Journal of Iran Futures Studies

Print ISSN: 6365-2423

Online ISSN: 2676-6183

Proposing a Hybrid BWM-COCOSO Approach for Selecting Technology Foresight Method

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Abstract

Objective: Technology foresight is a critical strategic approach in innovation management and technology development, serving as an essential tool for analyzing and predicting future technological trends. However, the diversity of foresight methods and the lack of a comprehensive framework for selecting the most suitable method pose significant challenges. This study introduces an innovative framework based on the integration of the Best-Worst Method (BWM) and the Combined Compromise Solution (CoCoSo) to provide, for the first time, a comprehensive approach for selecting technology foresight methods.

Method: This research is applied in purpose and quantitative in nature, employing a descriptive approach for data collection and analysis. Initially, a literature review identified 12 primary foresight methods and 8 key evaluation criteria. The criteria were weighed using the BWM, and the methods were prioritized using the CoCoSo technique. Data were collected through questionnaires from 10 experts in the provinces of Tehran, Alborz, and Qazvin during the winter of 2024.

Results: The findings indicate that accuracy and flexibility are the most critical criteria for selecting technology foresight methods. Additionally, scenario planning and the Delphi method were identified by experts as the most suitable approaches for technology foresight.

Conclusion: Selecting an appropriate technology foresight method is vital for organizations to effectively address the challenges and opportunities arising from rapid technological changes. The proposed framework, emphasizing key criteria and integrating BWM and CoCoSo, enables organizations to enhance the accuracy and efficiency of their predictions and adapt to rapid technological advancements.

KeyWords: Technology Foresight, Foresight method, Weighting, Ranking, Decision making.

Cite this article: Nasrollahi Mahdi.(2025) Proposing a Hybrid BWM-COCOSO Approach for Selecting Technology Foresight Method, Volume9, NO.2 fall & winter 2025, 192-217

DOI: 10.30479/jfs.2025.21741.1618

Received on: 23June 2025 **Accepted on:** 9 March 2025

Publisher: Imam Khomeini International University

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Introduction

Technology foresight is a systematic and strategic process aimed at identifying and analyzing future trends in emerging technologies and their impacts on organizations and society (Glenn, 2009; Miller & Lessard, 2001). In the context of accelerating technological change, selecting the most appropriate foresight method is a critical challenge, given the diversity of methods and the absence of a comprehensive selection framework (Bishop et al., 2007). Studies highlight that using an unsuitable foresight method may lead to strategic failures, inefficient resource allocation, and poor organizational adaptability (McKinsey Global Institute, 2024; OECD, 2023). Moreover, many organizations -especially in high-tech industries- struggle with identifying emerging trends and technologies due to the lack of structured foresight processes (Appio et al., 2021). Recent research emphasizes the value of integrating evaluation criteria - such as accuracy, flexibility, and stakeholder engagement- in method selection (Popper, 2008; Sarpong & Maclean, 2011). Despite the availability of various qualitative, quantitative, and hybrid foresight methods (Cuhls, 2016; Marciano et al., 2024), decision-makers often face uncertainty when choosing the method that best fits their organizational needs, resources, and contextual factors. Without a robust and systematic framework, there is a risk of misaligned foresight efforts that fail to support strategic planning and innovation. This study addresses this gap by proposing an innovative hybrid framework that combines the Best-Worst Method (BWM) for weighting evaluation criteria with the Combined Compromise Solution (CoCoSo) technique for ranking foresight methods. The guiding research question is: How can foresight methods be effectively prioritized to enhance the accuracy and efficiency of technology foresight in organizations?

Methodology

This applied research adopts a quantitative and descriptive design. Following a comprehensive literature review, 12 major technology foresight methods and 8 key evaluation criteria were identified. The BWM was employed to weight these criteria, benefiting from its reduced inconsistency and fewer pairwise comparisons compared to AHP (Rezaei, 2015). Subsequently, the CoCoSo technique was used for prioritizing the foresight methods, leveraging its strength in integrating both compensatory and non-compensatory strategies (Ayan & Abacıoğlu, 2022). Data were collected through structured questionnaires administered to 10 experts in technology foresight and innovation management from universities and technology organizations in Tehran, Alborz, and Qazvin provinces during winter 2024. Experts were selected via purposive sampling based on a minimum of 10 years of relevant experience. The study adhered to the multi-criteria decision-making (MCDM) research process, with BWM and CoCoSo forming the core analytical framework.

Results

The BWM analysis revealed that among the eight evaluation criteria, "accuracy" (weight = 0.228) and "flexibility" (weight = 0.187) held the highest importance, underscoring their centrality in selecting foresight methods. "Implementation cost" (0.136), "repeatability" (0.104), "stakeholder participation" (0.100), "comprehensiveness" (0.093), "simplicity of implementation" (0.091), and "time consumption" (0.061) were also influential in shaping expert preferences (Table 1). These results highlight that experts prioritize foresight methods that provide reliable, adaptable outcomes while considering practical constraints such as cost and stakeholder engagement.

Table 1: Weights of Evaluation Criteria

Criteria	Weight
Accuracy	0.228
Flexibility	0.187
Repeatability	0.104
Time consumption	0.061
Stakeholder participation	0.100
Implementation cost	0.136
Simplicity of implementation	0.091
Comprehensiveness	0.093

Using the CoCoSo technique, which integrates both compensatory and non-compensatory decision strategies, the 12 foresight methods were systematically ranked. "Scenario planning" emerged as the top-ranked method (score = 0.999), recognized for its robust capability to manage uncertainty and develop multiple future scenarios (van der Heijden, 2005). The "Delphi method" followed closely (score = 0.993), appreciated for enabling structured expert consensus (Cuhls, 2023). "Technology forecasting," "technology roadmapping," and "competitive intelligence analysis" also achieved high rankings due to their applicability in rapidly evolving industries. The detailed ranking is presented in Table 2.

Table 2: Final ranking of foresight methods based on CoCoSo

Foresight Method	Final Score (CoCoSo)	Rank
Scenario Planning	0.999	1
Delphi Method	0.993	2
Technology Forecasting	0.943	3
Technology Roadmapping	0.928	4
Competitive Intelligence Analysis	0.903	5
Expert Networks	0.903	6
Brainstorming	0.85	7
Trend Analysis	0.783	8
Stakeholder Analysis	0.827	9
Structural Analysis	0.680	10
Simulation	0.530	11
Cross-impact Analysis	0.530	12

The results indicate that combining BWM and CoCoSo enables a transparent, systematic evaluation of foresight methods that aligns with organizational contexts and strategic goals. Moreover, the framework supports the identification of methods that balance methodological rigor with practical feasibility. By weighing criteria such as accuracy and flexibility more heavily, the approach reflects the dynamic nature of technology foresight environments. The adoption of this hybrid framework can help organizations make more informed, data-driven decisions regarding foresight methodology selection, ultimately enhancing their innovation capability and adaptability in uncertain technological landscapes.

Conclusions

This study reaffirms the critical role of foresight method selection in enhancing organizational preparedness for rapid technological change (Appio et al., 2021). The integration of BWM and CoCoSo techniques offers a novel and effective approach to method selection—contributing both to literature and to practice. The findings are consistent with prior studies emphasizing the need for multi-criteria, adaptable frameworks in dynamic environments (Godet, 1994; Gaponenko, 2022). The results underscore that methods excelling in "accuracy" and "flexibility" are most valued by experts, particularly in fast-evolving sectors. Compared to previous single-method approaches, this research provides a more comprehensive and systematic selection process, capable of accommodating different organizational contexts and strategic priorities. The practical utility of this hybrid framework lies in its ability to assist decision-makers in selecting foresight methods that not only enhance prediction accuracy but also align with resource constraints, stakeholder needs, and environmental uncertainties. Additionally, the emphasis on expert-driven criteria reflects real-world foresight challenges faced by organizations in volatile markets.

In alignment with studies by van der Heijden (2005) and Cuhls (2023), scenario planning and Delphi emerged as the top-ranked methods, reinforcing their robustness in navigating complex technological landscapes. Organizations can apply the proposed framework to strengthen their foresight capabilities, foster innovation, and develop more resilient long-term strategies. Future research may explore extending this framework to sector-specific applications (such as healthcare, energy, or ICT), incorporating emerging foresight methodologies, and refining evaluation criteria to reflect the dynamic nature of technology trends. It is also recommended that organizations institutionalize a periodic review process for foresight method selection to ensure continuous alignment with evolving strategic goals and environmental changes.

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