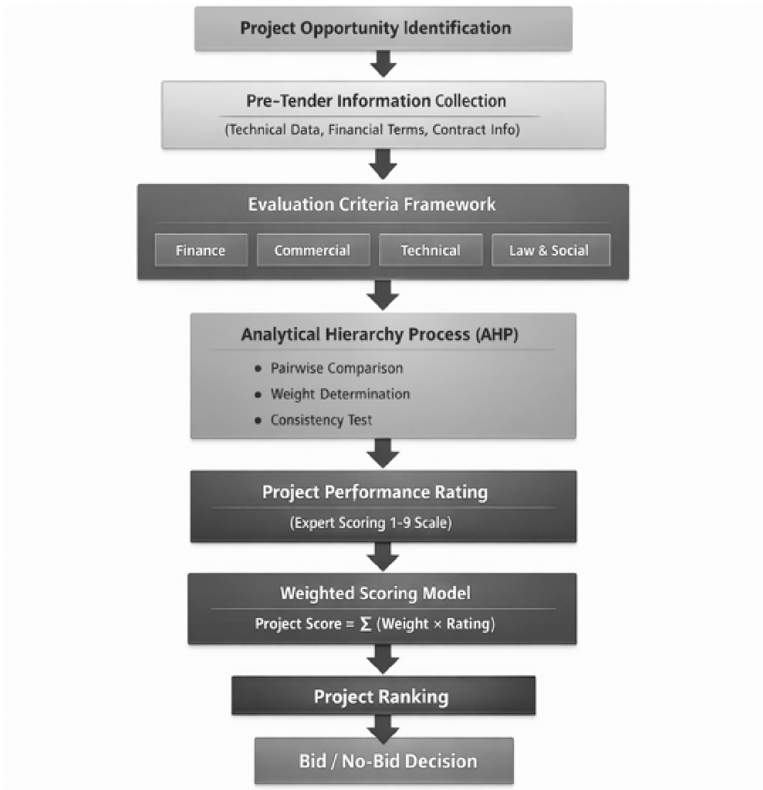

Figure 7. Pre-Tender decision support framework for oil and gas construction projects

Table 5. Evaluation of project A and Project B based on weighted pre-tender criteria.

Code	Criteria / sub-criteria	Weight	Project a. Pipeline installation	Project b. Oil storage terminal
X1	Finance	0.229		
X1.1	Payment method	0.209	8	6
X1.2	Payment system	0.217	7	6
X1.3	Source of funds	0.202	8	6
X1.4	Payment track record	0.205	7	6
X1.5	Upfront cost requirement	0.167	6	5
X2	Commercial	0.201		
X2.1	Expected profit margin	0.231	7	6
X2.2	Scope of work	0.193	7	6
X2.3	Contract type	0.195	7	6
X2.4	Project duration	0.184	6	5
X2.5	Resource utilization	0.197	8	6
X3	Technical	0.194		
X3.1	Previous project experience	0.205	8	6
X3.2	Implementation risk	0.222	7	5
X3.3	Land availability	0.201	7	6
X3.4	Project location accessibility	0.177	7	5
X3.5	Design completeness	0.195	8	6
X4	Marketing	0.183		
X4.1	Tender evaluation system	0.195	7	6
X4.2	Contract targets	0.203	7	6
X4.3	Project value	0.214	8	7
X4.4	Tender method	0.190	7	6
X4.5	Portfolio impact	0.198	8	7
X5	Law and Social	0.193		
X5.1	Tender document completeness	0.210	7	6
X5.2	Owner reputation	0.211	8	6
X5.3	Owner legality	0.228	8	7
X5.4	Governance transparency	0.184	7	6
X5.5	Local labor availability	0.167	7	6

enables contractors to perform structured and objective comparisons between project alternatives during the tender preparation phase.

Sensitivity analysis of criteria weights

While the case study results provide an initial demonstration of the practical application of the proposed model, it is also important to evaluate the robustness of the decision outcomes produced by the framework. In multi-criteria decision-making models such as the Analytical Hierarchy Process, sensitivity analysis is commonly conducted to assess whether variations in criteria weights significantly influence the final ranking of decision alternatives.

In this study, sensitivity analysis was performed to examine how changes in the weighting structure may affect the evaluation results obtained from the proposed pre-tender assessment model. Particular attention was given to the financial criterion (X1), which obtained the highest priority weight in the AHP analysis and therefore represents the most influential factor in the decision hierarchy.

Three weighting scenarios were examined in the sensitivity analysis. The first scenario represents the baseline condition using the original AHP weights derived from the survey results. The second scenario increases the relative importance of the financial criterion to simulate situations in which contractors prioritize financial stability and cash flow considerations. The third scenario decreases the weight of the financial criterion to represent conditions in which technical capability or strategic positioning becomes more dominant in project selection decisions.

The adjusted criteria weights for the three evaluation scenarios are presented in Table 7. Table 7 illustrates the redistribution of weights among the five primary evaluation criteria under the three scenarios. When the financial weight is increased, the remaining criterion weights are proportionally reduced. Conversely, when the financial weight is decreased, relatively greater emphasis is placed on commercial, technical, marketing, and legal-social considerations.

Using these modified weighting structures, the project evaluation scores were recalculated to determine whether the ranking of project alternatives would change under different decision priorities. The resulting evaluation outcomes are presented in Table 8.

The results presented in Table 8 indicate that the ranking of project alternatives remains stable across all examined scenarios. Project A consistently achieves a higher evaluation score than Project B, regardless of whether the financial criterion weight is increased or decreased. This finding suggests that the proposed decision-support model yields stable, reliable decision outcomes and that the project ranking is not overly sensitive to moderate variations in criterion weights.

The stability observed in the sensitivity analysis strengthens the credibility of the proposed risk-based pre-tender assessment framework. It indicates that the model can provide consistent

Table 7. Alternative weighting scenarios used for sensitivity analysis.

Scenario	Finance	Commercial	Technical	Marketing	Law & social
Baseline	0.229	0.201	0.194	0.183	0.193
Financial increase	0.30	0.18	0.18	0.17	0.17
Financial decrease	0.18	0.22	0.21	0.19	0.20

Table 8. Sensitivity analysis results for the evaluated project alternatives.

Scenario	Project A score	Project B score	Ranking
Baseline	7.48	6.32	A > B
Financial increase	7.55	6.20	A > B
Financial decrease	7.31	6.40	A > B

decision guidance even when different organizational priorities or risk perspectives are applied during the project evaluation process.

Overall, the combined results of the case study application and the sensitivity analysis confirm that the proposed AHP-based framework can serve as a practical and robust decision-support tool for contractors operating in complex and high-risk oil and gas construction environments.

CONCLUSION

Based on the results of the data analysis, all criteria and sub-criteria employed in this study were demonstrated to be valid, reliable, and to satisfy established consistency requirements. The differences observed between the descriptive analysis and the Analytical Hierarchy Process (AHP) results were minimal and primarily attributable to rounding effects during data processing. Consequently, both analytical approaches produced highly consistent outcomes and can be regarded as reliable quantitative foundations for risk-based pre-tender assessment.

The AHP analysis demonstrates that pre-tender decision-making in oil and gas construction projects is influenced by multiple interrelated financial, commercial, technical, marketing, and legal-social considerations rather than a single dominant factor. This finding suggests that pre-tender decision-making in oil and gas construction projects is influenced by multiple interrelated factors rather than a single dominant criterion. Financial aspects emphasize the importance of payment mechanisms, funding sources, payment track records, and upfront cost requirements in maintaining financial stability during project execution. Commercial considerations include profit margins, contract types, project duration, and resource utilization. Technical factors address previous project experience, implementation risk, land availability, project location, and design completeness. Meanwhile, marketing considerations relate to strategic positioning and portfolio development, while legal and social aspects highlight the importance of regulatory compliance, owner credibility, governance transparency, and local workforce considerations.

The practical applicability of the proposed framework was further demonstrated through a case-study evaluation of two representative oil and gas construction projects: a pipeline installation project and an oil storage terminal development project. The case study results indicate that the proposed assessment model can effectively differentiate project alternatives by integrating AHP-based criteria weighting with expert-based performance ratings. The evaluation results show that the pipeline installation project achieved a higher feasibility score compared with the oil storage terminal project, indicating a more balanced combination of financial feasibility, technical readiness, and manageable implementation risk.

To further evaluate the robustness of the proposed model, sensitivity analysis was conducted by modifying the weighting structure of the most influential criterion, namely the financial aspect. The sensitivity analysis results demonstrate that the ranking of project alternatives remains stable across multiple weighting scenarios. This stability indicates that the proposed risk-based pre-tender assessment framework yields consistent decision outcomes and is not overly sensitive to moderate variations in the weighting of criteria.

Overall, the development of the risk-based pre-tender assessment tool in this study provides a structured and practical decision-support framework for contractors involved in oil and gas construction projects. By integrating systematic criteria identification, AHP-based weighting, and quantitative project scoring, the proposed model enables decision-makers to evaluate project feasibility in a transparent, objective, and measurable manner prior to tender commitment. The model therefore has the potential to improve bid/no-bid decision quality, reduce exposure to unfavorable project risks, and support more strategic project selection in complex and capital-intensive oil and gas construction environments. In practical applications, the proposed framework may assist contractors and tender management teams in improving bid selectivity and prioritizing project opportunities that align with organizational capabilities, financial capacity, and acceptable risk exposure. The model also supports more consistent and transparent go/no-go decision-making during the early stages of project evaluation.

Despite its practical contribution, this study has several limitations. The assessment framework was developed based on respondents operating primarily within the Indonesian construction industry context, which may limit the generalizability of the findings to other industrial or regional environments. In addition, the weighting process relies on expert judgment through the Analytical Hierarchy Process, which may still contain a degree of subjectivity despite consistency validation procedures.

Future studies may extend the proposed framework by incorporating advanced multi-criteria decision-making approaches, such as Fuzzy AHP, ANP, or hybrid AHP-TOPSIS models, to better address uncertainty and interdependencies among evaluation criteria. Further validation using larger datasets and real project performance outcomes may also strengthen the practical robustness of the proposed risk-based pre-tender assessment model.

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Author contribution

All authors contributed equally as the main contributor of this paper. All author read and approved the final paper.

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None

The use of AI or AI-assisted technologies

None

GLOSSARY OF TERMS AND SYMBOLS

Symbol	Definition	Unit
AHP	Analytical hierarchy process, a multi-criteria decision-making method used to determine priority weights within a structured and hierarchical assessment framework	
CI	Consistency index used to evaluate the logical consistency of pairwise comparison matrices in ahp analysis	
CR	Consistency ratio used to assess the acceptability of consistency in ahp judgments (cr ≤ 0.10 indicates acceptable consistency)	
X1	Financial aspect in pre-tender assessment, representing financial risk and cash flow sustainability considerations	
X2	Commercial aspect in pre-tender assessment, representing contractual and economic feasibility considerations	
X3	Technical aspect in pre-tender assessment, representing engineering readiness, implementation risk, and technical feasibility	
X4	Marketing aspect in pre-tender assessment, representing strategic positioning and portfolio-related considerations	

X5	Law and social aspect in pre-tender assessment, representing regulatory compliance, governance, and social acceptability
X1.1–X1.5	Financial sub-criteria (payment method, payment system, funding source, payment track record, upfront cost)
X2.1–X2.5	Commercial sub-criteria (profit margin, scope of work, contract type, project duration, resource utilization)
X3.1–X3.5	Technical sub-criteria (previous experience, implementation risk, land availability, project location, design completeness)

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