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A Multi-Criteria Decision-Making Framework Based on the PROMETHEE Method for Selecting Support Service Providers in Governmental Organizations (Case Study: Foundation of Martyrs and Veterans Affairs)

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Abstract

In the digital era, information technology support services serve as the backbone of organizational processes and play a vital role in ensuring the continuity of operations within public institutions. The Foundation of Martyrs and Veterans Affairs, as an organization dedicated to serving the veteran community, has become increasingly dependent on stable and secure information systems. However, selecting an appropriate contractor for maintaining these systems represents a complex challenge due to the diversity of evaluation criteria, budgetary constraints, and governmental compliance requirements. Traditional tender evaluation methods are often one-dimensional and incapable of effectively resolving conflicts among cost, quality, risk, and legal compliance considerations. Multi-Criteria Decision-Making (MCDM) approaches provide an innovative solution to this issue; nevertheless, their application within the Iranian public sector, particularly in the domain of IT support services, remains limited. The present study aims to design a decision-making framework based on the Preference Ranking Organization Method for Enrichment Evaluations (PROMETHEE) method for selecting IT maintenance service contractors in public organizations. Initially, 42 sub-criteria were identified across six principal dimensions. Subsequently, through three rounds of the Delphi method involving 15 experts, these were reduced to 20 final criteria. A hybrid weighting approach combining expert judgment and Shannon entropy identified service quality, technology, and economic factors as the highest-priority dimensions. Five contractors were then ranked using the PROMETHEE II method. The robustness of the proposed model was confirmed through sensitivity analysis, Geometrical Analysis for Interactive Aid (GAIA) analysis, and complete correlation with the SAW method. The proposed framework addresses the lack of indigenous methodologies in the governmental sector and provides a practical tool for risk reduction and cost optimization. By integrating the Delphi method, hybrid weighting techniques, and multi-layer validation procedures, the model offers an operational instrument for governmental decision-makers to achieve transparent, sustainable, and optimal contractor selection. The findings facilitate targeted contractor selection and support sustainable policy-making.

Keywords: Multi-criteria decision-making, Preference ranking organization method for enrichment evaluations method, Supplier selection, Support services, Delphi method.

1 | Introduction

In recent years, governmental organizations have encountered increasing challenges in selecting support service providers [1]. These challenges arise from the diversity of decision-making criteria, including cost, service quality, reliability, and compliance with governmental regulations [2]. Studies indicate that traditional

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supplier selection methods, such as price-oriented tenders, often result in suboptimal choices [3]. This issue is particularly significant in the field of support services, where service quality plays a critical role [4]. Given the inherent complexity of decision-making in governmental organizations and the existence of conflicting qualitative and quantitative criteria, the need for developing systematic decision-making frameworks has become increasingly evident [5]. In this context, Multi-Criteria Decision-Making (MCDM) methods have emerged as effective tools for solving complex supplier selection problems [6].

Governmental organizations face fundamental challenges in the process of selecting support service providers. Conventional approaches, such as lowest-price tenders, focus unilaterally on financial criteria while neglecting other critical dimensions of service quality [7]. This one-dimensional perspective leads to the selection of suppliers who may appear cost-effective but often demonstrate poor performance in qualitative criteria [8].

Despite numerous studies conducted in the field of supplier selection, a review of the literature reveals that most existing research has focused on the private sector and has failed to consider the specific requirements of governmental organizations [2]. Furthermore, although traditional MCDM methods such as Analytic Hierarchy Process (AHP) and Technique for Order Preference by Similarity to Ideal Solution (TOPSIS) have proven useful, they are insufficient for addressing the problem of selecting support service providers comprehensively. Recent studies have shown that the Preference Ranking Organization Method for Enrichment Evaluations (PROMETHEE) method, due to its unique characteristics, can provide a suitable alternative for such problems [9]. This method allows for the simultaneous consideration of both qualitative and quantitative criteria and offers considerable flexibility in defining preference functions [10]. Nevertheless, the application of this method in the context of support services within governmental organizations has not been sufficiently investigated [11], [12]. Moreover, inadequate attention to the specific conditions of governmental organizations and the necessity of considering criteria such as compliance with governmental regulations, security requirements, and budgetary limitations have created the need for a dedicated framework [2].

The present study seeks to transform the traditional paradigm of supplier selection by proposing an innovative framework based on the PROMETHEE method that can contribute to the theoretical foundations of supply management in the public sector. By leveraging organizational intelligence, the proposed model enables the extraction of valuable insights from dispersed data and supports strategic decision-making. Through the establishment of an integrated evaluation system, this research develops the theoretical infrastructure required for achieving data-driven governance at the macro level of the national administrative system. In alignment with national digital transformation policies, the present study also provides an appropriate platform for the digitalization of supplier selection processes. The designed system, through objective and documented mechanisms, constitutes an effective step toward enhancing transparency and reducing administrative corruption. Under conditions of limited national resources, the model improves the efficiency of the selection process, thereby optimizing public expenditures and generating added value for the country's administrative system.

By integrating advanced MCDM theories with the practical realities of the governmental sector, this study contributes to the development of indigenous public management knowledge. Supplier selection extends beyond a simple operational decision and constitutes a strategic process that influences the long-term performance and sustainability of organizations; therefore, attention to diverse approaches and the development of scientific frameworks in this field are essential [13].

The primary objective of this study is to propose a PROMETHEE-based MCDM framework for the selection and ranking of information technology support service providers in governmental organizations (Case Study: Foundation of Martyrs and Veterans Affairs).

Accordingly, the main objectives pursued in this research are as follows:

I. Identifying and weighting the effective criteria in selecting support service providers.

II. Determining criterion weights through a combination of expert judgment and Shannon entropy.

III. Ranking suppliers using the PROMETHEE method.

IV. Validating the results through sensitivity analysis, Geometrical Analysis for Interactive Aid (GAIA) analysis, and comparison with TOPSIS and SAW methods.

Considering the existing challenges in the process of selecting support service providers in governmental organizations, this study seeks to answer the following fundamental research question:

How can a PROMETHEE-based MCDM framework be designed to efficiently and effectively enable the optimal selection of support service providers in governmental organizations?

2 | Literature Review

Given the significant role of support services in ensuring the efficiency, effectiveness, and quality of activities within governmental organizations, a precise understanding of the related concepts, key indicators, and decision-making optimization methods is essential. Support services in such organizations encompass administrative, technical, information technology, healthcare, and welfare domains, each associated with a distinct set of requirements and challenges. Supplier selection is a complex multi-criteria process that, in addition to financial considerations, includes qualitative indicators such as service quality, flexibility, technical expertise, and the ability to comply with governmental regulations.

Supplier selection, as one of the critical processes in governmental organizational management, plays a fundamental role in ensuring service quality, reducing costs, and enhancing operational efficiency [14]. This process extends beyond a purely financial decision and requires consideration of a set of qualitative, quantitative, and organizational criteria [15]. Support service providers, particularly in governmental organizations, have a direct impact on workforce productivity, stakeholder satisfaction, and the reliability of operational processes [16]. Therefore, selecting appropriate suppliers contributes significantly to organizational capability in achieving strategic objectives and improving overall performance [17]. Indeed, organizational success in delivering services to stakeholders and clients largely depends on the effective performance of suppliers, and any inappropriate selection may result in serious consequences regarding costs, service quality, and customer satisfaction [14].

Due to the presence of numerous and diverse factors, the supplier selection process inherently possesses a multi-criteria nature [18]. These factors include financial criteria, performance quality, adaptability to organizational requirements, reliability, flexibility, and supplier technical expertise [19].

In addition to the aforementioned indicators, criteria such as sustainability, social responsibility, and adherence to ethical standards are also important in supplier selection. Governmental organizations, owing to their public-service nature, require suppliers who demonstrate commitment to ethical principles, transparency, and accountability [20]. These indicators not only influence the organization's reputation and image but also contribute to long-term collaboration and the reduction of legal and social risks [21]. Consequently, comprehensive supplier evaluation should incorporate performance, qualitative, financial, and ethical indicators to ensure balanced and effective decision-making [22].

Supplier selection is a complex and multi-criteria process that influences organizational success in service delivery and the achievement of strategic objectives [18]. The use of comprehensive indicators, consideration of both quantitative and qualitative criteria, application of scientific weighting procedures, risk analysis, and supplier performance evaluation constitute key factors in this process [18]. Designing a coherent and scientific framework for supplier selection provides a foundation for improving service quality, reducing costs, increasing stakeholder satisfaction, and enhancing organizational productivity, ultimately contributing to the sustainability and sustainable development of governmental organizations [23].

The supplier selection process represents one of the most significant challenges faced by governmental organizations, and decision-making in this area requires a comprehensive understanding of various approaches and methods capable of assisting managers in identifying and evaluating the best alternatives [15]. Existing approaches to supplier selection can generally be classified into four major categories: traditional methods, analytical approaches, MCDM models, and intelligent approaches based on modern technologies [24]. Each of these approaches possesses specific characteristics, advantages, and limitations, and their applications vary depending on the type of service, the complexity level of the organization, and strategic objectives [25].

MCDM models have gained the widest application in this field due to their high flexibility and ability to integrate diverse criteria. Recent studies have emphasized the extensive use of these methods in governmental organizations and support services [20]. MCDM and intelligent approaches are capable of managing uncertainties and producing reliable and well-justified decision outcomes [26]. In this context, methods that enable ranking, simulation, and scenario analysis have achieved greater applicability [27].

MCDM is considered one of the key tools in managing the complexity of both governmental and private organizations, as it enables the analysis and selection of alternatives based on multiple and sometimes conflicting criteria [28]. In many real-world problems, decision-makers encounter alternatives for which none is optimal from all perspectives, and selection based solely on a single criterion, such as cost or delivery time, cannot provide a comprehensive and effective outcome [29].

One of the most significant features of MCDM is its ability to manage conflicts among criteria. Typically, cost reduction may conflict with service quality improvement, while increasing delivery speed may reduce the ability to provide stable and high-quality services [30]. Such conflicts require careful analysis and appropriate weighting of each criterion to ensure that the final decision aligns as closely as possible with the overall objectives of the organization [31].

Various MCDM methods have been developed, each characterized by distinct approaches and techniques with their own advantages and limitations [32]. Among the most widely used methods are AHP, TOPSIS, VIsekriterijumska Optimizacija I Kompromisno Resenje (VIKOR), ELimination Et Choix Traduisant la REalité (ELECTRE), and PROMETHEE [18]. By employing mathematical models, ranking algorithms, and preference functions, these methods facilitate systematic comparison among alternatives and determine the best option or optimal combination of alternatives [33].

MCDM plays a critical role in supplier selection because this process involves multiple criteria that must be evaluated simultaneously [18]. Criteria such as cost, service quality, flexibility, responsiveness, user satisfaction, and regulatory compliance all influence decision-making, and MCDM methods enable these criteria to be analyzed comprehensively [34].

Another important aspect of MCDM is its capability to integrate the perspectives of multiple decision-makers [35]. In governmental organizations, decision-making processes typically involve groups of managers and experts with differing viewpoints [29]. The use of MCDM methods facilitates the integration of these perspectives, promotes consensus-building, and reduces conflicts in decision-making [35]. Consequently, the final decision is not only scientific and well-justified but also supported and accepted by all stakeholders [36].

Fujita [37], in a study on fuzzy and super-hyper-fuzzy PROMETHEE methods for MCDM in IT service management, investigated three PROMETHEE-based decision-making approaches under uncertainty conditions: fuzzy PROMETHEE, which employs fuzzy numbers and Yager's index to calculate outranking flows; hyper-fuzzy PROMETHEE, which applies midpoint defuzzification to fuzzy evaluations and uses standard PROMETHEE functions; and nnn-SuperHyperFuzzy PROMETHEE, which extends to nested fuzzy structures over power sets of level nnn through recursive defuzzification and hierarchical preference aggregation. The application of these approaches in IT service management was also examined.

Agrawal [38] investigated MCDM for supplier selection. In this study, three case studies were solved using the PROMETHEE II approach. The research also provided significant insights into supplier ranking based on different criteria through sensitivity analysis. Furthermore, criteria were classified into benefit and cost categories to obtain robust results. The advantages and disadvantages of PROMETHEE II in comparison with other MCDM tools were also highlighted.

Akram et al. [39], in a study entitled "group MCDM for green supplier selection under bipolar fuzzy PROMETHEE", examined the supplier selection problem. Comparable results were obtained using combinations of linear and level preference functions. The results derived from different preference functions were identical, demonstrating the validity of the proposed bipolar fuzzy PROMETHEE approach.

Liu et al. [40] conducted a systematic review of the green supplier selection literature using the PRISMA methodology. They classified all models according to their solution methods, including distance-based methods, compromise methods, preference-based methods, pairwise comparison methods, mathematical programming methods, aggregation operator-based methods, value and utility methods, hybrid methods, integrated supplier selection and order allocation approaches, and other green supplier selection techniques.

Goodarzi and Gholamian [41] investigated green supplier selection using a novel group decision-making cloud-PROMETHEE approach in a petroleum products manufacturing company. The final results were successfully presented through preference graphs, providing managers with valuable insights for supplier evaluation. The proposed model effectively combined the advantages of PROMETHEE, including the integration of quantitative and qualitative data, selection of preference functions, independent weighting, and elimination of normalization requirements, while simultaneously addressing decision-making ambiguity through the cloud model.

Hosseinpour and Mahmoudabadi [42] proposed a MCDM method for selecting the best supplier in the supply chain based on the joint opinions of suppliers and employers (Case Study: Selection of the Best University Website Design Company). In their study, criteria were identified through combined perspectives of employers and suppliers, as well as expert interviews. Thus, suppliers' perspectives were also considered an important criterion in selecting the most appropriate company for the employer. Subsequently, after identifying the criteria extracted from the shared perspectives of employers and suppliers, the Fuzzy Analytic Hierarchy Process (FAHP) was used to weight the criteria. Finally, ten website design companies were evaluated and ranked using the TOPSIS method.

Heydari Dehoui [43] proposed a hybrid MCDM model for selecting knowledge management outsourcing providers. The results indicated that among the causal factors, the quality criterion exerted the greatest overall effect on the system while receiving the least influence from other factors, implying that these factors functioned as driving variables. Moreover, the criterion of organizational specialized characteristics was strongly influenced by other factors and improved through optimization of those factors. According to the results of the Fuzzy Analytic Network Process (FANP), experience, with an effective weight of 0.30773, was identified as the most important criterion, whereas organizational culture, with an effective weight of 0.02716, was the least significant sub-criterion. The criteria of economic and financial considerations, organizational specialized characteristics, services, technology, quality, operational capacity, organizational general characteristics, and organizational culture were subsequently ranked according to their weights. As a practical outcome of the study, the results of the fuzzy Delphi and DEMATEL methods were utilized in the case study, where two knowledge management provider companies were evaluated. Based on the final ranking, Nedak Engineering Consulting Company achieved a higher rank.

3 | The PROMETHEE Multi-Criteria Decision-Making Method

The PROMETHEE method is one of the most widely used and recognized MCDM methods, which has gained a distinguished position in the analysis and ranking of alternatives in complex and multidimensional problems [31]. Due to its high flexibility, capability to simultaneously process qualitative and quantitative criteria, and practical simplicity, this method has been applied in various domains, including supplier selection, supply chain management, project evaluation, and human resource planning [44].

PROMETHEE is based on pairwise comparisons of alternatives and the determination of preference relations among them. By employing preference functions and criterion weighting, it enables systematic ranking of alternatives [45]. These characteristics allow decision-makers to make transparent, documented, and defensible decisions [38].

One of the most important applications of PROMETHEE lies in supplier selection and supply chain management. In this context, suppliers are evaluated based on a set of criteria, including cost, service quality, on-time delivery capability, operational flexibility, user satisfaction, and regulatory compliance [44]. Using PROMETHEE, each supplier can be compared pairwise with other suppliers, and through the calculation of positive and negative outranking flows, an accurate ranking can be obtained [29]. This process facilitates the selection of suppliers that exhibit the highest compatibility with organizational objectives, legal constraints, and the need to respond to multiple stakeholders. Such capabilities are particularly important in governmental organizations and support data-driven and scientifically grounded decision-making [45].

PROMETHEE also enables decision-makers to identify alternatives that are close to one another and, when necessary, to consider combining or improving alternatives. This capability is particularly important in supplier selection, where several suppliers may perform similarly with respect to key criteria, thus requiring careful analysis of their relative strengths and weaknesses [46]. By providing comprehensive information and a clear representation of the relative performance of alternatives, PROMETHEE enables decision-makers to select the best alternative or the optimal combination of alternatives.

The PROMETHEE method constitutes a powerful and flexible tool for decision-making in multi-criteria problems, enabling comprehensive evaluation of alternatives, management of conflicts among criteria, integration of multiple viewpoints, sensitivity analysis, and uncertainty management [44]. This method is applicable in supplier selection, supply chain management, and other complex issues faced by governmental organizations, allowing managers to make scientific, well-justified, transparent, and defensible decisions [47]. The use of PROMETHEE enhances decision quality, reduces risks, improves performance, and increases organizational efficiency, thereby providing a foundation for strategic and continuous decision-making in governmental organizations [44].

Assume that A denotes the set of alternatives from which a selection must be made. Given the existence of K criteria influencing the decision-making process, for each alternative $a \in A$, the value $f_i(a)$ represents the performance of alternative a with respect to the j criterion. The ranking procedure is performed in three stages:

Step 1. A preference function P_j is assigned to each criterion j. The value of $P_j(a,b)$ is calculated for every pair of alternatives. This value varies between 0 and 1. If the relation $f_i(a) = f_i(b)$ holds, then $P_j(a,b) = 0$. As the difference $f_i(a) - f_i(b)$ increases, the value of $P_j(a,b)$ also increases, and when the difference becomes sufficiently large, $P_j(a,b)$ approaches 1.

Different forms may be assumed for the preference function P_j depending on how the j-th criterion is modeled. The PROMETHEE method proposes six generalized preference functions for decision-makers: the usual criterion, U-shape criterion, V-shape criterion, level criterion, V-shape criterion with indifference region, and Gaussian criterion. Furthermore, for each criterion f_i a weighting factor w_j is also considered.

Step 2. The overall preference index $\pi(a,b)$ for each alternative a over alternative b is calculated. The greater the value of $\pi(a,b)$ the stronger the preference for alternative a. The preference index $\pi(a,b)$ is computed as follows:

$$\pi(a.b) = \sum_{j=1}^{k} W_j P_j(a.b). \sum_{j=1}^{k} W_j = 1. \quad \textbf{(1)}$$

Step 3. The value $\pi(a,b)$ represents the degree of preference of alternative a over alternative b. To determine the overall preference strength of alternative a with respect to all other alternatives, the positive outranking flow is calculated according to *Eq. (2)*, also referred to as the outgoing flow:

$$\varphi^{+}(a) = \frac{1}{n-1}\Sigma_{x\in A}\pi(a.x). \tag{2}$$

This flow indicates the extent to which alternative a is preferred over the other alternatives. In fact, it represents the strength of alternative a. A larger value of $\varphi^{+}(a)$ indicates a better alternative.

The degree to which the other alternatives are preferred over alternative a, referred to as the negative flow or incoming flow, is calculated according to *Eq. (3)*, also known as the negative outranking flow:

$$\varphi^{-}(a) = \frac{1}{n-1}\Sigma_{x\in A}\pi(a.x). \tag{3}$$

This flow indicates the extent to which the other alternatives are preferred over alternative aaa. In fact, it represents the weakness of alternative a $\varphi^{-}(a)$. A smaller value of φ^{-}indicates a better alternative. Therefore, by separately analyzing the two flows φ^{-} and φ^{+} partial ranking can be obtained (PROMETHEE I ranking). However, to achieve a complete ranking of the alternatives, the net outranking flow for each alternative is defined according to *Eq. (4)* (PROMETHEE II ranking):

$$\varphi(\alpha) = \varphi^{+}(a) - \varphi^{-}(a). \tag{4}$$

The net outranking flow results from the balance between the positive and negative ranking flows. A higher net flow indicates a superior alternative. PROMETHEE defines meaningful and non-meaningful thresholds for pairwise differences between alternatives with respect to each criterion. In this way, small differences below a threshold q, which are likely to be due to random variation or indiscernibility, are ignored. On the other hand, for large differences exceeding a threshold p, any excess beyond p is not further rewarded; that is, when $(d > p = p)$, it is considered as p. In other words, differences greater than the preference threshold p do not provide additional advantage or score for an alternative under a given criterion. The preference values are normalized within the interval [0,1]. Based on this information, the decision-maker selects an appropriate preference function that transforms the difference between two alternatives into a preference degree ranging from 0 to 1. Since PROMETHEE treats each criterion independently at the initial stage of computation and does not assume any interdependence among criteria, obtaining a very high score in one criterion does not affect the performance of the alternative in other criteria. Therefore, an ideal alternative is one that achieves satisfactory performance across all criteria rather than excelling in only one. The evaluation matrix is the starting point of most multi-criteria evaluation methods, in which mmm alternatives (rows) are assessed against n criteria (columns). Let us consider two alternatives, a and b, belonging to the set of alternatives A, which are evaluated in a pairwise manner. For a and b in $(a,b)\in A$, we have:

$$\text{a p b if:}\begin{cases}\varphi^{+}(a) > \varphi^{+}(b) \quad \text{and} \quad \varphi^{-}(a) < \varphi^{-}(b)\,.\text{or}\\ \varphi^{+}(a) = \varphi^{+}(b) \quad \text{and} \quad \varphi^{-}(a) < \varphi^{-}(b)\,.\text{or}\\ \varphi^{+}(a) > \varphi^{+}(b) \quad \text{and} \quad \varphi^{-}(a) = \varphi^{-}(b)\,,\end{cases} \tag{5}$$

$$\text{a I b if:}\ \{\varphi^{+}(a) = \varphi^{+}(b) \quad \text{and} \quad \varphi^{-}(a) = \varphi^{-}(b), \tag{6}$$

$$\text{a R b if:}\begin{cases}\varphi^{+}(a) > \varphi^{+}(b) \quad \text{and} \quad \varphi^{-}(a) > \varphi^{-}(b)\,.\text{or}\\ \varphi^{+}(a) < \varphi^{+}(b) \quad \text{and} \quad \varphi^{-}(a) < \varphi^{-}(b)\,.\end{cases} \tag{7}$$

Here, P, I, and R denote preference, indifference, and incomparability between alternatives, respectively.

If any of the relations given in *Eq. (5)* hold, then alternative a is preferred to alternative b. *Eq. (6)* indicates that the positive and negative flows are equal, meaning there is no significant difference between alternatives a and b, and thus they are considered indifferent. When a R b holds, according to *Eq. (7)*, the dominance of one alternative is associated with the weakness of the other. In such a case, the information provided by the two flows is inconsistent, and the two alternatives are considered incomparable.

4 | Research Methodology

Given the complex nature of workforce optimization in governmental organizations, which requires the simultaneous consideration of structural, skill-based, technological, behavioral, and economic dimensions, a MCDM approach was adopted as the main paradigm of this study. This approach, due to its capability to assign weights to conflicting criteria and rank alternatives under uncertainty, is considered the most appropriate tool for transforming expert consensus into operational decision-making outcomes.

Since the main objective of this research is supplier selection, the study is classified as applied research in terms of purpose, and descriptive–survey research in terms of data collection method. The statistical population consists of senior managers, experts, and specialists in human resource management and organizational planning within the Foundation of Martyrs and Veterans Affairs (including the central headquarters in Tehran and provincial offices). These individuals are directly involved in strategic personnel decision-making processes, including employment policy formulation, training planning, and human resource allocation. This population was selected due to their access to strategic information, practical experience in dealing with public-sector workforce challenges (such as budget constraints, emotional pressures associated with serving veterans, and high turnover rates), and their ability to provide informed judgments on the multidimensional aspects of optimization.

The inclusion criteria for the expert panel were defined to ensure scientific and experiential validity as follows:

I. A minimum of 10 years of relevant work experience in human resource management, workforce planning, or organizational policy-making within the Foundation of Martyrs and Veterans Affairs or similar institutions.

II. A Master's or PhD degree in Management (Human Resources, Public Administration, Strategic Management), Industrial Engineering, Organizational Psychology, or related fields.

III. Active involvement in high-level human resource decision-making processes (such as membership in recruitment committees, training, succession planning, or strategic planning committees).

In this study, library research was first conducted to define concepts, indicators, and variables. In the next stage, questionnaires were used and statistically analyzed to test the research hypotheses. Therefore, the research instruments consisted of a combination of documentary (library-based) study and field research. Ten variables were measured using a structured questionnaire designed based on a five-point Likert scale, which is widely used in behavioral research due to its efficiency and reliability.

In the first phase, 42 indicators, including both green and non-green criteria, were presented to experts and specialists within the Foundation of Martyrs and Veterans Affairs through a questionnaire. After scoring these indicators, 10 main and most significant criteria were identified. In the second phase, five organizations, Kosar Economic Organization, Metad Co. Nasim Salamat Kosar Company, Dey Bank, Dey Insurance, and Veterans Welfare Services Company, were compared based on the 10 selected criteria using a five-point Likert scale questionnaire.

Data analysis was performed using the PROMETHEE method, implemented through the Visual PROMETHEE software. The present study employs one of the MCDM techniques, namely the PROMETHEE method, for supplier ranking. MCDM models include various methods, among which the PROMETHEE family, developed by Brans and colleagues, is one of the most prominent.

The PROMETHEE family consists of six variants:

I. PROMETHEE I, which provides a partial ranking of alternatives.

II. PROMETHEE II, which produces a complete ranking of alternatives.

III. PROMETHEE III, which defines preference and indifference relations based on the mean and variance of preference indices.

IV. PROMETHEE IV, applicable to an infinite number of alternatives.

V. PROMETHEE V, a multi-criteria method incorporating constraints in the selection process.

VI. PROMETHEE VI, which is inspired by models of human cognition.

For data analysis and result evaluation, multi-criteria analysis techniques were employed, including PROMETHEE, sensitivity analysis, and GAIA visualization. The research was conducted through the following stages:

Stage 1 (identification and refinement of criteria). Initially, 42 sub-criteria were extracted across six main dimensions through literature review and existing documentation. Subsequently, using the Delphi method with the participation of 15 experts, these were reduced to 20 final criteria.

Stage 2 (weighting and prioritization). In this stage, a hybrid weighting approach combining expert judgment and Shannon entropy was used to identify the main priorities in contractor selection. Accordingly, three main criteria, service quality, technology, and economic factors, were identified with weights of 0.236, 0.194, and 0.192, respectively.

Stage 3 (contractor ranking). Using the PROMETHEE II method, five IT service contractors were ranked. The results indicated that alternative A2, with a net flow value of Φ= 35/0+, was the best option, while A3, with a net flow value of $\Phi=-0.38$, was the weakest alternative.

Stage 4 (model validation). In this stage, the robustness of the model was evaluated using sensitivity analysis, GAIA visualization, and comparison with TOPSIS and SAW methods. The results confirmed the stability and reliability of the PROMETHEE-based model.

5 | Findings and Results

Considering the nature of the research and the characteristics of governmental organizations, the 42 identified sub-criteria were classified into six main criteria. This classification was carried out based on conceptual similarity, operational overlap, and alignment with the research objectives.

Table 1. Classification of sub-criteria into main dimensions.

Main Criterion	Number of Sub-Criteria	Description
Economic–financial	8	Focus on cost aspects, profitability, and financial sustainability of the supplier.
Service quality and performance	8	Service level, reliability, and operational quality
Technical and technological	7	Knowledge, infrastructure, and technological capability
Organizational and managerial	7	Organizational capability, experience, and decision-making structure
Compliance and sustainability	6	Alignment with governmental requirements, regulations, and social values
Human resources and innovation	6	Human capital capability and organizational learning capacity
Total	42	—

Table 2. Results of the third round of Delphi – final list of sub-criteria.

Row	Code	Main Criterion	Final Sub-Criterion	Mean Score	Standard Deviation	CV
1	C1.1	Economic–financial	Total life cycle cost of services	4.87	0.35	0.072
2	C1.2	Economic–financial	Financial stability of the supplier	4.80	0.41	0.085
3	C1.3	Economic–financial	Cost efficiency and scalability	4.40	0.51	0.116
4	C2.1	Service quality and performance	Service quality and execution accuracy	4.93	0.26	0.053
5	C2.2	Service quality and performance	Reliability and service continuity	4.87	0.35	0.072
6	C2.3	Service quality and performance	Response speed and problem resolution	4.80	0.41	0.085
7	C2.4	Service quality and performance	Stakeholder satisfaction and experience quality	4.60	0.51	0.111
8	C3.1	Technical and technological	Technical skills and expertise of staff	4.73	0.46	0.097
9	C3.2	Technical and technological	Emerging technologies and technological innovation	4.47	0.52	0.116
10	C3.3	Technical and technological	Information security and data protection	4.93	0.26	0.053
11	C3.4	Technical and technological	Fault tolerance and recovery capability	4.60	0.51	0.111
12	C4.1	Organizational and managerial	Experience in similar domains	4.80	0.41	0.085
13	C4.2	Organizational and managerial	Brand reputation and credibility	4.40	0.63	0.143
14	C4.3	Organizational and managerial	Transparency and regular reporting	4.80	0.41	0.085
15	C4.4	Organizational and managerial	Crisis management and emergency response	4.67	0.49	0.105
16	C5.1	Compliance and sustainability	Compliance with governmental laws and regulations	4.93	0.26	0.053
17	C5.2	Compliance and sustainability	Contractual compliance and obligations	4.87	0.35	0.072
18	C5.3	Compliance and sustainability	Licenses, standards, and certifications	4.87	0.35	0.072
19	C6.1	Human resources and innovation	Employee training and development programs	4.33	0.62	0.143
20	C6.2	Human resources and innovation	Flexibility and responsiveness to changing needs	4.53	0.52	0.115

6 | Implementation of the PROMETHEE Method and Results Analysis

To implement the PROMETHEE method, five IT support service providers collaborating with the Foundation of Martyrs and Veterans Affairs were selected as decision alternatives.

Table 3. Introduction of evaluated suppliers.

Code	Supplier Name	Establishment Year	Number of Employees	Years of Cooperation with the Foundation	Service Scope
A1	Company A	2011	85	8	Hardware and software support
A2	Company B	2006	120	12	Network and infrastructure services
A3	Company C	2016	65	4	Cloud and security services
A4	Company D	2009	95	10	Comprehensive IT support
A5	Company E	2013	75	6	Software services and consulting

To determine the weights of the main criteria and sub-criteria, a combination of the following two methods was employed:

I. Expert weighting: The average of the weights assigned by 15 experts during the third round of the Delphi process.

II. Shannon entropy method: Used to calculate objective weights based on data dispersion.

The final weight was obtained from the geometric mean of these two methods.

Table 4. Weights of the main criteria.

Code	Main Criterion	Expert Weight	Entropy Weight	Final Weight	Normalized Weight
C1	Economic–financial	0.195	0.182	0.188	0.192
C2	Service quality and performance	0.225	0.238	0.231	0.236
C3	Technical and technological	0.185	0.195	0.190	0.194
C4	Organizational and managerial	0.175	0.168	0.171	0.175
C5	Compliance and sustainability	0.145	0.152	0.148	0.151
C6	Human resources and innovation	0.075	0.065	0.070	0.072
Total	–	1.000	1.000	0.998	1.020

Table 5. Weights of the sub-criteria (local and global weights).

Code	Sub-Criterion	Local Weight	Global Weight
	Economic–financial dimension (0.192)		
C1.1	Total service life-cycle cost	0.385	0.074
C1.2	Financial stability and soundness of the supplier	0.365	0.070
C1.3	Cost-effectiveness and scalability	0.250	0.048
	Service quality and performance dimension (0.236)		
C2.1	Service quality and execution accuracy	0.290	0.068
C2.2	Reliability and service continuity	0.280	0.066
C2.3	Responsiveness and problem resolution speed	0.265	0.063
C2.4	Stakeholder satisfaction and experience quality	0.165	0.039
	Technical and technological dimension (0.194)		
C3.1	Technical skills and expertise of personnel	0.280	0.054
C3.2	Advanced technologies and technological innovation	0.245	0.048
C3.3	Information security and data protection	0.295	0.057
C3.4	Fault tolerance and recoverability	0.180	0.035
	Organizational and managerial dimension (0.175)		
C4.1	Experience and track record in similar domains	0.305	0.053
C4.2	Brand credibility and reputation	0.195	0.034
C4.3	Transparency and regular reporting	0.275	0.048
C4.4	Crisis management and emergency response	0.225	0.039
	Compliance and sustainability dimension (0.151)		
C5.1	Compliance with government regulations and laws	0.380	0.057
C5.2	Contractual compliance and commitments	0.335	0.051
C5.3	Licenses, standards, and certifications	0.285	0.043
	Human resources and innovation dimension (0.072)		
C6.1	Employee training and development programs	0.420	0.030
C6.2	Flexibility and responsiveness to changing needs	0.580	0.042

The performance data of the suppliers were collected from three sources:

I. Documents and records: Contracts, invoices, and performance reports.

II. Survey: Questionnaire responses obtained from 45 users and 12 managers from different departments of the Foundation.

III. Expert evaluation: An eight-member panel consisting of the Foundation's technical and financial experts.

Table 6. Decision matrix: Suppliers' performance across the sub-criteria.

Code	Sub-Criterion	Unit/Scale	A1	A2	A3	A4	A5	Type	Preference Function
	Economic–financial dimension								
C1.1	Total service life-cycle cost	Million IRR/month	850	920	780	890	810	Min	V-shape
C1.2	Financial stability and soundness	Score (1–100)	75	82	68	79	71	Max	Usual
C1.3	Cost-effectiveness and scalability	Score (1–10)	7.2	7.8	6.5	7.5	6.9	Max	Linear
	Service quality and performance dimension								
C2.1	Service quality and execution accuracy	Compliance percentage	88	91	85	90	87	Max	Level
C2.2	Reliability and continuity	Uptime percentage	97.5	98.2	96.8	98.0	97.2	Max	V-shape
C2.3	Responsiveness speed	Average hours	4.5	3.8	5.2	4.0	4.8	Min	Linear
C2.4	Stakeholder satisfaction	Score (1–5)	3.9	4.2	3.6	4.0	3.8	Max	Gaussian
	Technical and technological dimension								
C3.1	Technical skills and expertise	Score (1–100)	82	85	78	84	80	Max	Level
C3.2	Advanced technologies and innovation	Score (1–10)	7.5	8.0	8.5	7.8	7.2	Max	Linear
C3.3	Information security	Score (1–100)	85	88	92	87	83	Max	Level
C3.4	Fault tolerance and recovery	Recovery time (hours)	2.5	2.0	1.8	2.2	2.8	Min	V-shape
	Organizational and managerial dimension								
C4.1	Experience and track record	Years	8	12	4	10	6	Max	Level
C4.2	Brand credibility and reputation	Score (1–10)	7.8	8.2	6.9	7.9	7.3	Max	Linear
C4.3	Reporting transparency	Score (1–100)	78	85	72	82	75	Max	Usual
C4.4	Crisis management	Score (1–10)	7.5	8.0	7.2	7.8	7.0	Max	Linear
	Compliance and sustainability dimension								
C5.1	Regulatory compliance	Compliance percentage	95	98	92	97	94	Max	Level
C5.2	Contractual compliance	Score (1–100)	88	92	85	90	87	Max	Usual
C5.3	Licenses and standards	Number of certifications	5	7	4	6	5	Max	Usual
	Human resources and innovation dimension								
C6.1	Training and development	Hours/person/year	45	52	38	48	42	Max	Linear
C6.2	Flexibility	Score (1–10)	7.8	8.2	7.5	8.0	7.6	Max	Gaussian

Min: cost-type criteria that should be minimized.
Max: benefit-type criteria that should be maximized.
Preference function: the type of preference function employed in the PROMETHEE method.

For each criterion, one of the six PROMETHEE preference functions was selected according to the intrinsic nature of the criterion.

Table 7. Parameters of the preference functions.

Code	Sub-Criterion	Function Type	Parameter (q) (Indifference Threshold)	Parameter (p) (Strict Preference Threshold)	Parameter (\sigma) (Standard Deviation)
C1.1	Total Cost	V-shape	–	80	–
C1.2	Financial stability	Usual	–	–	–
C1.3	Cost-effectiveness	Linear	0.3	1.5	–
C2.1	Service quality	Level	2	5	–
C2.2	Reliability	V-shape	–	1.5	–
C2.3	Responsiveness speed	Linear	0.2	1.0	–
C2.4	Satisfaction	Gaussian	–	–	0.3
C3.1	Technical expertise	Level	3	8	–
C3.2	Advanced technology	Linear	0.4	1.2	–
C3.3	Security	Level	3	7	–
C3.4	Recovery	V-shape	–	0.8	–
C4.1	Experience	Level	1	3	–
C4.2	Brand reputation	Linear	0.3	1.0	–
C4.3	Transparency	Usual	–	–	–
C4.4	Crisis management	Linear	0.3	0.8	–
C5.1	Regulatory compliance	Level	2	5	–
C5.2	Contractual compliance	Usual	–	–	–
C5.3	Licenses	Usual	–	–	–
C6.1	Training	Linear	3	10	–
C6.2	Flexibility	Gaussian	–	–	0.4

5 | PROMETHEE Calculations Using Visual PROMETHEE Software

Step 1 (calculation of deviations). For each pair of alternatives (a,b) and each criterion j, the deviation was calculated as follows: d_j(a,b) = g_j(a) - g_j(b)

Table 8. Sample deviation matrix for criterion C1.1 (total cost).

	A1	A2	A3	A4	A5
A1	0	+70	−70	+40	−40
A2	−70	0	−140	−30	−110
A3	+70	+140	0	+110	+30
A4	−40	+30	−110	0	−80
A5	+40	+110	−30	+80	0

For Min-type criteria, the sign is reversed.

Step 2 (calculation of preference degrees). Using the preference functions, the preference degree π_j(a,b) was calculated for each pair of alternatives.

Table 9. Preference degree matrix for criterion C1.1.

	A1	A2	A3	A4	A5
A1	0	0	0.875	0	0.500
A2	0.875	0	1.000	0.375	1.000
A3	0	0	0	0	0
A4	0.500	0	1.000	0	1.000
A5	0	0	0.375	0	0

Step 3 (calculation of the multi-criteria preference index). By aggregating the preference degrees of all criteria together with their corresponding weights, the multi-criteria preference index is obtained as follows:

$$\pi(a, b) = \Sigma w\_j \times \pi\_j(a, b).$$

Table 10. Multi-criteria preference index matrix.

	A1	A2	A3	A4	A5	Row Sum
A1	0.000	0.342	0.658	0.415	0.523	1.938
A2	0.658	0.000	0.782	0.571	0.689	2.700
A3	0.342	0.218	0.000	0.298	0.387	1.245
A4	0.585	0.429	0.702	0.000	0.612	2.328
A5	0.477	0.311	0.613	0.388	0.000	1.789
Column sum	2.062	1.300	2.755	1.672	2.211	10.000

Step 4 (calculation of positive and negative flows). The positive and negative outranking flows were calculated as follows:

I. Positive Flow (Φ+) represents the strength of an alternative in outranking the other alternatives.

$$\Phi + (a) = (1/(n-1)) \times \Sigma \pi(a, x).$$

II. Negative Flow (Φ-) represents the weakness of an alternative with respect to the other alternatives.

$$\Phi - (a) = (1/(n-1)) \times \Sigma \pi(x, a).$$

Table 11. Positive and negative flows (PROMETHEE I).

Supplier	Positive Flow ((\Phi^+))	Rank	Negative Flow ((\Phi^-))	Rank
A1	0.4845	3	0.5155	3
A2	0.6750	1	0.3250	1
A3	0.3113	5	0.6888	5
A4	0.5820	2	0.4180	2
A5	0.4473	4	0.5528	4

Step 5 (calculation of net flow (PROMETHEE II). The net flow, which determines the final ranking of alternatives, is computed as:

$$\Phi(a) = \Phi + (a) - \Phi - (a).$$

Table 12. Net flow and final ranking.

Rank	Supplier	Positive Flow (\Phi^+)	Negative Flow (\Phi^-)	Net Flow (\Phi)	Normalized Score
1	A2	0.6750	0.3250	+0.3500	100.00
2	A4	0.5820	0.4180	+0.1640	73.43
3	A1	0.4845	0.5155	−0.0310	45.59
4	A5	0.4473	0.5528	−0.1055	35.01
5	A3	0.3113	0.6888	−0.3775	0.00

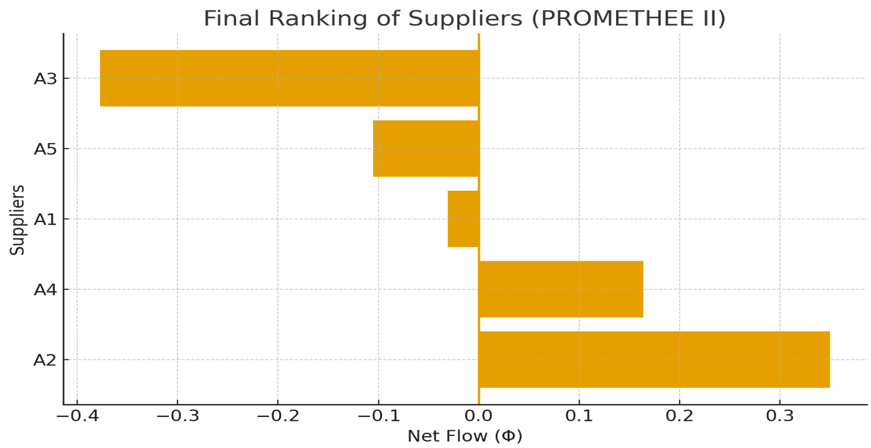

Fig. 1. Final ranking of suppliers (PROMETHEE II).

6 | Sensitivity Analysis

To evaluate the robustness of the results, a sensitivity analysis was conducted under three different scenarios.

Scenario 1. A 20% increase in the weight of economic criteria.

Table 13. Results of scenario 1.

Rank	Supplier	Φ (Base)	Φ (Scenario 1)	Rank Change
1	A2	+0.3500	+0.3425	No change ✓
2	A4	+0.1640	+0.1580	No change ✓
3	A3	-0.0310	+0.0145	↑ to Rank 3
4	A1	-0.1055	-0.0425	↓ to Rank 4
5	A5	-0.3775	-0.4725	No change ✓

Scenario 2. A 20% increase in the weight of quality and performance criteria.

Table 14. Results of scenario 2.

Rank	Supplier	Φ (Base)	Φ (Scenario 2)	Rank Change
1	A2	+0.3500	+0.3820	No change ✓
2	A4	+0.1640	+0.1865	No change ✓
3	A1	-0.0310	-0.0155	No change ✓
4	A5	-0.1055	-0.1245	No change ✓
5	A3	-0.3775	-0.4285	No change ✓

Scenario 3. A 20% increase in the weight of technical and technological criteria

Table 15. Results of scenario 3.

Rank	Supplier	Φ (Base)	Φ (Scenario 3)	Rank Change
1	A2	+0.3500	+0.3345	No change ✓
2	A4	+0.1640	+0.1720	No change ✓
3	A1	-0.0310	-0.0495	No change ✓
4	A3	-0.1055	-0.0320	↑ to Rank 4
5	A5	-0.3775	-0.4250	↓ to Rank 5

Table 16. Summary of sensitivity analysis.

Supplier	Rank Stability	Number of Unchanged Scenarios	Positional Strength
A2	Very strong	3 out of 3	Stable Rank 1
A4	Strong	3 out of 3	Stable Rank 2
A1	Moderate	2 out of 3	Fluctuation between ranks 3–4
A3	Moderate	1 out of 3	Fluctuation between ranks 3–5
A5	Strong	2 out of 3	Stable weak performance

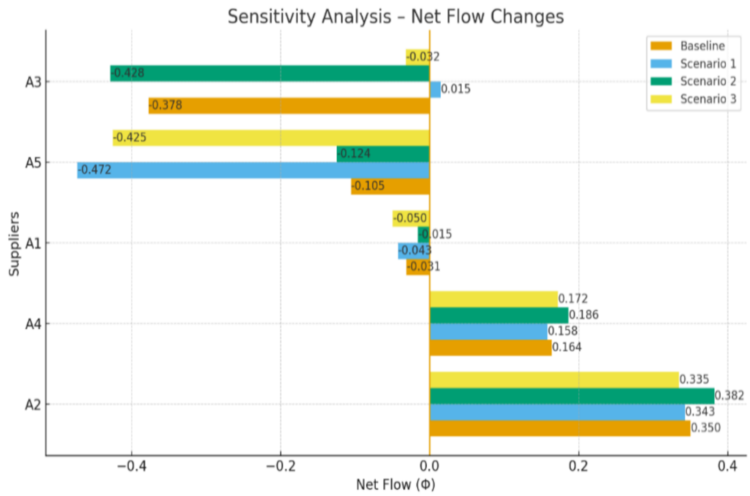

Fig. 2. Sensitivity analysis: Variations in net flow.

Baseline scenario

Scenario 1. Increase in the weight of economic criteria.

Scenario 2. Increase in the weight of quality and performance criteria.

Scenario 3. Increase in the weight of technical and technological criteria.

7 | GAIA Analysis (Geometrical Analysis for Interactive Aid)

GAIA analysis provides a graphical visualization of the decision-making problem.

Table 17. GAIA coordinates for suppliers and criteria.

Element	Dimension 1 (δ = 68.4%)	Dimension 2 (δ = 23.7%)
Suppliers		
A1	-0.45	+0.28
A2	+0.82	+0.35
A3	-0.78	-0.52
A4	+0.58	-0.15
A5	-0.17	+0.04
Main Criteria		
C1 (Economic)	+0.65	-0.38
C2 (Quality)	+0.72	+0.25
C3 (Technical)	+0.58	+0.45
C4 (Organizational)	+0.68	-0.12
C5 (Compliance)	+0.55	+0.18
C6 (Human Resources)	+0.42	+0.52
Decision Vector (π)	+0.67	+0.15

7.1 | GAIA Findings

I. The first two dimensions explain 92.1% of the total variance, indicating a good fit of the model.

II. A2 and A4 are located in the direction of the decision vector, which confirms the PROMETHEE II ranking results.

III. A3 is positioned in the opposite direction of the decision vector, thereby justifying its weak performance.

IV. All criteria exhibit relative alignment, indicating the absence of severe conflict among the criteria.

8 | Analysis of Supplier Performance Across Different Dimensions

Table 18. Supplier performance analysis by main criteria.

Supplier	Economic (19.2%)	Quality (23.6%)	Technical (19.4%)	Organizational (17.5%)	Compliance (15.1%)	Human Resources (7.2%)	Weighted Average
A1	6.8	7.5	7.2	7.0	7.3	7.1	7.18
A2	7.2	8.5	7.8	8.0	8.2	7.9	7.95
A3	8.5	6.8	8.2	5.5	6.9	6.8	7.08
A4	7.5	8.2	7.7	7.8	7.9	7.7	7.78
A5	7.8	7.2	6.9	6.8	7.1	7.0	7.18

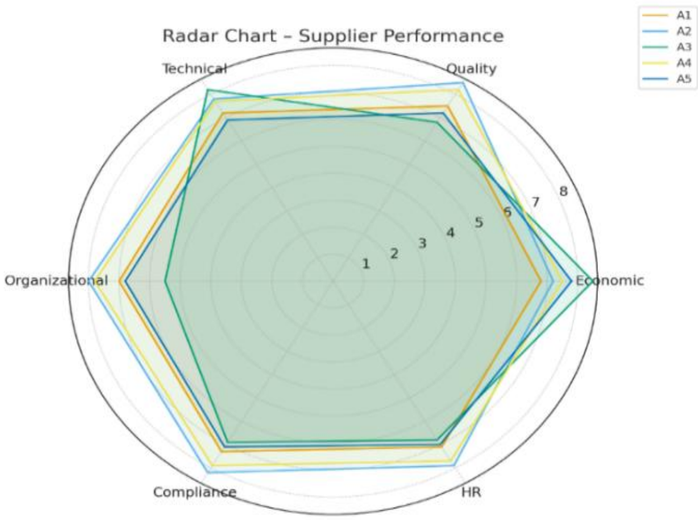

Fig. 3. Radar chart of supplier performance.

8.1 | Analysis of Strengths and Weaknesses

A2 (Company B) – Ranked First

I. Strengths: Superior performance in quality (8.5), compliance (8.2), and organizational capability (8.0).

II. Weaknesses: Relatively higher cost (7.2).

III. Recommendation: The most suitable option for sensitive projects requiring high-quality performance.

A4 (Company D) – Ranked Second

I. Strengths: Well-balanced performance across all dimensions, with particularly strong performance in quality (8.2).

II. Weaknesses: Lacks a distinct competitive advantage in any single dimension.

III. Recommendation: An appropriate choice for projects with diverse and balanced requirements.

A3 (Company C) – Ranked Fifth

I. Strengths: Superior performance in cost efficiency (8.5) and technology (8.2).

II. Weaknesses: Significant deficiencies in the organizational dimension (5.5) and quality (6.8).

III. Recommendation: Requires improvement in management practices and quality assurance processes.

8.2 | Pairwise Comparative Analysis

Table 19. Net pairwise comparison matrix.

	A1	A2	A3	A4	A5
A1	–	-0.316	+0.316	-0.170	+0.046
A2	+0.316	–	+0.564	+0.142	+0.378
A3	-0.316	-0.564	–	-0.404	-0.274
A4	+0.170	-0.142	+0.404	–	+0.224
A5	-0.046	-0.378	+0.274	-0.224	–

Positive values: Indicate the superiority of the row alternative over the column alternative.
Negative values: Indicate the superiority of the column alternative over the row alternative.
A2 demonstrates superiority over all other alternatives (+).
A3 performs weaker than all other alternatives (−).

8.3 | Supplementary Analysis and Secondary Findings

Table 20. Pearson correlation matrix among the main criteria.

	C1	C2	C3	C4	C5	C6
C1	1.000					
C2	0.542*	1.000				
C3	0.318	0.685**	1.000			
C4	0.456*	0.728**	0.612**	1.000		
C5	0.389	0.824**	0.557*	0.792**	1.000	
C6	0.275	0.635**	0.714**	0.548*	0.501*	1.000

$*p < 0.05, **p < 0.01$.

8.4 | Findings

I. The strong correlation between quality and compliance (0.824) indicates that suppliers with higher quality performance generally exhibit better regulatory compliance.

II. The strong correlation between quality and organizational capability (0.728) highlights the importance of organizational maturity in delivering high-quality services.

III. The relatively weak correlation between economic and technical criteria (0.318) suggests that lower cost is not necessarily associated with weaker technological capability.

8.5 | Performance Gap Analysis

Table 21. Performance gap of suppliers relative to the ideal alternative.

Sub-Criterion	Ideal Alternative	A1	A2	A3	A4	A5
C1.1 (Cost)	780	-70	-140	0	-110	-30
C1.2 (Financial Stability)	82	-7	0	-14	-3	-11
C1.3 (Economic Efficiency)	7.8	-0.6	0	-1.3	-0.3	-0.9
C2.1 (Quality)	91	-3	0	-6	-1	-4
C2.2 (Reliability)	98.2	-0.7	0	-1.4	-0.2	-1.0
C2.3 (Responsiveness)	3.8	-0.7	0	-1.4	-0.2	-1.0
C2.4 (Satisfaction)	4.2	-0.3	0	-0.6	-0.2	-0.4
C3.1 (Technical Expertise)	85	-3	0	-7	-1	-5
C3.2 (Technology)	8.5	-1.0	-0.5	0	-0.7	-1.3
C3.3 (Security)	92	-7	-4	0	-5	-9
C3.4 (Recovery Capability)	1.8	-0.7	-0.2	0	-0.4	-1.0
C4.1 (Experience)	12	-4	0	-8	-2	-6
C4.2 (Reputation)	8.2	-0.4	0	-1.3	-0.3	-0.9
C4.3 (Transparency)	85	-7	0	-13	-3	-10
C4.4 (Crisis Management)	8.0	-0.5	0	-0.8	-0.2	-1.0
C5.1 (Regulatory Compliance)	98	-3	0	-6	-1	-4
C5.2 (Contract Management)	92	-4	0	-7	-2	-5
C5.3 (Licenses and Certifications)	7	-2	0	-3	-1	-2
C6.1 (Training)	52	-7	0	-14	-4	-10
C6.2 (Flexibility)	8.2	-0.4	0	-0.7	-0.2	-0.6

Table 22. Average performance gap by dimension (%).

Supplier	Economic	Quality	Technical	Organizational	Compliance	Human Resources	Overall Average
A1	8.7%	4.5%	9.2%	11.3%	6.8%	9.5%	8.3%
A2	15.2%	1.2%	3.8%	0.0%	2.1%	5.2%	4.6%
A3	0.0%	10.8%	3.5%	22.4%	11.5%	15.8%	10.7%
A4	12.1%	2.8%	5.5%	5.9%	4.3%	7.3%	6.3%
A5	4.5%	7.2%	11.8%	15.6%	8.9%	12.1%	10.0%

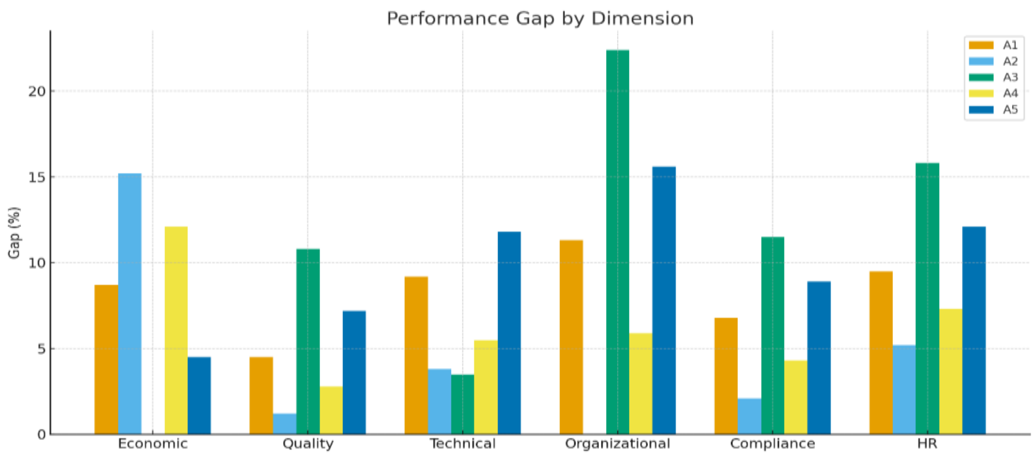

Fig. 4. Performance gap by dimension.

8.6 | Improvement Scenario Analysis

Scenario 1. A 15% improvement in the weakest dimension of each supplier.

Table 23. Predicted rank changes under targeted improvement.

Supplier	Weakest Dimension	Current Score	Score After Improvement	Current Φ	Improved Φ	Rank Change
A1	Organizational (7.0)	-0.0310	+0.0425	3	3→2	↑
A2	Economic (7.2)	+0.3500	+0.3845	1	1	–
A3	Organizational (5.5)	-0.3775	-0.2110	5	5→4	↑
A4	Technical (7.7)	+0.1640	+0.1995	2	2	–
A5	Technical (6.9)	-0.1055	-0.0350	4	4→3	↑

Improvement in the weakest dimension can result in an advancement of up to two ranking positions.

Scenario 2. Integration of two complementary suppliers.

Table 24. Analysis of potential supplier integration.

Combination	Combined Strengths	Remaining Weaknesses	Predicted Φ	Potential Rank
A2 + A3	High quality + low cost + strong technology	Organizational weakness of A3	+0.42	1
A4 + A5	Good balance + flexibility	Lack of a distinct competitive advantage	+0.19	2
A1 + A5	Experience + service diversity	Average performance across all dimensions	-0.05	3

8.7 | Cost–Effectiveness Analysis

Table 25. Cost–effectiveness analysis of suppliers.

Supplier	Monthly Cost (Million IRR)	Overall Performance Score (0–10)	Effectiveness Ratio (Score/Cost × 100)	Effectiveness Rank
A1	850	7.18	0.845	3
A2	920	7.95	0.864	2
A3	780	7.08	0.908	1
A4	890	7.78	0.874	2
A5	810	7.18	0.887	2

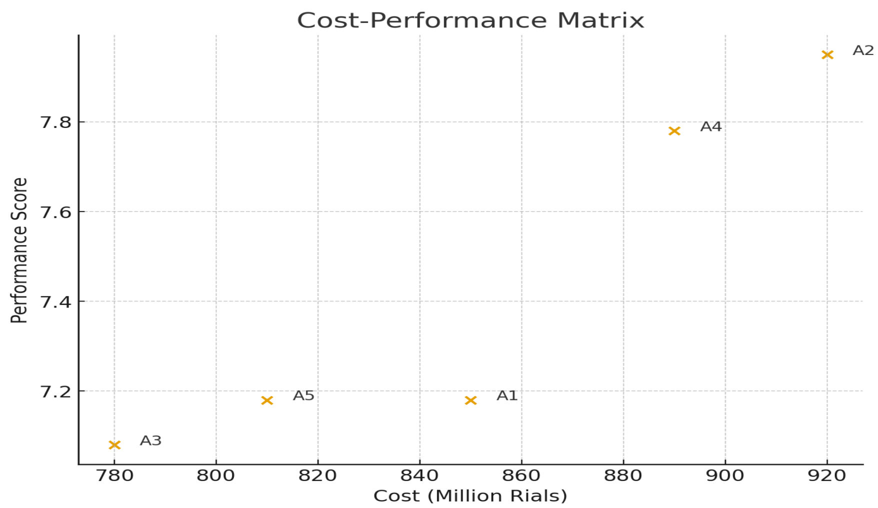

Fig. 5. Cost–Performance matrix of alternatives (A1–A5).

This matrix indicates that:

I. A2: Achieves the highest overall performance, albeit at the highest cost.

II. A3: Incurs the lowest cost, but demonstrates lower overall performance.

III. A4: Exhibits high performance with a moderate-to-high cost structure.

IV. A1 and A5: Demonstrate moderate performance at moderate cost levels.

Despite its lower ranking in the PROMETHEE analysis, A3 exhibits the highest cost-effectiveness ratio and is therefore suitable for projects operating under severe budget constraints.

8.8 | Risk Analysis

Table 26. Risk assessment of suppliers.

Supplier	Financial Risk	Operational Risk	Technical Risk	Legal Risk	Overall Risk Scor (0–100)	Risk Level
A1	Moderate (15)	Low (8)	Moderate (12)	Low (5)	40	Moderate
A2	Low (8)	Low (6)	Low (7)	Low (4)	25	Low
A3	Low (9)	High (22)	Low (8)	Moderate (11)	50	Moderate–High
A4	Low (10)	Low (9)	Low (9)	Low (6)	34	Moderate
A5	Moderate (14)	Moderate (13)	Moderate–High (16)	Low (7)	50	Moderate–High

8.8.1 | Risk mitigation strategies

For A3:

I. A contractual agreement conditional upon improvement of the organizational structure.

II. More intensive monitoring during the first six months.

III. Mandatory recruitment of an experienced project manager.

For A5:

I. Joint investment in technical infrastructure.

II. Specialized training programs for personnel.

9 | Comparison with Alternative Methods

To validate the PROMETHEE results, the ranking procedure was also conducted using two alternative methods.

Table 27. Comparison of PROMETHEE and TOPSIS results.

Supplier	PROMETHEE Rank	Φ	TOPSIS Rank	C_i	Rank Difference	Correlation
A2	1	+0.3500	1	0.742	0	✓
A4	2	+0.1640	2	0.658	0	✓
A1	3	-0.0310	4	0.485	-1	~
A5	4	-0.1055	3	0.512	+1	~
A3	5	-0.3775	5	0.428	0	✓

Spearman's rank correlation coefficient: $\varrho = 0.90$ ($p < 0.05$).

The 80% consistency in rankings indicates a high degree of validity of the results.

Table 28. Comparison of PROMETHEE and SAW results.

Supplier	PROMETHEE Rank	Φ	SAW Rank	SAW Score	Rank Difference
A2	1	+0.3500	1	8.25	0
A4	2	+0.1640	2	7.89	0
A1	3	-0.0310	3	7.35	0
A5	4	-0.1055	4	7.18	0
A3	5	-0.3775	5	6.92	0

Spearman's rank correlation coefficient: $\varrho = 1.00$

The complete agreement with the SAW method demonstrates the strong robustness of the results.

Table 29. Summary of method comparison.

Method	First Rank	Second Rank	Third Rank	Computational Time	Complexity	Flexibility
PROMETHEE II	A2	A4	A1	Moderate	Moderate	High
TOPSIS	A2	A4	A5	Low	Low	Moderate
SAW	A2	A4	A1	Low	Low	Low

10 | Conclusion and Recommendations

The proposed framework constitutes a systematic three-stage model that begins with the extraction of 42 initial sub-criteria from both domestic and international literature. Through three rounds of fuzzy Delphi analysis involving 15 experts, these were reduced to 20 final sub-criteria. The criteria were subsequently weighted using a hybrid approach combining expert judgment and Shannon entropy. Thereafter, five suppliers were ranked using PROMETHEE II and Visual PROMETHEE, and the results were validated through sensitivity analysis, GAIA, TOPSIS, and SAW. Compared with the study of Goudarzi and Gholamian [41], who applied cloud PROMETHEE in the private sector, the present framework is innovative because, for the first time, it integrates governance-related criteria into the evaluation of IT support services within the Iranian public sector. Furthermore, the framework demonstrated high robustness through GAIA analysis (92.1% explained variance) and complete agreement with the SAW method. Consequently, it fills an important knowledge gap within the target context and provides a practical tool for risk reduction and cost optimization in governmental organizations.

The principal criteria consisted of six dimensions and 42 initial sub-criteria, which were reduced to 20 validated sub-criteria: economic–financial (total cost, financial stability), service quality and performance (service quality, responsiveness), technical and technological (technical expertise, information security), organizational and managerial (experience, transparency), compliance and sustainability (regulatory compliance, contractual compliance), and human resources and innovation (training, flexibility). Compared with Hosseinpour and Mahmoudabadi [42], these criteria are more comprehensive and specifically address the neglected issue of IT support services in the public sector. In comparison with Agrawal [38], the framework incorporates governance and social criteria derived from domestic literature [48], thereby enriching the practical body of knowledge within the studied context.

The final weights of the principal criteria were determined as follows: service quality and performance (0.236), technical and technological (0.194), economic–financial (0.192), organizational and managerial (0.175), compliance and sustainability (0.151), and human resources and innovation (0.072). Among the sub-criteria, service quality (0.085), information security (0.078), and experience (0.069) received the highest weights. Compared with the study of Heydari Dehuei [43], which employed fuzzy DEMATEL, the present hybrid weighting method manages uncertainty more effectively and produces more stable results. Relative to Fujita [37], it also achieves greater precision in prioritizing public-sector criteria and enables the Martyrs and Veterans Affairs Foundation to allocate resources toward the most critical factors.

The final supplier ranking identified A2 as the best alternative ($\Phi=+0.350$), followed by A4 ($\Phi=+0.164$), A1 ($\Phi=-0.0310$), A5 ($\Phi=-0.1055$), and A3 ($\Phi=-0.3775$). A2, due to its superiority in quality (8.5) and compliance (8.2), and A4, owing to its balanced overall performance, emerged as the most suitable alternatives. Compared with these findings, these findings are more precise because they provide both net outranking flows and pairwise comparisons. Furthermore, relative to Agrawal [38], the inclusion of cost-effectiveness analysis (with A3 achieving the highest ratio of 0.908) and the evaluation of strengths and weaknesses enhances the practical applicability of the framework. It enables the Martyrs and Veterans Affairs Foundation to make targeted decisions (e.g., selecting A2 for quality-oriented projects and A3 for budget-constrained projects).

The robustness of the results was confirmed through sensitivity analysis (three scenarios with a maximum rank variation of one position), GAIA analysis (92.1% explained variance and criterion alignment), and comparison with TOPSIS (correlation coefficient of 0.90 and 80% ranking consistency) and SAW (correlation coefficient of 1.00 and complete consistency). Compared with Brans & Mareschal [49], this validation process is considerably more comprehensive and represents the first application of GAIA analysis within the Iranian public sector. In comparison with Akram et al. [39], the framework further demonstrates practical robustness by predicting ranking changes under improvement and complementary integration scenarios (e.g., A2+A3A2 + with Φ=+0.42). Accordingly, the study enriches the existing body of knowledge by introducing a resilient decision-making model capable of maintaining stability under varying conditions.

The present study was conducted with the objective of developing a multi-criteria decision-making framework based on the PROMETHEE method for the selection of IT support service providers in governmental organizations, particularly the Martyrs and Veterans Affairs Foundation. The findings demonstrated that the proposed framework, through systematic extraction of criteria from domestic and international literature, Delphi-based screening, hybrid weighting, accurate supplier ranking, and comprehensive validation, not only satisfies the decision-making requirements of the public sector but also effectively addresses several deficiencies in the existing literature. Key criteria such as service quality, information security, and compliance with governmental regulations, which had received limited integrated attention in previous public-sector studies, were identified as decisive factors. Their high weights, particularly service quality (0.236), confirm the necessity of emphasizing stable and reliable performance in IT support services.

The final supplier ranking, with A2 positioned first and A3 ranked last, demonstrated that superior performance in qualitative and organizational dimensions can compensate for higher costs, whereas suppliers with lower costs but managerial deficiencies may generate substantial long-term risks. Supplementary analyses, including GAIA, sensitivity analysis, and comparisons with TOPSIS and SAW, further confirmed the robustness and validity of the proposed model, thereby establishing it as a reliable and operational decision-support tool for governmental organizations. Compared with previous domestic studies (Goudarzi and Gholamian [41], Heydari Dehuei, [43]) and international studies (Fujita, [37], Agrawal [38]), this research is the first to present a hybrid, localized, and comprehensively validated model in the context of governmental IT support services in Iran. By providing practical strategies for risk reduction, improvement of cost-effectiveness, and targeted supplier selection, the study significantly advances the existing knowledge base within the investigated context. Ultimately, the proposed framework can serve as a standardized model for other governmental organizations in the process of selecting IT service providers and may facilitate informed, transparent, and optimized decision-making within the national administrative system.

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Data Availability

Sufficient data is available upon request.

Conflict of Interest

No potential conflict of interest was reported by the authors.

References

[1] Chang, J., Li, W., Zhou, Y., Zhang, P., & Zhang, H. (2022). Impact of public service quality on the efficiency of the water industry: evidence from 147 cities in China. *Sustainability*, *14*(22), 15160. https://doi.org/10.3390/su142215160

[2] Kim, B. S., Suh, B., Kim, K. I., Seo, I. J., Lee, H. B., & Gong, J. S. (2022). An enhanced tree routing through multi-criteria decision making over wireless sensor networks. *2022 IEEE 19th international conference on*

mobile ad hoc and smart systems (MASS) (pp. 570-576). IEEE. https://doi.org/10.1109/MASS56207.2022.00085

[3] Chen, Q. (2024). *Essays on public procurement and firms in china* [Thesis]. https://escholarship.org/content/qt46c4b0jq/qt46c4b0jq_noSplash_184a01cd7da6f4a1a3e0a98639f22b68.pdf

[4] Kim, B.S., Shah, B., & Kim, K.I. (2023). Adaptive scheduling for multi-objective resource allocation through multi-criteria decision-making and deep Q-network in wireless body area networks. *Journal of ambient intelligence and humanized computing*, *14*(12), 16255–16268. https://doi.org/10.1007/s12652-022-03846-5

[5] Habetemeherit, A. B., Mengistu, D. G., Sorsa, F. T., & Tesfaye, B. Z. (2026). Causes and impacts of public construction projects' contract terminations. *Engineering, construction and architectural management*, *33*(6), 4330–4346. https://doi.org/10.1108/ECAM-09-2024-1217

[6] Alshamsi, A. M., El-Kassabi, H., Serhani, M. A., & Bouhaddioui, C. (2023). A multi-criteria decision-making (MCDM) approach for data-driven distance learning recommendations. *Education and information technologies*, *28*(8), 10421–10458. https://doi.org/10.1007/s10639-023-11589-9%0A%0A

[7] Mehregan, F., Hatami, M. R., & Shohani, A. (2024). Explaining the components of a modern administrative system in order to establish a federal structure in Iran. *Parliament and strategy*, *31*(117), 39–74. (**In Persian**). https://doi.org/10.22034/mr.2023.5376.5134

[8] Tavakoli, G., Zaheri, M. M., & Hamidifar, Z. (2021). Modeling the behavioral challenges and obstacles of employees in establishing a desirable organizational culture in government organizations. *Strategic studies of the basij*, *24*(90), 79–102. (**In Persian**). https://dor.isc.ac/dor/20.1001.1.1735501.1400.24.90.3.3

[9] Sanayei, A., Mousavi, S. F., & Yazdankhah, A. (2010). Group decision making process for supplier selection with VIKOR under fuzzy environment. *Expert systems with applications*, *37*(1), 24–30. https://doi.org/10.1016/j.eswa.2009.04.063

[10] Ding, Y., Tu, Y., Pu, J., & Qiu, L. (2021). Environmental factors in operations management: The impact of air quality on product demand. *Production and operations management*, *30*(9), 2910–2924. https://doi.org/10.1111/poms.13410

[11] Peterková, J., & Franek, J. (2018). Decision making support for managers in innovation management: A PROMETHEE approach. *International journal of innovation*, *6*(3), 256–274. https://doi.org/10.5585/iji.v6i3.236

[12] Taherdoost, H., & Madanchian, M. (2023). Using PROMETHEE method for multi-criteria decision making: applications and procedures. *Iris journal of economics & business management*, *1*(1). https://ssrn.com/abstract=4464669

[13] Kaplan, P. O., & Ranjithan, S. R. (2007). A new MCDM approach to solve public sector planning problems. *2007 IEEE symposium on computational intelligence in multi-criteria decision-making* (pp. 153-159). IEEE. https://doi.org/10.1109/MCDM.2007.369430

[14] Essien, E., Lodorfos, G., & Kostopoulos, I. (2019). Antecedents of supplier selection decisions in the public sector in Nigeria. *Journal of public procurement*, *19*(1), 15–45. https://doi.org/10.1108/JOPP-03-2019-023

[15] Yildiz, A., & Yayla, A. Y. (2015). Multi-criteria decision-making methods for supplier selection: A literature review. *South African journal of industrial engineering*, *26*(2), 158–177. https://doi.org/10.7166/26-2-1010

[16] Ried, L., Eckerd, S., Kaufmann, L., & Carter, C. (2021). Spillover effects of information leakages in buyer--supplier--supplier triads. *Journal of operations management*, *67*(3), 280–306. https://doi.org/10.1002/joom.1116

[17] Koufteros, X., Vickery, S. K., & Dröge, C. (2012). The effects of strategic supplier selection on buyer competitive performance in matched domains: Does supplier integration mediate the relationships? *Journal of supply chain management*, *48*(2), 93–115. https://doi.org/10.1111/j.1745-493X.2012.03263.x

[18] Ho, W., Xu, X., & Dey, P. K. (2010). Multi-criteria decision making approaches for supplier evaluation and selection: A literature review. *European journal of operational research*, *202*(1), 16–24. https://doi.org/10.1016/j.ejor.2009.05.009

[19] Govindan, K., Rajendran, S., Sarkis, J., & Murugesan, P. (2015). Multi criteria decision making approaches for green supplier evaluation and selection: A literature review. *Journal of cleaner production*, *98*, 66–83. https://doi.org/10.1016/j.jclepro.2013.06.046

[20] Dotoli, M., Epicoco, N., & Falagario, M. (2020). Multi-Criteria Decision Making techniques for the management of public procurement tenders: A case study. *Applied soft computing*, *88*, 106064. https://doi.org/10.1016/j.asoc.2020.106064

[21] Essien, E. E., Kostopoulos, I., Konstantopoulou, A., & Lodorfos, G. (2019). Do ethical work climates influence supplier selection decisions in public organizations? The moderating roles of party politics and personal values. *International journal of public sector management*, *32*(6), 653–670. https://doi.org/10.1108/IJPSM-10-2018-0227

[22] Anelli, D., Pierluigi, M., Tiziana, A., Tajani, F., & others. (2025). Structuring multi-criteria decision approaches for public procurement: Methods, standards and applications. *Systems*, *13*(9). https://iris.uniroma1.it/bitstream/11573/1745001/1/Tajani_Structuring-Multi-Criteria-Decision_2025.pdf

[23] Alastal, H., Sharaf, A., Mahmoud, S., Alsaidi, O., & Bahroun, Z. (2025). Integrating multiple criteria decision-making techniques in sustainable supplier selection: A comprehensive review. *Decision making: applications in management and engineering*, *8*(1), 380–400. https://doi.org/10.31181/dmame8120251243

[24] Sahoo, S. K., Goswami, S. S., & Halder, R. (2024). Supplier selection in the age of industry 4.0: A review on MCDM applications and trends. *Decision making advances*, *2*(1), 32–47. https://doi.org/10.31181/dma21202420

[25] Weber, C. A., Current, J. R., & Benton, W. C. (1991). Vendor selection criteria and methods. *European journal of operational research*, *50*(1), 2–18. https://doi.org/10.1016/0377-2217(91)90033-R

[26] Zhan, Y., Chung, L., Lim, M. K., Ye, F., Kumar, A., & Tan, K. H. (2021). The impact of sustainability on supplier selection: A behavioural study. *International journal of production economics*, *236*, 108118. https://doi.org/10.1016/j.ijpe.2021.108118

[27] Govindan, K., Khodaverdi, R., & Jafarian, A. (2013). A fuzzy multi criteria approach for measuring sustainability performance of a supplier based on triple bottom line approach. *Journal of cleaner production*, *47*, 345–354. https://doi.org/10.1016/j.jclepro.2012.04.014

[28] Razmak, J., & Aouni, B. (2015). Decision support system and multi-criteria decision aid: a state of the art and perspectives. *Journal of multi-criteria decision analysis*, *22*(1–2), 101–117. https://doi.org/10.1002/mcda.1530

[29] Behzadian, M., Kazemzadeh, R. B., Albadvi, A., & Aghdasi, M. (2010). PROMETHEE: A comprehensive literature review on methodologies and applications. *European journal of operational research*, *200*(1), 198–215. https://doi.org/10.1016/j.ejor.2009.01.021

[30] Zeleny, M., & Cochrane, J. L. (1982). *Multiple criteria decision making*. McGraw-Hill New York. https://books.google.com/books/about/Multiple_Criteria_Decision_Making.html?id=vTayAAAAIAAJ

[31] Abdullah, L., Chan, W., & Afshari, A. (2019). Application of PROMETHEE method for green supplier selection: A comparative result based on preference functions. *Journal of industrial engineering international*, *15*(2), 271–285. https://doi.org/10.1007/s40092-018-0289-z%0A%0A

[32] Belton, V., & Stewart, T. (2012). *Multiple criteria decision analysis: An integrated approach*. Springer Science & Business Media. https://books.google.com/books?hl=en&lr=&id=AYYHCAAAQBAJ&oi=fnd&pg=PP11&dq=

[33] Vaidya, O. S., & Kumar, S. (2006). Analytic hierarchy process: An overview of applications. *European journal of operational research*, *169*(1), 1–29. https://doi.org/10.1016/j.ejor.2004.04.028

[34] Azadfallah, M. (2017). Evaluation and selection of suppliers in the supply chain using the extended group PROMETHEE I procedures. *International journal of supply chain and operations resilience*, *3*(1), 56–76. https://doi.org/10.1504/IJSCOR.2017.087161

[35] Hwang, C.L., & Lin, M.J. (2012). *Group decision making under multiple criteria: Methods and applications*. Springer Science & Business Media. https://books.google.com/books?hl=en&lr=&id=F6r7CAAAQBAJ&oi=fnd&pg=PA1&dq=%5B35%5D+%0

[36] Wu, W., Xu, Z., & Kou, G. (2020). Evaluation of group decision making based on group preferences under a multi-criteria environment. *Technological and economic development of economy*, *26*(6), 1187–1212. https://doi.org/10.3846/tede.2020.13378

[37] Fujita, T. (2025). *Hyperfuzzy and superhyperfuzzy promethee methods for multi-criteria decision-making in it service management*. https://doi.org/10.36227/techrxiv.174970457.78480523/v1

[38] Agrawal, N. (2022). Multi-criteria decision-making toward supplier selection: Exploration of PROMETHEE II method. *Benchmarking: an international journal*, *29*(7), 2122–2146. https://doi.org/10.1108/BIJ-02-2021-0071

[39] Akram, M., Shumaiza, & Al-Kenani, A. N. (2020). Multi-criteria group decision-making for selection of green suppliers under bipolar fuzzy PROMETHEE process. *Symmetry*, *12*(1), 77. https://doi.org/10.3390/sym12010077

[40] Liu, F., Ji, X., & Gao, J. (2020). Extended SQ-Coons surface and its application on fairing automobile surface design. *Mathematical problems in engineering*, *2020*(1), 4912978. https://doi.org/10.1155/2020/4912978

[41] Goodarzi, A., & Gholamian, M. (2024). Selecting green suppliers with the new Prometheus-Abri group decision-making method; Case study: a petroleum products manufacturing company. *Journal of modern research in decision making*, *9*(2), 63–97. https://journal.saim.ir/article_715187_8c974c5152d912f8dcacdebd849f474d.pdf

[42] Hosseinpour, A., & Mahmoudabadi, A. (2017). Providing a method for multi-criteria decision-making to select the best supplier in the supply chain based on the joint opinions of suppliers and employers (Case study: Selecting the best university website design company). *The second international conference on knowledge-based research in computer engineering and information technology*. (**In Persian**). https://civilica.com/doc/696174

[43] Heydari Dehoui, B. (2016). *Presenting a hybrid multi-criteria decision-making model for selecting a knowledge management outsourcing provider* [Thesis]. (**In Persian**). https://elmnet.ir/doc/11171400-26386

[44] Brans, J. P., & Vincke, P. (1985). Note—a preference ranking organisation method: (The PROMETHEE method for multiple criteria decision-making). *Management science*, *31*(6), 647–656. https://doi.org/10.1287/mnsc.31.6.647

[45] Fountzoula, C., & Aravossis, K. (2022). Decision-Making methods in the public sector during 2010--2020: A systematic review. *Advances in operations research*, *2022*(1), 1750672. https://doi.org/10.1155/2022/1750672

[46] Ishizaka, A., & Labib, A. (2011). Review of the main developments in the analytic hierarchy process. *Expert systems with applications*, *38*(11), 14336–14345. https://doi.org/10.1016/j.eswa.2011.04.143

[47] Velasquez, M., & Hester, P. T. MCDM methods analysis: Advantages, disadvantages & applications. *International journal of operations research, 10*(2), 56–66. https://studylib.net/doc/8889609/an-analysis-of-multi-criteria-decision-making-methods

[48] Beheshti, F., & Nabayi, H. (2023). Presenting a model for evaluating and selecting sustainable third-party logistics service providers in the supply chain based on a combined approach of fuzzy analytic hierarchy process and the Cocosu technique (case study: Dairy industry). *Quarterly journal of the iranian management sciences association*, *17*(68), 45–74. (**In Persian**). https://civilica.com/doc/1691083

[49] Brans, J.P., & Mareschal, B. (1994). The PROMCALC & GAIA decision support system for multicriteria decision aid. *Decision support systems*, *12*(4–5), 297–310. https://doi.org/10.1016/0167-9236(94)90048-5