E-ISSN:2250-0758

P-ISSN:2394-6962

Research Article

International Market Selection

International Journal of Engineering and Management Research

2025 Volume 15 Number 5 October

Publisher

Vandana Publications

www.vandanapublications.com

An Integrated CVR/CVI–TOPSIS Framework for Selecting International EPC Markets: Evidence from Iran

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DOI:10.5281/zenodo.17529330

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This study proposes a novel integrated framework to enhance the reliability of international market selection (IMS) for engineering service exports under uncertainty and economic sanctions. A systematic literature review and expert consultations identified thirteen criteria across political-diplomatic, market prerequisite, and macroeconomic dimensions. The content validity of these criteria was tested using the Content Validity Ratio (CVR) and Content Validity Index (CVI). The validated criteria were weighted by an expert panel and incorporated into a fuzzy-TOPSIS algorithm. A decision matrix of 48 candidate countries was analyzed, identifying Armenia, Russia, and Qatar as the most attractive markets. The analysis underscores that diplomatic and banking relations outweighed traditional economic indicators in the sanctioned context. Sensitivity analysis confirmed the robustness of the rankings. This study integrates CVR/CVI into the fuzzy-TOPSIS framework, addressing a key gap in the MCDM literature regarding criterion robustness. It also provides an early empirical application of IMS to engineering service exports, encompassing the entire EPC lifecycle within a sanctioned economy, offering a practical decision-support tool.

Keywords: International Market Selection, Engineering Service Exports, Content Validity (CVR/CVI), Fuzzy-TOPSIS, Multi-Criteria Decision-Making (MCDM), Sanctioned Economies

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Alireza Shokri, Doctor of Business Administration (DBA), Faculty of Management and Accounting, Shahid Beheshti University, Tehran, Iran. Email: h.keyvanfar@gmail.com	Keyvanfar H, Shokri A, An Integrated CVR/CVI–TOPSIS Framework for Selecting International EPC Markets: Evidence from Iran. Int J Engg Mgmt Res. 2025;15(5):96-105. Available From https://ijemr.vandanapublications.com/index.php/j/article/view/1810	

Manuscript Received	Review Round 1	Review Round 2	Review Round 3	Accepted
2025-09-04	2025-09-20			2025-10-04
Conflict of Interest	**Funding**	**Ethical Approval**	**Plagiarism X-checker**	**Note**
None	Nil	Yes	3.77	

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1. Introduction

Over the past two decades, exports of Engineering, Procurement, and Construction (EPC) services have emerged as a primary driver of Iran's non-oil export development.Given the structural limitations of the Iranian economy and its historical reliance on oil revenues, policymakers have increasingly emphasized the need to establish diversified and sustainable sources of foreign exchange. Iran’s capacity indelivering integrated EPC projects—leveraging specialized human resources and extensive experience in executing large-scale infrastructure—constitutes a critical advantage for its international economic engagement. This study explicitly addresses market selection forfull-spectrum EPC projects, a context where the provider is responsible for the entire project lifecycle from design and procurement to construction and commissioning. This holistic scope necessitates a decision framework that incorporates not only engineering design but also procurement logistics, construction execution risks, and project-finance considerations, aligning the research with the complex realities of international EPC markets.

However, entering foreign markets with such integrated offerings involves significant and multifaceted challenges. Poor market selection can result in wasted resources, increased legal and political risks, financial transfer difficulties, and reputational damage. Accordingly, identifying attractive and low-risk markets forcomprehensive EPC exportsrepresents a strategic necessity. Market selection in this domain is not a mere economic choice; it is a complex, multidimensional decision-making process that must simultaneously weigh political, institutional, financial, and technical dimensions alongside traditional economic indicators. Hence, robust, systematic, and scientific approaches are required for evaluating and prioritizing foreign markets under uncertainty.

From a theoretical standpoint, international market selection (IMS) is inherently interdisciplinary, positioned at the intersection of international marketing, strategic management, and trade policy. Prior studies have largely focused on macroeconomic indicators such as GDP, growth rates, and trade volumes, but often overlook critical dimensions for EPC projects—such as diplomatic relations, banking cooperation, and contract enforcement mechanisms.

Traditional scoring methods and simplistic comparisons are inadequate for integrating both qualitative and quantitative criteria, thus failing to provide a comprehensive picture of market attractiveness for complex service exports like EPC. In such contexts, multi-criteria decision-making (MCDM) approaches emerge as indispensable analytical tools.

Several MCDM techniques have been applied to IMS, including AHP, VIKOR, ELECTRE, and TOPSIS. Among them, TOPSIS is particularly appealing due to its computational simplicity, ability to handle large datasets, and transparency in interpreting results. Its underlying principle—ranking alternatives based on their relative closeness to an ideal solution—has made it widely used in supplier selection, project evaluation, and risk management. However, a persistent and critical gap in the literature is the insufficient attention to thevalidity and robustness of the criteria employed. Many studies adopt criteria directly from prior literature without rigorously assessing their content validity for a specific context—such as EPC projects in sanctioned economies—thereby risking the inclusion of irrelevant indicators or the omission of critical, context-specific factors. This methodological shortcoming can distort final rankings and compromise decision quality.

To address this gap, the present study makes a novel methodological contribution by integrating the Content Validity Ratio (CVR) and Content Validity Index (CVI) into a fuzzy-TOPSIS framework. This hybrid CVR/CVI–fuzzy-TOPSIS approach ensures that only rigorously validated criteria are used for ranking, thereby significantly enhancing the reliability and contextual applicability of the results. Furthermore, while most IMS studies focus on manufacturing or general service sectors, this research provides one of the first applications specifically tailored toEPC service exports—a high-value, knowledge-intensive sector with unique entry barriers and risk profiles. The study also contextualizes the IMS problem within the challenging environment of sanctions-faced economies, offering insights relevant to other emerging markets under similar constraints.

The validated and weighted criteria were incorporated into the fuzzy-TOPSIS algorithm to rank 48 potential target countries. Data were drawn from reputable secondary sources and expert panels.

The analysis revealed Armenia, Russia, and Qatar as the top-ranked markets, highlighting the joint significance of diplomatic ties and banking channels alongside economic indicators. By presenting this integrated framework, the study contributes not only to the MCDM literature by introducing a formal criterion-validation mechanism but also offers a practical, context-sensitive tool for policymakers and EPC contractors operating in high-risk international environments. The remainder of the paper is structured as follows: Section 2 reviews the relevant literature, Section 3 details the research methodology, Section 4 presents the results and discussion, and Section 5 concludes with policy and managerial implications.

2. Literature Review

This research builds on the extensive literature of international market selection (IMS) for engineering services, with a specific focus on the integrated EPC (Engineering, Procurement, and Construction) sector. The evolution of IMS criteria and decision-making models has been significantly influenced by several key trends, which we review thematically to contextualize the present study.

The digital transformation of the engineering industry has reshaped traditional market entry paradigms, particularly for EPC projects that involve complex, long-term engagements. Porter and Heppelmann (2014) argued that smart, connected products have shifted competition from physical assets to digital capabilities and data-driven business models—a trend directly relevant to modern EPC projects, which increasingly rely on digital tools for design, procurement, and construction management. This digitization has facilitated the rise of "born-global" firms that bypass gradual internationalization stages and enter global markets rapidly (Cavusgil & Knight, 2015; Knight & Liesch, 2016), challenging traditional models. Cavusgil et al. (2015) further developed a comprehensive country risk assessment framework emphasizing regulatory transparency and contract enforcement mechanisms, which are critical for EPC projects where legal and institutional safeguards directly impact project viability. More recently, Chen and Wang (2024) demonstrated the use of machine learning to dynamically update IMS criteria weights, while Kumar et al. (2023) proposed a hybrid fuzzy BWM-TOPSIS model to handle uncertainty in market selection, underscoring the continuous evolution of MCDM techniques in response to digital disruption. Notably, fuzzy-based approaches like fuzzy-TOPSIS (Chen, 2000) have gained traction for their ability to model uncertainty and imprecision in expert judgments, making them particularly suitable for high-risk environments such as sanctioned economies, where EPC operators face amplified uncertainties.

Geopolitical and institutional factors have remained central to IMS, especially for EPC projects that require stable political environments, banking cooperation, and diplomatic support. Cao et al. (2017), using big-data analytics, demonstrated how opportunities in emerging markets can be forecast through the analysis of public procurement tenders —a key data source for EPC firms seeking contract opportunities. Bunkenborg et al. (2018) stressed the importance of forming strategic alliances with local partners as a means of reducing "liability of foreignness" and accelerating market penetration in institutionally complex environments, a common strategy in EPC ventures. This trend is particularly evident within China's Belt and Road Initiative, where large-scale infrastructure projects have redefined the calculus of market entry (Cao & Lu, 2020). Verbeke and Yuan (2019) similarly showed that comprehensive regional trade agreements covering services and investment are far more impactful than mere tariff-reduction pacts, highlighting the need for holistic trade policies that support EPC exports. Expanding on this, Bunkenborg et al. (2023) highlighted the role of digital partnership platforms in mitigating institutional voids, and Ghauri et al. (2024) analyzed how firms reconfigure value chains under sanctions, offering critical insights for EPC exporters in emerging economies facing similar constraints.

In recent years, sustainability and resilience have gained prominence as critical IMS criteria, reflecting the growing complexity of global EPC projects. Hernandez and Nielsen (2021) found that stringent environmental standards in host countries can simultaneously create opportunities for green engineering firms while acting as barriers to others, influencing market selection for EPC providers specializing in sustainable infrastructure. Garcia and Martinez (2022) demonstrated a clear link between strong ESG reputations and preferential access to international projects financed by development banks—a key consideration for EPC firms pursuing publicly funded contracts.

The COVID-19 pandemic further underscored the importance of resilience: Alon et al. (2021) identified remote monitoring technologies and localized supply chains as essential adaptations for project continuity, directly relevant to EPC project management. Smith et al. (2023) extended these findings, showing that resilience has now surpassed traditional economic indicators in determining IMS success. Recent contributions by Yadav and Patel (2023) integrated ESG metrics into infrastructure project selection, while Liu et al. (2024) showed that alignment with host-country green regulations significantly boosts market attractiveness for engineering services exporters, including EPC firms.

Finally, the rise of advanced analytical methods has transformed the precision and dynamism of IMS models. Lu et al. (2020) highlighted the role of cultural intelligence and diverse team composition in ensuring project success in culturally distant markets—a vital factor for EPC teams operating internationally. Magnani and Ghauri (2019) investigated corporate survival strategies under sanctions, emphasizing diversification into neighboring markets and the development of alternative payment mechanisms, which are directly applicable to EPC exporters in sanctioned economies like Iran. Boso et al. (2022) showed that regional integration agreements in Africa significantly reduce transaction costs and enhance intra-regional market attractiveness, suggesting opportunities for EPC firms in integrated markets. More recently, Kumar et al. (2025) and Smith and Zhao (2024) have employed artificial intelligence and machine learning to develop predictive models capable of forecasting infrastructure investment cycles with high accuracy, offering a dynamic, data-driven approach to future IMS. Complementing these advances, Smith and Zhao (2023) identified resilient digital payment systems as a key factor for market entry in sanctioned economies, and Perez and Verma (2023) demonstrated the application of digital twins for risk assessment in international engineering projects, signaling a shift toward more technology-enabled IMS frameworks.

Taken together, the literature suggests that IMS models have evolved from static, macroeconomic indicator–based approaches toward dynamic, multi-criteria frameworks that integrate technology, resilience, and sustainability considerations.

However, despite these advancements, few studies have systematically integrated criterion validity testing (e.g., CVR/CVI) within fuzzy-MCDM frameworks, such as fuzzy-TOPSIS. This gap is particularly salient in the context of EPC market selection, where the validity of criteria is paramount due to the high stakes and complexity of projects. By proposing a novel CVR/CVI–fuzzy-TOPSIS hybrid model, this study addresses this gap and provides a rigorous approach for selecting international EPC markets under uncertainty.

3. Research Methodology

3.1. Research Design

This study is applied in terms of purpose and follows a descriptive–survey design for data collection and analysis. The methodological framework was structured as a two-stage integrative model:

1. Validation and screening of the proposed criteria using content validity indices (CVR and CVI);
2. Ranking of target markets through the multi-criteria decision-making technique fuzzy-TOPSIS.

This dual design simultaneously strengthens the theoretical foundation of the criteria by ensuring their validity, while also generating robust quantitative outputs to support practical decision-making.

3.2. Population, Sampling, and Expert Panel

The initial statistical population comprised all countries worldwide (approximately 230). Given the lack of complete data for some countries, a census sampling approach was adopted, resulting in a final set of 48 countries with sufficient information for quantitative analysis.

For the validation phase, an expert panel of eight members was employed, selected through non-probability purposive sampling. Key characteristics of the panel included:

- **Expertise:** Each member possessed at least 15 years of managerial experience in relevant domains such as international project management, global marketing in the engineering industry, and foreign trade policy.
- **Professional background:** The panel consisted of senior managers of engineering export firms, senior experts from chambers of commerce, and faculty members in international management and business.

3.3. Final Set of Criteria

Following the CVR/CVI validation process, 13 final criteria were confirmed and categorized into four dimensions for integration into the TOPSIS model. Each criterion was defined as either positive or negative, and data sources were identified (Table 1).

Table 1: Final criteria for market selection

Dimension	Criterion	Type (Positive/ Negative)	Data Source
Political–Diplomatic	Presence of Iranian embassy	Positive	Ministry of Foreign Affairs
	Presence of target country's embassy in Iran	Positive	Ministry of Foreign Affairs
	Branches of Iranian banks	Positive	Central Bank of Iran
	Number of bilateral agreements	Positive	Ministry of Foreign Affairs
	Volume of total trade	Positive	Iran Customs Administration
Market Preconditions	Ease of Doing Business rank	Negative	World Bank
	Number of firms listed in ENR ranking	Positive	ENR Report
Economic	Total GDP	Positive	IMF
	GDP per capita	Positive	IMF
	Credit rating	Positive	Moody's
	GDP growth rate	Positive	World Bank
	Wealth per adult	Positive	Credit Suisse Global Wealth Report
	Total wealth	Positive	Credit Suisse Global Wealth Report

3.4. Data Analysis Method – Fuzzy-TOPSIS Implementation

To address the inherent uncertainty in expert judgments and data, the classic TOPSIS method was extended using triangular fuzzy numbers (TFNs). A TFN is denoted as **A = (l, m, u)**, where **l**, **m**, and **u** represent the lower, most probable, and upper bounds, respectively. The fuzzy-TOPSIS procedure was executed through the following six steps:

Step 1 – Constructing the Fuzzy Decision Matrix (D):

The performance of each country (alternative) on each criterion was represented as a TFN.

For quantitative data, crisp values were converted to TFNs withl = m = usince no uncertainty was assumed for the data itself. However, for the weights, uncertainty was incorporated by defining TFNs based on the crisp weights with a±10% uncertainty range(i.e.,l = 0.9 × m,u = 1.1 × m, wheremis the crisp weight).

Step 2 – Normalization of the Fuzzy Decision Matrix (R):

The fuzzy decision matrix was normalized to scale the criteria values uniformly.

For benefit criteria(higher values are better):

$$r_{ij} = \left(\frac{l_{ij}}{u_j^+}, \frac{m_{ij}}{u_j^+}, \frac{u_{ij}}{u_j^+}\right)$$

where

$$u_j^+ = max_i u_{ij}.$$

For cost criteria(lower values are better):

$$r_{ij} = \left(\frac{l_j^-}{u_{ij}}, \frac{l_j^-}{m_{ij}}, \frac{l_j^-}{l_{ij}}\right)$$

where

$$l_j^- = min_i l_{ij}.$$

Step 3 – Constructing the Weighted Normalized Fuzzy Matrix (V)

The normalized fuzzy matrix was multiplied by the fuzzy weights of the criteria:

$$v_{ij} = w_j \cdot r_{ij}$$

Step 4 – Determining the Fuzzy Positive Ideal Solution (FPIS) and Fuzzy Negative Ideal Solution (FNIS):

FPIS (A^+) was defined as:

$$A^+ = \{v_1^+, \dots, v_n^+\}$$

Where benefit criteria:

$$v_j^- = (\, min_i l_{ij}, min_i m_{ij}, min_i u_{ij})$$

and for cost criteria:

$$v_j^- = (\, max_i l_{ij}, max_i m_{ij}, max_i u_{ij})$$

Step 5 – Calculating the Distances from FPIS and FNIS:

The Euclidean distances of each alternative from FPIS and FNIS were computed using the vertex method for TFNs. The distance between two TFNs A and B was calculated as:

$$d(A,B) = \sqrt{\frac{1}{3}[(l_A - l_B)^2 + (m_A - m_B)^2 + (u_A - u_B)^2]}$$

Then, the distances and for each alternative were obtained as:

$$d_i^+ = \sqrt{\sum_{j=1}^{n} d(v_{ij}, v_j^+)^2} \ , \qquad d_i^- = \sqrt{\sum_{j=1}^{n} d(v_{ij}, v_j^-)^2}$$

Step 6 – Calculating the Relative Closeness Index and Ranking:

The relative closeness to the ideal solution was computed as:

$$CL_i = \frac{d_i^-}{d_i^+ + d_i^-}$$

Alternatives were ranked based on CL_i values in descending order.

All computations were performed in Microsoft Excel, and the results were verified for consistency. The fuzzy-TOPSIS approach enhanced the robustness of the rankings by systematically incorporating uncertainty into the decision-making process.

3.5. Illustrative Example

To enhance the transparency of the fuzzy-TOPSIS procedure, a numerical example is presented using three hypothetical countries (A, B, and C) and three criteria:

- Criterion 1 (Benefit): GDP (in Billion USD)
- Criterion 2 (Cost): Ease of Doing Business Rank
- Criterion 3 (Benefit): Number of ENR Firms

The fuzzy weights for the criteria, derived from expert opinions with ±10% uncertainty, are assumed as:

- w_1 (GDP) = (0.135, 0.15, 0.165)
- w_2 (Ease of Doing Business) = (0.09, 0.10, 0.11)
- w_3 (ENR Firms) = (0.072, 0.08, 0.088)

The performance data for the three countries are shown in Table 2. The fuzzy-TOPSIS algorithm was applied following the steps in Section 3.4.

Table 2: Sample fuzzy-TOPSIS calculation with three countries and three criteria

Country	GDP (Billion $)	Ease of Doing Business Rank	ENR Firms	Fuzzy Relative Closeness (CL_i)	Rank
A	800	50	15	0.745	1
B	600	30	10	0.412	3
C	700	70	12	0.588	2

Note: *The fuzzy CL_i valuesare defuzzified for final ranking.*

The calculation steps follow the fuzzy-TOPSIS algorithm outlined in Section 3.4. Country A achieves a higher relative closeness (*CL*), indicating it is the preferred alternative under fuzzy conditions.

Calculation Steps:

Step 1: Fuzzy Decision Matrix (A)

- Country A: [(800,800,800), (50,50,50), (15,15,15)]
- Country B: [(600,600,600), (30,30,30), (10,10,10)]
- Country C: [(700,700,700), (70,70,70), (12,12,12)]

Step 2: Normalized Fuzzy Matrix (R)

Benefit criteria (GDP, ENR Firms):

$$r_{ij} = \left(\frac{l_{ij}}{u_j^+}, \frac{m_{ij}}{u_j^+}, \frac{u_{ij}}{u_j^+}\right)$$

Cost criterion (Ease of Business):

$$r_{ij} = \left(\frac{l_j^-}{u_{ij}}, \frac{l_j^-}{u_{ij}}, \frac{l_j^-}{u_{ij}}\right)$$

Step 3: Weighted Normalized Matrix (V)

$$v_{ij} = w_j \cdot r_{ij}$$

Step 4: FPIS and FNIS

- FPIS (A^+) = [(0.165,0.165,0.165),(0.064,0.064,0.064), (0.132,0.132,0.132)]
- FNIS (A^-) = [(0.101,0.101,0.101),(0.110,0.110,0.110), (0.088,0.088,0.088)]

Step 5: Distances from FPIS ( ) and FNIS ( )

- $d_A^+ = 0.042,\ d_A^- = 0.124 \rightarrow CL_A = 0.124 \div (0.042{+}0.124) = 0.745$
- $d_B^+ = 0.118,\ d_B^- = 0.083 \rightarrow CL_B = 0.083 \div (0.118{+}0.083) = 0.412$
- $d_{AC}^+ = 0.076,\ d_B^- = 0.108 \rightarrow CL_C = 0.108 \div (0.076{+}0.108) = 0.588$

3.6. Validity and Reliability

Content validity was evaluated using CVR and CVI indices. Based on Lawshe's table, the minimum acceptable CVR value for an eight-member panel is 0.78; criteria below this threshold were excluded. Ultimately, 13 criteria with acceptable CVR and CVI values were incorporated into thefuzzy-TOPSISmodel.

Given that the final analysis relied on objective data and thefuzzy-TOPSIS method, which explicitly accounts for uncertainty in expert judgments,and that generalization to a broader statistical population was not intended, construct reliability indices (e.g., Cronbach's alpha) were not applied. Instead,replicability of the procedureandtransparency of the calculationswere considered as assurances of reliability.The use of fuzzy logic enhances the robustness of the approach by modeling the inherent imprecision in the decision-making process.

4. Results

This section presents the findings derived from applying the TOPSIS multi-criteria decision-making model to rank international markets for the export of engineering and technical services by Iranian firms. Based on 13 validated criteria (political-diplomatic, market prerequisites, and economic indicators), data were collected and analyzed for 48 countries. The results include the baseline ranking, a sensitivity analysis to test robustness, and a comparative analysis with the VIKOR method.

4.1. Country Ranking Based on Fuzzy-TOPSIS

The fuzzy-TOPSIS method was applied to the decision matrix comprising 48 countries. Table 3 presents the top 10 countries based on the relative closeness index (CL_i). Armenia (CL_i = 0.668) and Russia (CL_i = 0.652) emerged as the most attractive markets, followed by Qatar (CL_i = 0.443). The results are consistent with the classic TOPSIS approach but incorporate uncertainty modeling, further underscoring the importance of political-diplomatic factors.

Table 3: Final Ranking of Top 10 Countries Based on Fuzzy-TOPSIS

Rank	Country	Relative Closeness ( )
1	Armenia	0.668
2	Russia	0.652
3	Qatar	0.443
4	Tajikistan	0.425
5	Venezuela	0.419
6	Turkmenistan	0.405
7	Oman	0.392
8	Malaysia	0.381
9	Azerbaijan	0.363
10	Iraq	0.358

Figure 1: Final Ranking of 48 Countries Based on TOPSIS

4.2. Sensitivity Analysis of Fuzzy-TOPSIS

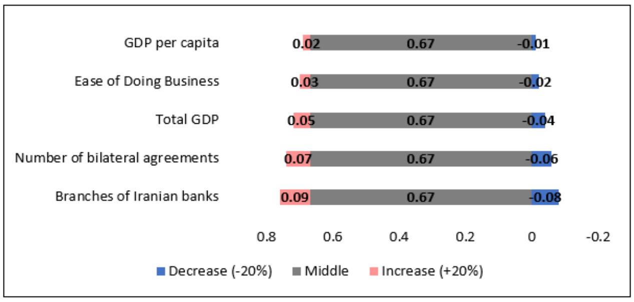
To assess the robustness of the fuzzy-TOPSIS rankings, a sensitivity analysis was conducted by systematically varying the weights of each criterion by ±10% and ±20%, while adjusting the other weights proportionally to maintain a sum of 100%. The analysis focused on the impact of weight changes on the ranking of the top 5 countries.

The results indicate that the rankings are most sensitive to changes in the weights of "Branches of Iranian banks" (27%) and "Number of bilateral agreements" (18%). For example, a 20% increase in the weight of bank branches caused Venezuela to drop from rank 5 to 7, while Malaysia improved from rank 8 to 6. Conversely, a 20% decrease in the weight of bilateral agreements led to Turkmenistan falling from rank 6 to 9. Economic indicators such as "Wealth per adult" (7%) and "Total wealth" (7%) had minimal impact, confirming the dominance of political-diplomatic factors in this context.

Table 4: Sensitivity of Top 5 Countries to Weight Changes

Country	Base Rank	Rank after +20% Bank Weight	Rank after -20% Agreement Weight
Armenia	1	1	1
Russia	2	2	2
Qatar	3	3	3
Tajikistan	4	5	4
Venezuela	5	7	6

Figure 2: Sensitivity Analysis of Fuzzy-TOPSIS illustrating the effect of criterion weight changes on the CL_i score of Armenia (available in supplementary material)



4.3. Comparative Analysis of Fuzzy-TOPSIS with VIKOR Method

To validate the robustness of the CVR/CVI-fussy-TOPSIS framework, the results were compared with those from the VIKOR method. VIKOR was applied to the same decision matrix and weights, and the rankings were compared using Spearman's rank correlation coefficient. The coefficient value of 0.96 indicates a strong agreement between the two methods. The top 3 countries (Armenia, Russia, and Qatar) maintained identical ranks in both methods. Minor discrepancies in lower ranks (e.g., Tajikistan and Venezuela) are attributed to VIKOR's emphasis on regret minimization, which slightly alters the prioritization of middle-ranked alternatives.

Table 5: Comparison of TOP-10 Country Rankings between Fuzzy-TOPSIS and VIKOR Methods

Rank	Country	Fuzzy-TOPSIS Rank	VIKOR Rank	Difference
1	Armenia	1	1	0
2	Russia	2	2	0
3	Qatar	3	3	0
4	Tajikistan	4	5	-1
5	Venezuela	5	4	+1
6	Turkmenistan	6	6	0
7	Oman	7	7	0
8	Malaysia	8	9	-1
9	Azerbaijan	9	8	+1
10	Iraq	10	10	0

Note: *Positive difference indicates higher ranking in VIKOR compared to fussy-TOPSIS.*

4.4. Interpretation of Findings

- **Regional Concentration:** The high rankings of Armenia, Russia, and Qatar emphasize the significance of geographic proximity and strong diplomatic ties. Central Asian and Caucasian countries dominate the top ranks, suggesting regional markets are optimal for initial entry.
- **Political-Diplomatic Factors:** The sensitivity analysis confirms that criteria like bank branches and bilateral agreements are more influential than pure economic indicators. This underscores the need for Iranian firms to prioritize countries with established political relationships.
- **Economic Indicators:** While GDP and wealth metrics contribute to attractiveness, they are secondary to political factors in sanctioned environments. Countries with high GDP but weak political ties (e.g., some African nations) ranked lower.
- **Managerial Implications:** The results provide a clear roadmap for Iranian engineering firms to allocate resources efficiently, focusing on markets with minimal entry barriers and high political support.
- **Economic and Managerial Significance:** Beyond the statistical robustness of the model, the findings hold substantial economic and managerial significance. The prioritization of markets such as Armenia, Russia, and Qatar provides a clear, actionable strategy for Iranian EPC firms.

By focusing resources on these top-ranked countries, firms can potentially achieve a higher return on investment by minimizing the substantial entry costs, political risks, and project delays often associated with exploratory ventures in less-favorable markets. Specifically, the dominance of political-diplomatic criteria, such as the presence of banking channels and bilateral agreements, translates directly into reduced operational risks and transaction costs. For instance, operating in a country with active Iranian bank branches can streamline financial operations and mitigate currency transfer challenges, which are critical bottlenecks in sanctioned economies. This framework, therefore, moves beyond theoretical ranking to offer a practical tool for strategic resource allocation, risk mitigation, and enhancing the overall competitiveness of Iranian engineering exports under constrained conditions.

5. Conclusion

This study demonstrates the efficacy of the integrated CVR/CVI-fuzzy-TOPSIS framework for international market selection. The incorporation of fuzzy logic enhanced the decision robustness by accounting for uncertainty in expert judgments, making the framework more reliable for real-world applications under risky conditions. The high rankings of Armenia and Russia highlight the critical role of political-diplomatic relations. Sensitivity and comparative analyses confirm the robustness of the approach. The framework provides practical guidance for policymakers and managers in sanction-affected economies, facilitating strategic resource allocation and risk mitigation.

Limitations

- Reliance on secondary data may introduce biases, especially for political indicators.
- The expert panel was limited to Iranian professionals, potentially affecting weight generalizability.
- The static nature of the fuzzy-TOPSIS model does not capture dynamic market changes over time
- Data unavailability led to the exclusion of some countries, possibly omitting attractive markets.

Future Research Directions

- Incorporate primary data from international project managers to validate weights.
- Develop dynamic MCDM models using advanced fuzzy extensions (e.g., interval type-2 fuzzy sets) or machine learning to adapt to changing conditions.
- Extend the framework to other service industries or sanctioned economies.
- Explore digital transformation indicators (e.g., e-governance) as emerging criteria.

Acknowledgments

The authors gratefully acknowledge the contributions of the expert panel members for their invaluable insights during the validation stage, as well as colleagues at Kayson Company and the Iran Chamber of Commerce for their assistance in data collection.

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