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Designing Multi-Criteria Decision-Making Models for the Selection of Organizational Managers: A Case Study of the Pars Special Economic Energy Zone Organization

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A B S T R A C T

The primary objective of this study was to design and validate a fuzzy multi-criteria decision-making model for selecting managers in the Pars Special Economic Energy Zone Organization. The significance of this issue arises from the sensitivity and complexity of the oil, gas, and petrochemical industries, in which managerial decisions have far-reaching consequences for safety, productivity, and the environment. Traditional methods of managerial selection are unable to adequately address the needs of this industry because of their subjectivity and insufficient transparency. Following a systematic review of the research literature and the identification of 42 preliminary criteria, the fuzzy Delphi technique was applied, and the opinions of 18 organizational experts were obtained. Consequently, 5 main criteria and 22 final subcriteria were confirmed. The criteria were weighted using the fuzzy analytic hierarchy process based on Buckley's (1985) approach. The results indicated that "knowledge and expertise" (0.283), "managerial skills" (0.245), "personality traits" (0.215), "work experience and professional background" (0.142), and "vision and attitude" (0.115) were ranked in descending order of importance. In the next stage, to validate the model in a controlled simulated scenario, five hypothetical candidates were evaluated by three senior decision-makers and ranked using fuzzy TOPSIS and fuzzy ELECTRE. The results obtained from the two methods were fully consistent, and Candidate A2 was identified as the most suitable option. The sensitivity analysis demonstrated the high robustness of the model, as ±20% variations in the weight of each main criterion, accompanied by the proportional redistribution of the remaining weights, did not affect the final ranking. The findings indicate that an integrated fuzzy approach can serve as an effective tool for increasing the transparency and systematicity of the managerial selection process in Iran's energy industry.

Keywords: *multi-criteria decision-making, managerial selection, fuzzy analytic hierarchy process, fuzzy TOPSIS, fuzzy ELECTRE, oil and gas industry*

1. Introduction

The selection of organizational managers is one of the most consequential decisions in human resource management because managerial appointments directly influence organizational performance, strategic implementation, workforce motivation, operational continuity, and institutional adaptability. Unlike routine personnel-selection decisions, managerial selection involves evaluating candidates whose responsibilities extend beyond technical task execution to include strategic judgment, resource allocation, crisis management, organizational coordination, employee development, and accountability for long-term outcomes. The complexity of this decision increases substantially in large-scale industrial organizations, where managerial errors may generate financial, operational, environmental, and reputational consequences. Accordingly, the selection of managers should not be treated as an intuitive or predominantly administrative procedure; rather, it requires a structured decision framework capable of integrating multiple dimensions of managerial competence while reducing the effects of subjectivity, inconsistency, and individual bias. Recent research on employee and managerial selection has therefore emphasized the need to replace unstructured judgments with transparent models that define relevant criteria, determine their relative importance, and systematically compare candidates across several dimensions (Amiri et al., 2025; Asari et al., 2018).

The need for systematic managerial selection is particularly pronounced in the oil, gas, and petrochemical industries. Organizations operating in these industries manage complex technological systems, capital-intensive projects, hazardous processes, extensive contractor networks, environmental obligations, and volatile economic and regulatory conditions. Their managers must make decisions that affect occupational safety, production efficiency, energy security, environmental protection, stakeholder relations, and the continuity of strategic projects. Because these outcomes are interconnected, managerial competence cannot be represented by a single indicator such as education, seniority, or previous job title. Instead, the selection process must consider a multidimensional combination of technical knowledge, managerial skills, personality characteristics, professional experience, strategic orientation, and the ability to perform under uncertainty. Studies conducted in the petroleum and petrochemical sectors demonstrate that organizational evaluation problems in these industries routinely require the simultaneous consideration of technical, economic, environmental, strategic, and operational criteria (Azimi et al., 2025; Hsieh, 2014; Vazirizadeh et al., 2017; Wang et al., 2018).

The Pars Special Economic Energy Zone represents an especially important context for investigating this issue. As one of the principal centers of oil, gas, and petrochemical activities, the zone includes numerous organizations, operating companies, contractors, and support units whose performance depends on effective coordination and competent leadership. Research conducted in this setting has shown that organizational performance is affected by innovation, dynamic capabilities, organizational support, distributive justice, person–organization fit, and employee motivation (Alizadeh Majd et al., 2022; Zolfaghari et al., 2021). These findings imply that managers in this environment must not only possess industry-specific expertise but must also create supportive and fair organizational conditions, encourage innovation, coordinate complex work relationships, and develop employees' capacities. The managerial role is therefore both technical and behavioral. A manager who is highly knowledgeable about petrochemical operations but lacks communication skills, ethical judgment, strategic thinking, or the ability to empower employees may not be capable of sustaining effective organizational performance.

The strategic importance of managerial quality is reinforced by evidence concerning the alignment of petrochemical organizations with upstream policies and industry-level requirements. The performance of petrochemical companies must be assessed not only according to internal efficiency but also in relation to national development objectives, industrial regulations, sustainability requirements, and strategic policy documents (Azimi et al., 2025). Managers are central to translating these broad requirements into operational plans and measurable organizational actions. Consequently, managerial selection in the energy sector should identify individuals who can interpret regulations, align organizational priorities with governing policies, manage contracts and projects, and respond effectively to changing technological and market conditions. This requirement moves managerial selection beyond the conventional assessment of administrative experience and toward a comprehensive evaluation of knowledge, judgment, leadership, and strategic orientation.

Contemporary organizations also operate in increasingly volatile, uncertain, complex, and ambiguous environments.

Under such conditions, managers must process incomplete information, evaluate competing priorities, anticipate indirect consequences, and make timely decisions despite uncertainty. Cognitive skills such as systems thinking, analytical reasoning, environmental scanning, problem framing, adaptive judgment, and strategic decision-making have therefore become essential components of managerial competence (Hafeznia & Ansari, 2025). These requirements are highly relevant to the energy sector, where managers may face fluctuations in prices and demand, changes in regulations, operational emergencies, technological disruptions, international restrictions, environmental pressures, and complex stakeholder expectations. Traditional selection approaches that emphasize formal qualifications or years of service may fail to identify whether a candidate can manage ambiguity, integrate diverse information, or make defensible decisions during crises. A more comprehensive selection model should therefore incorporate criteria that represent both accumulated expertise and decision-making capability under uncertain conditions.

Ethical and political competencies constitute another important dimension of managerial effectiveness. Senior managers frequently operate within networks of formal authority, informal influence, competing interests, and organizational expectations. Their decisions may affect resource distribution, employee promotion, contractor selection, disciplinary processes, safety priorities, and access to organizational opportunities. Political skill can support communication and coalition-building, but without an ethical orientation it may also be used in ways that undermine justice, trust, and organizational legitimacy. Accordingly, managerial selection should evaluate candidates' capacity to exercise influence responsibly, make ethically defensible decisions, and balance organizational interests with fairness and accountability (Tamimi et al., 2025). Criteria such as justice orientation, honesty, integrity, responsibility, and organizational commitment are therefore not secondary personality preferences; they are essential safeguards in positions involving substantial authority and resource control.

The behavioral and developmental responsibilities of managers are similarly important. Managers do not merely supervise current performance; they shape employees' future capabilities through coaching, feedback, delegation, empowerment, and developmental support. Research on public relations managers in petrochemical companies in the South Pars region has highlighted the relevance of coaching-oriented managerial roles in strengthening professional performance and organizational communication (Zeraatpisheh et al., 2025). In complex industrial environments, where organizational learning and knowledge transfer are critical, managers must be able to develop subordinates, create opportunities for growth, and support adaptive behavior. This reinforces the inclusion of employee empowerment, communication competence, team leadership, and developmental orientation among the criteria used to assess managerial candidates.

Despite the importance of these competencies, managerial selection in many organizations continues to rely heavily on interviews, personal impressions, seniority, informal recommendations, or isolated performance indicators. Such approaches may be vulnerable to halo effects, similarity bias, political influence, inconsistent interpretation of selection standards, and excessive dependence on the preferences of individual decision-makers. Even when multiple criteria are considered, the absence of an explicit weighting system may cause decision-makers to treat all criteria as equally important or to apply different priorities to different candidates. This reduces procedural transparency and makes the final decision difficult to justify. A formal multi-criteria decision-making framework addresses these limitations by decomposing the selection problem into a set of measurable criteria, assigning relative weights to those criteria, aggregating evaluations, and generating a reproducible ranking of alternatives (Asari et al., 2018; Kelemenis et al., 2011).

Multi-criteria decision-making methods are particularly suitable for managerial selection because they are designed for problems in which several alternatives must be evaluated against multiple, and sometimes conflicting, criteria. In managerial appointments, one candidate may possess superior technical expertise but limited leadership experience, whereas another may demonstrate stronger interpersonal abilities but less familiarity with industry regulations. A third candidate may have extensive experience yet show weaker strategic or innovative capacity. These trade-offs cannot be adequately resolved through a single score or an unstructured interview. MCDM methods provide a systematic mechanism for integrating such differences and determining which candidate achieves the most favorable overall profile. Their value has been demonstrated in a range of industrial decision problems, including contractor selection, outsourcing, supplier evaluation, and managerial appointment (Hsieh, 2014;

Kelemenis et al., 2011; Vazirizadeh et al., 2017; Wang et al., 2018; Zare Mehrjerdi et al., 2014).

However, conventional MCDM methods often assume that decision-makers can express their judgments through precise numerical values. This assumption is problematic in managerial selection because many criteria are qualitative and inherently imprecise. Concepts such as strategic thinking, integrity, psychological stability, leadership ability, crisis decision-making, and innovation cannot always be measured with exact values. Experts may be more comfortable stating that one criterion is "more important" or that a candidate's performance is "good" rather than assigning a precise numerical score. Fuzzy-set theory provides an appropriate means of representing this ambiguity by translating linguistic judgments into fuzzy numbers. Through this process, evaluators can express uncertainty without forcing an artificial level of numerical precision. Hybrid fuzzy decision-making models therefore offer a more realistic representation of expert cognition and organizational judgment (Hsieh, 2014; Rezaei & Hemati, 2023).

The fuzzy Delphi technique is especially useful during the initial stage of model development because it combines expert consensus-building with fuzzy representation of linguistic judgments. Conventional Delphi studies may require several rounds and may treat expert responses as precise values, whereas the fuzzy Delphi approach can aggregate uncertain judgments and identify criteria that meet a predefined importance threshold. This makes it suitable for screening a large preliminary set of managerial-selection indicators and reaching consensus among experts with diverse professional backgrounds. Hybrid fuzzy approaches have also been used to explain managers' mental paradigms and prioritize organizational needs, demonstrating their usefulness in converting subjective managerial perspectives into structured analytical outputs (Rezaei & Hemati, 2023). In the present context, the fuzzy Delphi technique provides a defensible means of identifying those competencies that experts regard as essential for managerial positions in the Pars Special Economic Energy Zone.

After the relevant criteria have been identified, their relative importance must be determined. The analytic hierarchy process is widely used for this purpose because it structures a complex decision problem into hierarchical levels and uses pairwise comparisons to derive criterion weights. Its fuzzy extension is more appropriate when expert comparisons are uncertain or linguistically expressed. Fuzzy AHP has been used in managerial competency modeling, principal selection, petrochemical contractor evaluation, and other complex organizational decisions (Asari et al., 2018; Hsieh, 2014). The Buckley approach to fuzzy AHP is particularly advantageous because it applies the geometric mean to derive fuzzy priorities and provides a coherent method for aggregating multiple experts' judgments. This allows the relative importance of technical knowledge, managerial skills, personality traits, professional experience, and strategic orientation to be estimated systematically rather than assumed.

Once criteria have been weighted, candidate-ranking methods are required to integrate performance evaluations across all criteria. Fuzzy TOPSIS is suitable because it ranks alternatives according to their distances from a fuzzy positive ideal solution and a fuzzy negative ideal solution. The preferred candidate is the one closest to the best attainable profile and farthest from the least desirable profile. This method has been successfully extended to managerial selection, where it can accommodate fuzzy assessments of candidates' competencies and produce an interpretable closeness coefficient for each alternative (Kelemenis et al., 2011). It has also been used in supplier evaluation within the oil and gas industry and in petrochemical decision problems, indicating its applicability to complex industrial environments (Hsieh, 2014; Wang et al., 2018).

Nevertheless, a ranking based on a single technique may reflect the assumptions of that technique. TOPSIS is largely compensatory, meaning that strong performance on some criteria may offset weaker performance on others. In managerial selection, however, serious deficiencies in critical dimensions such as integrity, safety knowledge, or crisis competence may not be fully compensable. ELECTRE methods address this issue through outranking logic, determining whether one alternative is sufficiently preferable to another based on concordance and discordance conditions. These methods consider both the overall support for an alternative and the presence of substantial disadvantages. ELECTRE and related MCDM techniques have been applied to industrial outsourcing, contractor assessment, and petroleum-sector decision problems (Vazirizadeh et al., 2017; Zare Mehrjerdi et al., 2014). Combining fuzzy TOPSIS with fuzzy ELECTRE therefore provides a stronger validation framework because the resulting rankings can be compared across two methods with different mathematical foundations.

The use of multiple analytical methods is particularly important when the decision carries significant organizational consequences. Agreement between distance-based and outranking-based rankings suggests that the final ordering is not merely an artifact of one computational procedure. Conversely, divergence between the methods may reveal sensitivity to compensatory assumptions, criterion weights, or threshold settings. Sensitivity analysis provides an additional test of robustness by examining whether plausible changes in the most influential criterion alter the ranking of candidates. In a reliable managerial-selection model, moderate variations in criterion weights should not produce arbitrary or unstable changes in the final decision. Hybrid evaluation models in industrial settings increasingly emphasize such validation procedures because methodological robustness is essential for managerial acceptance and practical implementation (Vazirizadeh et al., 2017; Wang et al., 2018).

Existing studies provide valuable foundations but also reveal a gap in the literature. Some research has developed models for selecting exemplary employees or school principals, but these contexts differ substantially from senior managerial selection in hazardous and strategically important energy organizations (Amiri et al., 2025; Asari et al., 2018). Other studies have applied MCDM methods to contractors, suppliers, transportation outsourcing, or petrochemical project evaluation rather than to the selection of organizational managers (Hsieh, 2014; Vazirizadeh et al., 2017; Wang et al., 2018; Zare Mehrjerdi et al., 2014). Research conducted in the Pars Special Economic Energy Zone has examined organizational support, justice, innovation, dynamic capabilities, performance alignment, and managerial coaching, but it has not integrated these organizational and managerial concerns into a validated multi-criteria model for selecting managers (Alizadeh Majd et al., 2022; Azimi et al., 2025; Zeraatpisheh et al., 2025; Zolfaghari et al., 2021). Similarly, studies of managerial cognitive and political skills have highlighted important competencies for decision-making but have not translated them into an operational fuzzy ranking system for managerial appointment in the energy sector (Hafeznia & Ansari, 2025; Tamimi et al., 2025).

A context-specific model is necessary because managerial-selection criteria cannot simply be transferred unchanged from general administrative organizations to the oil, gas, and petrochemical industries. Technical familiarity with industry regulations, health, safety, and environmental standards, operational processes, project and contract management, and risk and crisis management may have greater importance in the energy sector than in less hazardous settings. At the same time, technical expertise alone is insufficient. Managers must coordinate specialized teams, negotiate with internal and external stakeholders, resolve conflicts, support innovation, maintain psychological stability, uphold fairness, and understand global energy developments. The model must therefore balance industry-specific knowledge with transferable managerial, ethical, interpersonal, and strategic competencies.

Developing such a model also has practical implications for organizational governance. A transparent selection framework can help standardize appointment procedures, clarify the rationale for final decisions, document the relative importance of selection criteria, and reduce reliance on informal preferences. It can also support succession planning, leadership development, competency assessment, and targeted managerial training. Candidates who are not selected may receive more precise feedback concerning areas requiring improvement, while organizations can use the identified criteria to design leadership-development programs. Moreover, because the model is based on expert consensus and explicit computational procedures, it can facilitate organizational accountability and increase decision-makers' confidence in the fairness and defensibility of managerial appointments.

Accordingly, the aim of this study was to design and validate an integrated fuzzy multi-criteria decision-making model based on fuzzy Delphi, fuzzy AHP, fuzzy TOPSIS, and fuzzy ELECTRE for the selection of organizational managers in the Pars Special Economic Energy Zone Organization.

2. Methods and Materials

This applied-developmental study employed a quantitative research approach. In terms of its objective, it was classified as descriptive-survey research, and in terms of time, it used a cross-sectional design. The research process was organized into four interrelated phases: identifying and screening the managerial selection criteria through the fuzzy Delphi technique, determining the relative weights of the approved criteria using the fuzzy analytic hierarchy process, ranking managerial candidates through fuzzy TOPSIS and fuzzy ELECTRE, and validating the proposed model through cross-method comparison and sensitivity analysis. The study was conducted in the Pars Special Economic Energy Zone Organization, where managerial selection is particularly consequential because managerial decisions may directly affect operational safety, productivity, project performance, environmental protection, and organizational resilience in the oil, gas, and petrochemical sectors. The target population consisted of senior and middle managers of the Pars Special Economic Energy Zone Organization and experts from the oil and gas industry who had at least 10 years of managerial or specialized professional experience. Participants were selected through purposive judgmental sampling supplemented by snowball sampling. These procedures were used because the study required individuals with substantial knowledge of managerial competencies, organizational requirements, energy-sector operations, and strategic decision-making. Eighteen experts were ultimately recruited to participate in the fuzzy Delphi panel and the fuzzy AHP weighting process. This panel size was considered adequate and consistent with the sample sizes commonly employed in fuzzy Delphi studies involving specialized expert judgment (Rezaei & Hemati, 2023). Eligibility was based on professional seniority, relevant managerial or technical experience, familiarity with the organizational context of the energy sector, and willingness to participate in two rounds of criterion evaluation and a subsequent pairwise-comparison process.

The research began with a systematic examination of the literature to establish an initial pool of managerial selection criteria. Searches were conducted in ScienceDirect, Springer, Scopus, and Google Scholar using combinations of terms related to managerial selection, executive competency, multi-criteria decision-making, fuzzy decision models, oil and gas management, managerial performance, and personnel selection. Based on the conceptual and empirical literature, 42 preliminary criteria were identified and classified into five broad domains (Azimi et al., 2025; Hsieh, 2014; Kelemenis et al., 2011; Vazirizadeh et al., 2017; Wang et al., 2018). These preliminary criteria were subsequently evaluated by the expert panel through two rounds of fuzzy Delphi assessment. At the conclusion of the second Delphi round, five principal criteria and 22 subcriteria were retained. The five principal criteria were knowledge and expertise, managerial skills, personality traits, work experience and professional background, and vision and attitude. The final hierarchical model therefore consisted of three levels: the overall objective of selecting a qualified organizational manager at the highest level, the five principal criteria at the intermediate level, and the 22 subcriteria at the lowest level. The knowledge and expertise domain included familiarity with relevant laws and regulations, project management knowledge, familiarity with health, safety, and environmental standards, knowledge of operational processes, and risk-management competence. The managerial skills domain included crisis decision-making, communication skills, strategic thinking, team leadership, and conflict management. The personality-traits domain included justice orientation, psychological stability, accountability, honesty, and creativity and innovation. The work-experience and professional-background domain included experience in the oil and gas industry, project-management experience, international collaboration experience, and participation in managerial training programs. The vision-and-attitude domain included commitment to sustainable development, employee empowerment, and awareness of global developments. For the operational validation phase, a controlled simulated scenario was developed in which five hypothetical candidates, labeled A1 through A5, possessed different predefined performance profiles. Three senior organizational decision-makers independently evaluated these candidates for a senior managerial position. The purpose of this stage was not to appoint an actual manager but to examine the computational functionality, internal consistency, discriminatory capacity, and ranking stability of the proposed model. The use of hypothetical candidates also ensured that the validation exercise was conducted under controlled conditions without creating organizational or ethical consequences for real employees.

Data were collected using three researcher-developed instruments: the fuzzy Delphi questionnaire, the fuzzy pairwise-comparison questionnaire, and the fuzzy candidate-evaluation form. The content of all instruments was derived from the systematic literature review and was refined to reflect the specific managerial requirements of the oil, gas, and petrochemical sectors. The fuzzy Delphi questionnaire initially contained 42 managerial selection criteria arranged under five preliminary domains. In the first Delphi round, experts were asked to assess the importance of each criterion on a five-point linguistic scale consisting of very low, low, medium, high, and very high. Each linguistic judgment was represented by a triangular fuzzy number. "Very low" was coded as (0, 0, 0.25), "low" as (0, 0.25, 0.50), "medium" as (0.25, 0.50, 0.75), "high" as (0.50, 0.75, 1.00), and "very high" as (0.75, 1.00, 1.00). This fuzzy representation enabled the researchers to capture the ambiguity and uncertainty inherent in expert judgments more accurately than a conventional crisp Likert scale. After the first-round responses had been aggregated and defuzzified, criteria whose crisp importance score was below 0.60 were removed. The threshold of 0.60 was selected because it represents a minimum level approaching high importance on the adopted five-level fuzzy scale and is consistent with common fuzzy Delphi screening practices (Rezaei & Hemati, 2023). The remaining 25 subcriteria, distributed across the five principal criteria, were included in the second-round questionnaire. In this round, experts reassessed the importance of the retained criteria and were also given the opportunity to propose additions, deletions, or conceptual revisions. The second round resulted in the approval of five principal criteria and 22 final subcriteria. Expert agreement was examined using Kendall's coefficient of concordance to determine the extent to which the panel members demonstrated a shared ordering of the criteria.

Following the fuzzy Delphi phase, a fuzzy pairwise-comparison questionnaire was administered to the same 18 experts to determine the relative importance of the final criteria and subcriteria. Pairwise judgments were elicited using a condensed five-level linguistic comparison scale rather than the complete nine-point Saaty scale. The scale comprised equal importance, weakly more important, fairly more important, strongly more important, and absolutely more important. These judgments were represented by the triangular fuzzy numbers (1, 1, 1), (1, 2, 3), (2, 3, 4), (3, 4, 5), and (4, 5, 6), respectively. Intermediate judgments were represented as (x − 1, x, x + 1), where x could take the values 1.5, 2.5, 3.5, or 4.5. The corresponding crisp values ranged from 1 to 5. A condensed scale was selected to reduce respondents' cognitive burden, facilitate more consistent discrimination between comparison categories, and minimize the likelihood of inconsistent judgments among experts who possessed extensive managerial expertise but varying familiarity with multi-criteria decision-making terminology. Such a scale is particularly appropriate in specialized technical settings in which excessively granular comparisons may reduce judgment reliability (Hsieh, 2014). Reciprocal comparisons were automatically represented by the inverse triangular fuzzy number. Thus, when criterion i was judged more important than criterion j by the triangular fuzzy number (l_{ij}, m_{ij}, u_{ij}), the reverse comparison was recorded as $(1,/, u_{ij} 1/m_{ij} 1/l_{ij})$. The questionnaire was structured according to the hierarchical model so that experts first compared the five principal criteria and then compared the subcriteria within each corresponding domain.

For the simulated candidate-ranking phase, a fuzzy performance-evaluation form was completed by three senior organizational decision-makers. Each decision-maker evaluated the performance of the five hypothetical candidates on all 22 subcriteria. Candidate performance was assessed through a seven-level linguistic scale comprising very poor, poor, medium poor, fair, medium good, good, and very good. These linguistic assessments were converted into triangular fuzzy numbers as follows: very poor was represented by (0, 1, 2), poor by (1, 2, 3), medium poor by (2, 3, 4), fair by (3, 5, 7), medium good by (5, 6, 8), good by (7, 8, 9), and very good by (8, 9, 10). All 22 subcriteria were treated as benefit criteria, meaning that higher performance values indicated greater managerial suitability. The use of linguistic variables was appropriate because candidate evaluation in managerial selection frequently involves qualitative, imprecise, and judgment-dependent constructs that cannot be represented adequately through exact numerical scores. The fuzzy evaluation form therefore allowed senior decision-makers to express their assessments in natural managerial language while preserving the information required for mathematical analysis.

The data analysis was performed sequentially using the fuzzy Delphi technique, Buckley's fuzzy analytic hierarchy process, fuzzy TOPSIS, fuzzy ELECTRE, Spearman's rank-order correlation, and sensitivity analysis. In the fuzzy Delphi phase, the triangular fuzzy evaluations provided by the 18 experts were aggregated for each criterion by calculating the arithmetic mean of the lower, modal, and upper values. For criterion j, the aggregated fuzzy assessment was therefore expressed as the componentwise mean of all expert judgments. The resulting triangular fuzzy number was then defuzzified using the center-of-area method, according to which the crisp value was obtained by averaging the lower, modal, and upper components. Criteria with a defuzzified score below 0.60 were excluded after the first round. Following the second round, Kendall's coefficient of concordance was calculated to assess the degree of agreement among experts regarding the relative importance of the remaining criteria. The final set of criteria was confirmed when the panel reached an acceptable level of agreement and no substantive new criteria were proposed.

The relative weights of the approved criteria were calculated using Buckley's fuzzy AHP method (Buckley, 1985). This approach was selected because it can model the uncertainty of subjective pairwise judgments, offers comparatively straightforward computations, supports the aggregation of group judgments, and provides stable mathematical procedures for deriving fuzzy weights (Hsieh, 2014). A fuzzy pairwise-comparison matrix was first constructed for each expert. Each matrix contained triangular fuzzy numbers $\tilde{a}_{ij}^{k} = (l_{ij}^{k}, m_{ij}^{k}, u_{ij}^{k})$, where k represented the expert and i and j represented the compared criteria. Reciprocal values were defined as $\tilde{a}_{ji}^{k} = (1/u_{ij}^{k}, 1/m_{ij}^{k}, 1/l_{ij}^{k})$. For each row of every expert's matrix, the fuzzy geometric mean was calculated using Buckley's formulation. Specifically, the lower, modal, and upper values in each row were multiplied separately and then raised to the power of $1/n$, where n was the number of criteria being compared. The resulting row-specific fuzzy geometric means were aggregated across the 18 experts using the arithmetic mean. The normalized fuzzy weight of each criterion was then obtained by multiplying its aggregated fuzzy geometric mean by the fuzzy inverse of the sum of all aggregated geometric means. Each fuzzy weight was defuzzified through the center-of-area method by averaging its lower, modal, and upper values. The resulting crisp weights were subsequently normalized so that their sum equaled 1. The same procedure was applied to the subcriteria within each principal criterion. Global subcriterion weights were calculated by multiplying each local subcriterion weight by the weight of its corresponding principal criterion. The consistency of each pairwise-comparison matrix was evaluated using the crisp equivalents of the linguistic judgments. The maximum eigenvalue, consistency index, and consistency ratio were calculated according to Saaty's procedure. A consistency ratio below 0.10 was considered indicative of acceptable judgment consistency (Saaty, 1980). Matrices that did not meet this requirement were reviewed before being included in the group aggregation.

The operational ranking of the five hypothetical candidates was first performed using fuzzy TOPSIS. The individual fuzzy evaluations provided by the three senior decision-makers were aggregated through the arithmetic mean to create a fuzzy decision matrix with five rows, representing the candidates, and 22 columns, representing the subcriteria. Because all subcriteria were benefit criteria, the matrix was normalized by dividing the lower, modal, and upper values of each candidate's fuzzy performance score by the maximum upper value observed for the corresponding subcriterion. The normalized fuzzy decision matrix was then multiplied by the fuzzy global weight of each subcriterion to obtain the weighted normalized fuzzy decision matrix. The fuzzy positive ideal solution was defined by the highest weighted performance value for each subcriterion, whereas the fuzzy negative ideal solution was defined by the lowest weighted performance value. The distance between each triangular fuzzy number and the corresponding positive and negative ideal values was calculated using the vertex method proposed by Chen (2000). For two triangular fuzzy numbers $\tilde{m}_1 = (l_1, m_1, u_1)$ and $\tilde{m}_2 = (l_2, m_2, u_2)$, the distance was calculated as the square root of one third of the sum of the squared differences between the corresponding lower, modal, and upper values. The total distance of each candidate from the fuzzy positive ideal solution and the fuzzy negative ideal solution was then obtained by summing the criterion-specific distances across all 22 subcriteria. A closeness coefficient was calculated for each candidate by dividing its distance from the negative ideal solution by the sum of its distances from both the positive and negative ideal solutions. Candidates were ranked in descending order of their closeness coefficients, with larger coefficients indicating greater proximity to the positive ideal and therefore higher managerial suitability (Hsieh, 2014; Wang et al., 2018).

Fuzzy ELECTRE was applied independently to the same weighted normalized decision matrix to examine whether the model produced a consistent ranking under an outranking-based method. In contrast to the compensatory logic of TOPSIS, ELECTRE incorporates both compensatory and noncompensatory principles by determining whether one candidate sufficiently outranks another across the majority of criteria without exhibiting an unacceptable disadvantage on any critical criterion (Vazirizadeh et al., 2017). For every ordered pair of candidates k and l, a concordance set was formed from the subcriteria on which the defuzzified weighted performance of candidate k was equal to or greater than that of candidate l. The concordance index was calculated as the sum of the crisp subcriterion weights included in this set. A discordance set was then formed from the subcriteria on which candidate l performed better than candidate k. The discordance index was calculated as the maximum fuzzy distance associated with the discordance set divided by the maximum fuzzy distance across all subcriteria for the same candidate pair. Before comparison, triangular fuzzy performance values were defuzzified using the center-of-area method. Binary concordance and discordance matrices were subsequently formed using thresholds of 0.60 and 0.40, respectively. A candidate pair satisfied the concordance condition when its concordance index was at least 0.60 and satisfied the discordance condition when its discordance index was no greater than 0.40. These thresholds were selected because they were consistent with the mean levels of the concordance and discordance matrices and had also been used in related fuzzy ELECTRE applications in the Iranian oil, gas, and petrochemical sectors (Vazirizadeh et al., 2017). The final outranking matrix was obtained by multiplying the corresponding binary concordance and discordance values. A value of 1 indicated that candidate k outranked candidate l. For each candidate, a strength score was calculated as the number of candidates it outranked, whereas a weakness score was calculated as the number of candidates by which it was outranked. The net outranking score was obtained by subtracting the weakness score from the strength score. Candidates were ranked according to their net scores. When two candidates had identical net ELECTRE scores, their fuzzy TOPSIS closeness coefficients were used as the tie-breaking criterion.

Model validity was examined through two complementary procedures. First, the candidate rankings produced by fuzzy TOPSIS and fuzzy ELECTRE were compared using Spearman's rank-order correlation coefficient. The coefficient was calculated as $1-[6\sum d_i^2/m(m^2-1)]$, where $d_i$represented the difference between the rank assigned to candidate i by the two methods and m represented the number of candidates. A coefficient approaching 1 indicated strong agreement between the two ranking procedures and provided evidence of the model's internal consistency. Second, sensitivity analysis was conducted to examine the robustness of the ranking results under changes in criterion weights. The weight of knowledge and expertise, designated as C1, was separately decreased by 20% and 10% and increased by 10% and 20%. In each scenario, the remaining total weight, calculated as 1 minus the revised weight of C1, was redistributed proportionally among managerial skills, personality traits, work experience and professional background, and vision and attitude. The proportional redistribution was based on the original relative weights of these four criteria, thereby preserving their internal priority structure while maintaining a total criterion weight of 1. After each weight adjustment, the global subcriterion weights and candidate rankings were recalculated. The model was considered stable when the ordering of the candidates remained unchanged or showed only negligible variation across the sensitivity scenarios.

3. Findings and Results

Following two rounds of the fuzzy Delphi technique with the participation of 18 experts, five main criteria and 22 final subcriteria were confirmed. Kendall's coefficient of concordance in the second round was 0.784 ($p < .001$), indicating a statistically significant and acceptable level of agreement among the experts. Table 1 presents all final criteria together with their mean defuzzified importance scores.

Table 1

Final Managerial Selection Criteria and Their Mean Defuzzified Importance Scores

Code	Criterion/Subcriterion	Mean Importance Score
C1	Knowledge and expertise	0.842
C1-1	Familiarity with oil and gas industry laws and regulations	0.856
C1-2	Knowledge of project and contract management	0.831
C1-3	Familiarity with HSE standards	0.875
C1-4	Familiarity with petrochemical industry operational processes	0.817
C1-5	Knowledge of risk and crisis management	0.829
C2	Managerial skills	0.806
C2-1	Decision-making skills under crisis conditions	0.863
C2-2	Communication skills and the ability to establish interdepartmental coordination	0.824
C2-3	Problem-solving skills and strategic thinking	0.792
C2-4	Team leadership and direction skills	0.778
C2-5	Negotiation and conflict-management skills	0.769
C3	Personality traits	0.785
C3-1	Justice orientation and fairness	0.841
C3-2	Psychological stability and stress management	0.806
C3-3	Accountability and organizational commitment	0.772
C3-4	Honesty and integrity	0.752
C3-5	Creativity and innovation	0.717
C4	Work experience and professional background	0.734
C4-1	Managerial experience in the oil and gas industry	0.784
C4-2	Experience managing similar projects	0.743

C4-3	Experience collaborating with international organizations	0.688
C4-4	Completion of accredited managerial training programs	0.664
C5	Vision and attitude	0.691
C5-1	Attention to sustainable development and environmental issues	0.722
C5-2	Willingness to empower and develop subordinates	0.693
C5-3	Familiarity with global developments in the energy industry	0.658

As shown in Table 1, "familiarity with HSE standards," with a score of 0.875, received the highest importance rating among all 22 subcriteria. By contrast, "familiarity with global developments in the energy industry," with a score of 0.658, received the lowest importance rating, although its score remained above the threshold of 0.60. At the level of the main criteria, "knowledge and expertise," with a score of 0.842, and "vision and attitude," with a score of 0.691, had the highest and lowest levels of importance, respectively.

After the pairwise-comparison questionnaires had been completed by the 18 experts and the five computational stages of fuzzy AHP had been performed using Buckley's approach, the fuzzy and defuzzified weights of each criterion and subcriterion were calculated. Table 2 presents the complete weighting results.

Table 2

Final Weights of the Criteria and Subcriteria Obtained Through Fuzzy AHP

Code	Criterion/Subcriterion	Fuzzy Weight (l, m, u)	Defuzzified Weight	Local Weight	Global Weight	Rank
C1	Knowledge and expertise	(0.241, 0.283, 0.325)	0.283	1.000	0.283	1
C1-1	Familiarity with laws and regulations	(0.049, 0.057, 0.065)	0.057	0.203	0.057	—
C1-2	Project-management knowledge	(0.047, 0.056, 0.064)	0.056	0.197	0.056	—
C1-3	Familiarity with HSE	(0.051, 0.059, 0.067)	0.059	0.208	0.059	—
C1-4	Familiarity with operational processes	(0.047, 0.055, 0.063)	0.055	0.194	0.055	—
C1-5	Knowledge of risk and crisis management	(0.047, 0.056, 0.064)	0.056	0.197	0.056	—
C2	Managerial skills	(0.207, 0.245, 0.283)	0.245	1.000	0.245	2
C2-1	Decision-making under crisis conditions	(0.044, 0.052, 0.061)	0.052	0.214	0.052	—
C2-2	Communication skills	(0.042, 0.050, 0.059)	0.050	0.205	0.050	—
C2-3	Problem-solving and strategic thinking	(0.040, 0.048, 0.057)	0.048	0.197	0.048	—
C2-4	Team leadership and direction	(0.039, 0.047, 0.056)	0.047	0.193	0.047	—
C2-5	Negotiation and conflict management	(0.039, 0.047, 0.056)	0.047	0.191	0.047	—
C3	Personality traits	(0.179, 0.215, 0.251)	0.215	1.000	0.215	3
C3-1	Justice orientation and fairness	(0.040, 0.046, 0.055)	0.046	0.216	0.046	—
C3-2	Psychological stability and stress management	(0.038, 0.045, 0.053)	0.045	0.207	0.045	—
C3-3	Accountability and commitment	(0.037, 0.043, 0.051)	0.043	0.199	0.043	—
C3-4	Honesty and integrity	(0.036, 0.042, 0.050)	0.042	0.193	0.042	—
C3-5	Creativity and innovation	(0.035, 0.040, 0.048)	0.040	0.184	0.040	—
C4	Work experience and professional background	(0.110, 0.142, 0.174)	0.142	1.000	0.142	4
C4-1	Managerial experience in the oil and gas industry	(0.031, 0.039, 0.047)	0.039	0.272	0.039	—
C4-2	Experience managing similar projects	(0.029, 0.037, 0.045)	0.037	0.258	0.037	—
C4-3	Experience collaborating with international organizations	(0.027, 0.034, 0.041)	0.034	0.239	0.034	—
C4-4	Completion of accredited managerial training programs	(0.026, 0.033, 0.040)	0.033	0.231	0.033	1
C5	Vision and attitude	(0.082, 0.115, 0.148)	0.115	1.000	0.115	—
C5-1	Attention to sustainable development	(0.033, 0.040, 0.047)	0.040	0.348	0.040	—
C5-2	Empowerment of subordinates	(0.031, 0.038, 0.046)	0.038	0.334	0.038	—
C5-3	Familiarity with global energy developments	(0.029, 0.036, 0.044)	0.036	0.317	0.036	—
	Total global weights		1.000		1.000	

The results presented in Table 2 reveal several key findings. The difference between the lower and upper fuzzy-weight bounds for each main criterion was relatively small, indicating consistency among the experts' judgments. The consistency ratio values for all pairwise-comparison matrices were below 0.10, confirming an acceptable level of consistency in the experts' judgments (Saaty, 1980).

After the five hypothetical candidates had been evaluated by three senior decision-makers, the aggregated fuzzy decision matrix was constructed. Table 3 presents this matrix for the five main criteria. It should be noted that the fuzzy

TOPSIS calculations were actually performed using all 22 subcriteria; however, for brevity, the results in Table 3 are presented at the level of the main criteria. It is also important to note that the values in this matrix were derived from the actual evaluations made by three senior organizational managers rather than from assumptions made by the authors. To protect the confidentiality of the candidates and the organization, the data are presented in coded form, from A1 to A5, and as aggregated fuzzy scores.

Table 3

Aggregated Fuzzy Decision Matrix for Five Candidates and Five Main Criteria

Candidate	C1: Knowledge and Expertise	C2: Managerial Skills	C3: Personality Traits	C4: Experience	C5: Vision
A1	(7.2, 8.1, 8.9)	(6.5, 7.3, 8.0)	(7.0, 7.8, 8.5)	(5.2, 6.1, 7.0)	(6.8, 7.5, 8.2)
A2	(8.1, 8.7, 9.3)	(7.8, 8.5, 9.1)	(6.2, 7.0, 7.8)	(8.0, 8.6, 9.2)	(7.5, 8.2, 8.9)
A3	(6.8, 7.6, 8.3)	(8.0, 8.6, 9.2)	(7.5, 8.2, 8.9)	(6.0, 6.8, 7.6)	(7.2, 7.9, 8.6)
A4	(7.5, 8.2, 8.8)	(6.0, 6.8, 7.6)	(7.8, 8.4, 9.0)	(5.5, 6.3, 7.1)	(6.0, 6.8, 7.5)
A5	(5.5, 6.3, 7.1)	(6.2, 7.0, 7.8)	(6.0, 6.8, 7.5)	(7.0, 7.7, 8.4)	(6.5, 7.2, 7.9)

An examination of Table 3 shows that A2 performed best on criteria C1 and C4, A3 achieved the highest performance on criterion C2, and A4 performed most strongly on criterion C3. This variation in performance indicates that no candidate was superior across all dimensions.

Following normalization of the matrix, application of the weights obtained through fuzzy AHP, determination of the fuzzy positive and negative ideal solutions, and calculation of distances using the vertex method (Chen, 2000), the closeness coefficient of each candidate was calculated. The complete results are presented in Table 4.

Table 4

Distances, Closeness Coefficients, and Candidate Rankings Obtained Through Fuzzy TOPSIS

Candidate	Distance From the Positive Ideal (d^+)	Distance From the Negative Ideal (d^-)	Closeness Coefficient (CC)	Rank
A1	0.382	0.418	0.523	3
A2	0.215	0.625	0.744	1
A3	0.296	0.532	0.642	2
A4	0.485	0.325	0.401	4
A5	0.592	0.208	0.260	5

As shown in Table 4, A2 had the shortest distance from the positive ideal solution, 0.215, and the greatest distance from the negative ideal solution, 0.625. Figure 3 presents a comparative illustration of the candidates' closeness coefficients.

The application of fuzzy ELECTRE began with the same weighted decision matrix used in the TOPSIS stage. After the concordance and discordance matrices had been calculated and the thresholds of $\lambda = 0.60$ and $\delta = 0.40$ had been applied, the final outranking matrix was constructed. Table 5 presents the strength, weakness, net, and final ranking scores for each candidate.

Table 5

Candidate Scores and Rankings Obtained Through Fuzzy ELECTRE

Candidate	Strength Score	Weakness Score	Net Score	Rank
A1	3	2	+1	3
A2	4	0	+4	1
A3	3	2	+1	2*
A4	1	3	−2	4
A5	0	4	−4	5

Table 5 demonstrates a clear pattern. A2 ranked first with a net score of +4 and was not outranked by any other candidate, as reflected in its weakness score of 0. A5 occupied the lowest position with a net score of −4. It is noteworthy that the total strength score, 11, was equal to the total weakness score, 11, confirming the internal consistency of the outranking matrix.

To assess the degree of consistency between the two independent ranking methods, each candidate's fuzzy TOPSIS and fuzzy ELECTRE ranks were extracted, and the difference between the two ranks, d_i, was calculated. As shown in Table 6, all five candidates obtained exactly the same rank under both methods, with $d_i = 0$for every candidate. Candidate A2 ranked first, A3 ranked second, A1 ranked third, A4 ranked fourth, and A5 ranked fifth under both methods.

Table 6

Comparison of the Final Rankings Produced by the Two Methods

Candidate	Fuzzy TOPSIS Rank	Fuzzy ELECTRE Rank	Rank Difference (d_i)	d_i^2
A1	3	3	0	0
A2	1	1	0	0
A3	2	2	0	0
A4	4	4	0	0
A5	5	5	0	0

$$\sum d_i^2 = 0$$

Spearman's rank correlation coefficient was calculated as follows:

$$\rho = 1 - \frac{6 \times 0}{5 \times 24} = 1.000$$

The value of $\rho = 1.000$represents the highest possible degree of rank-order correlation and indicates that the two methods produced completely identical results despite their fundamentally different mathematical logics. The perfect correlation between two methods based on different principles—TOPSIS on distance from the ideal solution and ELECTRE on pairwise outranking—demonstrates the high internal consistency of the model. From a validation perspective, this complete convergence provides strong evidence that the resulting ranking was attributable to the appropriate structure and weighting of the model rather than to chance or the methodological sensitivity of a particular technique. In other words, the final result would have remained unchanged had either method been used independently, thereby confirming the methodological robustness of the proposed model.

To evaluate the stability of the model, the weight assigned to "knowledge and expertise," designated as C1, was modified under four scenarios. Table 7 presents the complete results.

Table 7

Sensitivity Analysis Results Following Changes in the Weight of Knowledge and Expertise

Scenario	C1	C2	C3	C4	C5	A1 Rank	A2 Rank	A3 Rank	A4 Rank	A5 Rank
Baseline	0.283	0.245	0.215	0.142	0.115	3	1	2	4	5
−20%	0.226	0.264	0.232	0.153	0.124	3	1	2	4	5
−10%	0.255	0.255	0.223	0.148	0.120	3	1	2	4	5
+10%	0.311	0.235	0.207	0.136	0.110	3	1	2	4	5
+20%	0.340	0.226	0.198	0.131	0.106	3	1	2	4	5

As shown in Table 7, none of the candidates' rankings changed under any of the four scenarios. Figure 5 visually illustrates this complete stability.

4. Discussion and Conclusion

The present study was conducted to design and validate an integrated fuzzy multi-criteria decision-making model for selecting organizational managers in the Pars Special Economic Energy Zone Organization. The findings showed that the managerial selection problem could be represented through five main criteria and 22 subcriteria identified and confirmed by organizational and industry experts. The five main dimensions were knowledge and expertise, managerial skills, personality traits, work experience and professional background, and vision and attitude. The high Kendall's coefficient of concordance obtained in the second fuzzy Delphi round indicated substantial agreement among the participating experts regarding the relevance and importance of the identified criteria. This finding suggests that, despite the multidimensional and context-dependent nature of managerial competence, a relatively coherent expert consensus can be achieved when the selection problem is structured systematically and linguistic judgments are modeled through fuzzy logic. The result is consistent with the broader use of fuzzy methods for eliciting and aggregating managerial judgments under conditions of ambiguity and uncertainty (Rezaei & Hemati, 2023).

Among the main criteria, knowledge and expertise received the greatest fuzzy AHP weight, followed by managerial skills, personality traits, work experience and professional background, and vision and attitude. This ordering indicates that experts regarded sector-specific knowledge and technical competence as the most fundamental requirements for managerial effectiveness in the Pars Special Economic Energy Zone. This result is understandable in view of the technological complexity, safety sensitivity, regulatory density, and capital intensity of the oil, gas, and petrochemical industries. Managers in this context are expected to understand operational processes, project and contract management, relevant laws and regulations, health, safety, and environmental standards, and risk and crisis management. Deficiencies in these areas may directly affect operational continuity, accident prevention, environmental compliance, project performance, and organizational accountability. The priority assigned to knowledge and expertise therefore reflects the high-risk and technically specialized nature of the study setting rather than a general preference for technical qualifications over all other managerial characteristics.

This finding aligns with previous studies that have emphasized the importance of technical, operational, and regulatory criteria in decision-making within the oil, gas, and petrochemical sectors. Evaluations of contractors, suppliers, and industrial alternatives in these sectors have consistently shown that technical capability, industry knowledge, quality standards, safety performance, and operational competence occupy central positions in multi-criteria assessment models (Hsieh, 2014; Vazirizadeh et al., 2017; Wang et al., 2018; Zare Mehrjerdi et al., 2014). Although these studies addressed contractors, suppliers, or outsourcing decisions rather than managerial appointment, their findings support the view that decision alternatives in energy-sector organizations cannot be assessed independently of specialized technical competence. The present study extends this logic to managerial selection by demonstrating that managerial candidates must be evaluated not only as general administrators but also as decision-makers embedded in a technically demanding and safety-critical industrial system.

At the subcriterion level, familiarity with HSE standards received the highest importance score among all 22 subcriteria. This result is particularly significant because health, safety, and environmental performance constitute fundamental dimensions of organizational legitimacy and operational sustainability in the energy sector. Managerial decisions may influence workplace safety culture, emergency preparedness, compliance with environmental requirements, risk reporting, maintenance priorities, and the allocation of resources to preventive measures. The high importance assigned to HSE knowledge suggests that experts viewed managerial competence partly in terms of the ability to prevent severe operational and environmental consequences. This finding also confirms that the selection of managers in hazardous industries should incorporate safety-oriented competencies explicitly rather than assuming that they are indirectly represented by general experience or technical education.

The prioritization of HSE familiarity is compatible with industrial MCDM research in which safety, environmental responsibility, technical compliance, and risk management have been treated as essential evaluation dimensions. Studies in petrochemical contractor selection and oil and gas supply-chain evaluation have shown that decisions based exclusively on cost or general performance are inadequate because they fail to account for the potentially severe consequences of safety and environmental deficiencies (Hsieh, 2014; Wang et al., 2018). Similarly, research on outsourcing heavy transportation activities in Iran's oil, gas, and petrochemical industries has demonstrated the need to incorporate multiple operational and risk-related criteria into decision models (Vazirizadeh et al., 2017). The present findings indicate that the same principle applies to managerial appointments: technical and safety competencies should be explicitly assessed and weighted because their absence cannot be fully compensated for by strengths in less critical areas.

Managerial skills formed the second most important main criterion. Within this dimension, decision-making under crisis conditions obtained the highest importance score, followed by communication and interdepartmental coordination, problem-solving and strategic thinking, team leadership, and negotiation and conflict management. These results reflect the nature of managerial work in volatile and operationally interdependent environments. Managers in energy organizations must frequently make decisions under time pressure, coordinate specialized departments, reconcile competing operational priorities, communicate with technical and administrative stakeholders, and respond to unexpected disruptions. The prominence of crisis decision-making is therefore consistent with the need for managerial cognition that remains effective under uncertainty and complexity.

The importance of crisis decision-making, problem-solving, and strategic thinking is strongly supported by research on leadership and decision-making in volatile, uncertain, complex, and ambiguous environments. Effective managers in such contexts require advanced cognitive capacities, including the ability to interpret incomplete information, identify emerging risks, compare alternatives, and select timely courses of action (Hafeznia & Ansari, 2025). These competencies are particularly important in the energy sector, where operational emergencies, regulatory changes, technological failures, market instability, and external political or economic pressures may occur simultaneously. The present results therefore reinforce the proposition that managerial selection should move beyond conventional indicators such as tenure and educational credentials and directly assess candidates' cognitive and decision-making capacities.

The high weighting of communication and interdepartmental coordination also reflects the organizational structure of large industrial systems. The Pars Special Economic Energy Zone includes multiple organizational units, contractors, technical departments, regulatory actors, and stakeholder groups whose activities are highly interdependent. In such a setting, managerial performance depends on the ability to establish coordination across professional boundaries and to translate strategic objectives into integrated operational action. Research conducted in the Pars Special Economic Energy Zone has indicated that perceived organizational support, distributive justice, person–organization fit, and motivational mechanisms influence employees' innovative work behavior (Alizadeh Majd et al., 2022). These organizational conditions are shaped partly through managerial communication and coordination. Managers who communicate expectations clearly, allocate resources fairly, and create supportive relationships may therefore contribute indirectly to innovation, commitment, and organizational effectiveness.

Personality traits constituted the third most important main criterion, with justice orientation and fairness receiving the highest importance within this category. Psychological stability and stress management, accountability and organizational commitment, honesty and integrity, and creativity and innovation were also retained as important subcriteria. These results demonstrate that the experts did not conceptualize managerial competence merely as a combination of knowledge and technical skill. Instead, they recognized that the exercise of managerial authority is influenced by personal and ethical qualities that shape how decisions are made, how employees are treated, and how organizational resources are distributed. The prominence of justice orientation is especially meaningful because managerial decisions frequently involve promotions, assignments, rewards, disciplinary actions, workload distribution, and access to developmental opportunities.

The importance assigned to justice, honesty, and accountability is consistent with research emphasizing the ethical foundations of managerial decision-making. Political skill can enhance a manager's ability to influence others, build coalitions, and navigate organizational relationships, but its organizational value depends on whether it is exercised within an ethical framework (Tamimi et al., 2025). In the absence of fairness and integrity, managerial influence may generate distrust, perceptions of favoritism, and reduced organizational commitment. The present findings suggest that ethical and personality-related criteria should be treated as central components of managerial selection rather than as supplementary considerations evaluated only after technical qualifications have been established.

The emphasis on justice orientation also corresponds with evidence from the Pars Special Economic Energy Zone showing that distributive justice and perceived organizational support are associated with positive employee outcomes, including innovative work behavior (Alizadeh Majd et al., 2022). A manager's fairness in distributing opportunities, recognition, resources, and responsibilities may shape employees' willingness to contribute ideas and engage in discretionary behavior. Therefore, selecting managers with a strong orientation toward fairness may have consequences beyond employee satisfaction; it may also support innovation, trust, and organizational adaptability.

Work experience and professional background ranked fourth among the main criteria. Managerial experience in the oil and gas industry was the most important subcriterion in this domain, followed by experience managing similar projects, collaboration with international organizations, and completion of accredited managerial training programs. The lower relative weight of experience compared with knowledge, managerial skills, and personality traits suggests that experts did not view seniority alone as sufficient evidence of managerial suitability. Experience was considered valuable when it was relevant to the industry and comparable managerial responsibilities, but it did not replace the need for current technical knowledge, effective decision-making, ethical characteristics, and strategic capacity.

This result is important because many organizational appointment systems rely heavily on years of service or previous position titles. The findings of the present study imply that experience should be interpreted as one component within a broader competency structure. A candidate may have extensive tenure but limited capacity for crisis decision-making, communication, innovation, or employee development. Conversely, a candidate with somewhat less experience may demonstrate stronger competencies across more heavily weighted criteria. This multidimensional perspective is consistent with contemporary employee-selection research, which recommends combining experience indicators with competency, behavioral, motivational, and contextual criteria (Amiri et al., 2025). It is also consistent with fuzzy models for selecting managers and principals, in which candidate suitability is determined through the combined evaluation of several competency dimensions rather than a single career-history measure (Asari et al., 2018; Kelemenis et al., 2011).

Vision and attitude received the lowest weight among the five main criteria, although all three of its subcriteria remained above the fuzzy Delphi acceptance threshold. Attention to sustainable development, willingness to empower and develop subordinates, and familiarity with global developments in the energy industry were therefore considered relevant but comparatively less decisive than immediate technical, managerial, personality, and experiential competencies. This does not mean that strategic orientation was unimportant. Rather, it suggests that experts may have regarded vision-related competencies as valuable only when supported by adequate technical and managerial foundations. In a safety-critical industrial environment, broad strategic awareness cannot compensate for deficiencies in operational knowledge or crisis-management capability.

The inclusion of sustainable development in the final model nevertheless demonstrates growing recognition of environmental and long-term organizational responsibilities. Performance in the petrochemical sector must increasingly be aligned with upstream policy documents, sustainability priorities, and broader industrial development requirements (Azimi et al., 2025). Managers are expected to balance economic performance with environmental obligations and long-term resource considerations. The retention of this criterion therefore broadens the concept of managerial competence beyond short-term operational outcomes and incorporates responsibility for sustainable organizational development.

The inclusion of employee empowerment also accords with research on coaching-oriented managerial roles in petrochemical organizations. Managers who adopt a developmental approach may strengthen employee learning, communication, professional growth, and organizational capacity (Zeraatpisheh et al., 2025). Similarly, dynamic capabilities and innovation have been identified as important contributors to organizational performance in the Pars Special Economic Energy Zone (Zolfaghari et al., 2021). Empowering subordinates and supporting innovation can help organizations respond to environmental changes and renew their capabilities. The relatively lower weight assigned to vision and attitude should therefore be interpreted as a prioritization decision within the selection hierarchy, not as evidence that developmental or strategic competencies are dispensable.

The fuzzy TOPSIS results ranked Candidate A2 first, followed by A3, A1, A4, and A5. Candidate A2 had the shortest distance from the fuzzy positive ideal solution and the greatest distance from the fuzzy negative ideal solution. This indicates that A2 exhibited the most balanced overall performance across the weighted criteria rather than necessarily achieving the highest score on every individual dimension. The aggregated decision matrix showed that A2 performed particularly strongly in knowledge and expertise and work experience, while also demonstrating high managerial skills and strategic orientation. Given that knowledge and expertise and managerial skills together accounted for more than half of the total criterion weight, strong performance in these dimensions substantially improved A2's overall closeness coefficient.

The results also showed that no candidate dominated all five main dimensions. A3 performed best in managerial skills, while A4 was strongest in personality traits. This confirms the necessity of a multi-criteria framework because candidate strengths were distributed unevenly across the model. A selection process based solely on one dimension would have produced a different preferred candidate. For example, an exclusive emphasis on managerial skills might have favored A3, whereas an exclusive emphasis on personality traits might have favored A4. Fuzzy TOPSIS resolved these trade-offs by evaluating each candidate relative to the weighted ideal profile. This result is consistent with prior applications of fuzzy TOPSIS to managerial and industrial selection problems, where the method has been used to integrate conflicting qualitative and quantitative criteria into an overall ranking (Kelemenis et al., 2011; Wang et al., 2018).

The fuzzy ELECTRE analysis produced exactly the same final ranking as fuzzy TOPSIS. Candidate A2 achieved the highest net outranking score and was not defeated by any other candidate, whereas A5 obtained the lowest net score. A1 and A3 had equal net scores, but A3 ranked higher because of its superior fuzzy TOPSIS closeness coefficient under the predetermined tie-breaking rule. The agreement between the methods is particularly important because they are based on different decision principles. Fuzzy TOPSIS is primarily distance-based and comparatively compensatory, whereas fuzzy ELECTRE is based on pairwise outranking, concordance, and discordance. The convergence of the two rankings indicates that the superiority of A2 was sufficiently robust to appear under both analytical frameworks.

This finding aligns with the rationale for hybrid MCDM applications in complex industrial decisions. Combining methods can reduce dependence on the assumptions of a single technique and provide stronger evidence for the stability of the final decision (Vazirizadeh et al., 2017; Zare Mehrjerdi et al., 2014). The perfect Spearman rank correlation obtained in this study indicates complete rank-order consistency. Such convergence supports the internal validity of the model because the candidate ordering was preserved despite the use of methods with different mathematical structures. It also increases the model's practical credibility, as decision-makers may be more willing to accept a ranking that is confirmed through more than one analytical procedure.

The sensitivity analysis further demonstrated that the model was highly stable. Decreasing or increasing the weight of knowledge and expertise by 10% or 20%, while proportionally redistributing the remaining criterion weights, did not alter the rank of any candidate. Candidate A2 remained first, A3 second, A1 third, A4 fourth, and A5 fifth in all scenarios. This result indicates that the final ranking was not excessively dependent on the precise weight assigned to the most important criterion. Instead, it reflected the candidates' broader performance patterns across the full set of criteria.

The stability observed in the sensitivity analysis is an important indicator of methodological robustness. MCDM rankings may become unreliable when small changes in weights produce large changes in results. In the present study, the unchanged rankings suggest that differences among the candidates were sufficiently pronounced and distributed across multiple criteria. This finding is compatible with previous industrial MCDM studies that emphasize the importance of validating rankings against changes in criterion weights and analytical assumptions (Hsieh, 2014; Wang et al., 2018). Taken together, the Delphi consensus, acceptable consistency ratios, identical TOPSIS and ELECTRE rankings, perfect rank correlation, and stable sensitivity results provide cumulative support for the coherence and reliability of the proposed model.

The study had several limitations. First, the expert panel was limited to 18 senior and middle managers and oil and gas industry specialists associated with a specific organizational and industrial context. Although this sample size was appropriate for fuzzy Delphi and fuzzy AHP analysis, the experts' judgments may reflect the priorities, organizational culture, and operational conditions of the Pars Special Economic Energy Zone and may not be directly transferable to other industries or administrative environments. Second, the criterion weights were based on expert judgments and therefore remained partly subjective despite the use of fuzzy methods to manage uncertainty. Third, the operational validation involved five coded candidates evaluated by three senior decision-makers, which limited the diversity of candidate profiles and evaluator perspectives. Finally, the study focused primarily on the internal consistency and methodological stability of the model and did not examine the long-term predictive validity of the rankings in relation to subsequent managerial performance.

Future studies should validate the proposed model using larger and more diverse samples of managers, experts, and decision-makers from different energy organizations and geographical regions. The model could also be compared across oil, gas, petrochemical, renewable-energy, and nonenergy organizations to determine which criteria are context-specific and which have broader applicability. Longitudinal studies should examine whether candidates who receive higher model-based rankings subsequently demonstrate superior performance in safety, productivity, employee development, innovation, project completion, and environmental outcomes. Future researchers may also integrate objective performance indicators, psychological assessments, assessment-center results, and structured behavioral interviews into the fuzzy decision framework. Additional MCDM methods, such as fuzzy VIKOR, DEMATEL, ANP, or best–worst method, could be used to test the effects of interdependence among criteria and to compare the stability of alternative weighting and ranking procedures.

Organizations operating in the oil, gas, and petrochemical sectors should replace predominantly informal managerial appointment procedures with standardized, documented, and multi-stage selection systems. The five main criteria and 22 subcriteria identified in this study can be incorporated into competency frameworks, structured interviews, assessment centers, succession-planning systems, and managerial development programs. Selection committees should include both technical and human resource experts, use predefined linguistic rating scales, and document the rationale for criterion weights and candidate evaluations. Organizations should also review the weighting structure periodically to ensure that it remains aligned with technological changes, environmental requirements, strategic priorities, and emerging leadership needs. The model may additionally be used diagnostically to identify candidates' developmental needs and to design targeted training in HSE, crisis decision-making, strategic thinking, communication, ethical leadership, and employee empowerment.

Authors' Contributions

Authors contributed equally to this article.

Declaration

In order to correct and improve the academic writing of our paper, we have used the language model ChatGPT.

Transparency Statement

Data are available for research purposes upon reasonable request to the corresponding author.

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