ARCHIVES OF TRANSPORT *ISSN (print):* *0866-9546*
Volume 75, Issue 3, 2025 ***e-ISSN (online):*** *2300-8830*
DOI: *10.61089/aot2025.sxzx6j49*

COMPARATIVE INNOVATIVE LOGISTICS PERFORMANCE ANALYSIS OF G7–BRICS COUNTRIES USING SWARA–MEREC BASED EDAS METHODOLOGY

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***Abstract**:*

In today's world, where globalization and digitalization are accelerating, the logistics sector has become a strategic element in determining countries' economic competitiveness. The increasing complexity of logistics and the rapid evolution of trade networks require innovative, adaptive logistics structures. In this process, innovation stands out as a key factor that increases the efficiency and sustainability of logistics systems. In particular, broad innovation capacity and supportive institutional environments significantly shape the development of modern logistics systems. A logistics infrastructure strengthened by innovative approaches both increases operational efficiency and supports environmental sustainability. This study proposes a new index measuring countries' Innovative Logistics Performance (ILP) by integrating data from the Global Innovation Index (GII) and the Logistics Performance Index (LPI). By combining these two widely recognized indices, the study offers a multidimensional perspective on the innovation–logistics nexus. The index provides a systematic tool to assess how innovation dynamics translate into logistics competitiveness at the national level. In this respect, the study introduces a new conceptual framework in the literature and presents a measurable structure for analyzing this relationship. The study's unique feature is its hybrid methodological approach, combining SWARA, MEREC, and EDAS for the first time. This multi-method approach allows for a more comprehensive evaluation compared to traditional single-method analyses. The proposed model integrates both subjective and objective weighting techniques, ensuring balance and reliability in the evaluation process. The findings indicate that the "Institutions" criterion is the most influential determinant of ILP, followed by "Customs" and "International Shipments." The United States, Germany, and Canada stood out as the top-performing countries. Furthermore, a sensitivity analysis was conducted to assess the model's reliability, confirming its robustness and consistency in the evaluation results.

Keywords: *logistics, innovation, SWARA, MEREC, EDAS*

To cite this article:

Kayar, G.A., Avsar, I.I. (2025). Comparative innovative logistics performance analysis of G7–BRICS countries using SWARA–MEREC based EDAS methodology. Archives of Transport, 75(3), 7-24. https://doi.org/10.61089/aot2025.sxzx6j49

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1. Introduction

The development of the logistics sector is primarily driven by the desire to increase competitiveness in international trade. Attracting foreign investors and promoting economic development are also closely tied to logistics activities. In this context, countries must be aware of the key criteria for improving their international logistics systems and develop strategies accordingly. The logistics sector is currently experiencing the direct effects of extremely rapid technological advances. Therefore, countries need to understand the impact of technological transformation on logistics (Bugarčić et al., 2024).

Various factors affect logistics performance (Anser et al., 2020; Meliana et al., 2021). For instance, innovation is crucial for enhancing logistics performance (Assabane & El Imrani, 2022). In this regard, businesses must prioritize logistics and innovation, focusing on methods that enhance the logistics sector, particularly through innovation (Ippolitova et al., 2024; Wang et al., 2025). This is because well-functioning logistics are crucial for countries to achieve their economic and social development goals (Loucanova et al., 2024). Furthermore, logistics play a critical role in the effective execution of various economic initiatives, particularly trade in services (Yingfei et al., 2022).

Coordination is essential at every stage of the supply chain. In modern supply chains, coordination is crucial for achieving success and sustainability. Processes must be carried out in a coordinated manner, information must be shared effectively, and decisions must be made collaboratively with stakeholders in the supply chain. This integrated approach reduces risks, promotes innovation, and positively impacts overall supply chain performance. Significant improvements in performance indicators such as agility and efficiency demonstrate this exceptionally well. It is also important to emphasise that innovation is a decisive factor in this success (García-Arca et al., 2020; Lee & Ha, 2025).

Innovation is essential for achieving sustainable economic development and fostering competitive countries (Nepytaliuk et al., 2024). However, a review of the literature reveals that innovation has largely been neglected at virtually every stage of supply chain management (Magazzino et al., 2021). Therefore, it would be valuable to address logistics performance alongside innovation in existing literature. Accordingly, this study analyses the relationship between logistics performance and innovation using the multi-criteria decision-making (MCDM) method. The study seeks to answer the following research questions:

RQ1: What are the weights of the logistics and innovation criteria?

RQ2: How are the alternatives ranked according to the criteria?

As discussed in the referenced literature, the logistics sector has become a cornerstone of global trade. Increasing competition, changing customer demands, and rising sustainability expectations necessitate continuous improvement of logistics processes. Innovation is a key tool for achieving this. Furthermore, innovation directly impacts various performance indicators, including cost reduction, streamlined processes, greater flexibility, and enhanced customer satisfaction. However, existing studies generally address the relationship between logistics performance and innovation separately. Assessing these two concepts together using the MCDM method has not been widely explored in the literature. In this respect, this study offers an original contribution to the literature at both conceptual and applied levels.

Furthermore, the combined application of the SWARA–MEREC and EDAS methods in this study, a hybrid methodological approach proposed for the first time in the literature, enables the holistic assessment of both subjective and objective weights in the decision-making process. Therefore, adopting an innovation-based approach to studying logistics performance not only fills a significant academic gap but also offers strategic implications for practice. Moreover, in today's rapidly evolving technological environment, analyzing the contribution of a country's or business's innovation capacity to its logistics success can provide valuable insights into achieving sustainable development goals.

2. Literature Research

Logistics is a highly challenging field due to its complex structure and multidimensional processes. However, when its strategic importance is considered, it becomes clear that it is a critical operational activity with economic and socio-political implications. Consequently, logistics has evolved into an interdisciplinary field, attracting researchers across theoretical and applied studies. Today, logistics activities extend beyond transporting goods and services to lie at the heart of the value chain, affecting all processes from production to consumption. Consequently, improving logistics performance is crucial for supporting local economic development and determining competitive strength within global trade networks. Therefore, logistics is an indispensable element in ensuring both local and global prosperity (Kabashkin, 2012; Dimitrov et al., 2024).

Economic development is a key indicator that enhances a country's overall welfare and living standards while promoting sustainable growth. In this context, innovation is a key factor that directly influences economic growth and supports development processes. Innovation activities, driven by scientific and technological advancements, enhance a country's global competitiveness and bolster the dynamism of its economic structure. Investments in innovation stimulate economic growth and make a significant contribution to social welfare. The development of new products and services creates market diversity, improves the quality of life, and enables more effective solutions to social issues.

Furthermore, the innovation process raises society's overall educational level by strengthening the education system and expanding access to knowledge. In summary, innovation is a vital tool for economic development, playing a strategic role in social progress and sustainable development. Therefore, if countries are to achieve long-term growth and increased prosperity, they must support it (Dempere et al., 2023; Dritsaki & Dritsaki, 2023; Hardi et al., 2025).

2.1. Logistics Performance Index and Global Innovation Index

In academic research, multiple datasets can be evaluated together to enable comprehensive analysis of a topic (Saini & Hrušecká, 2021; Udeagha & Ngepah, 2023). For instance, Soh et al. (2021) simultaneously examined the Global Competitiveness Index and the Logistics Performance Index (LPI). Similarly, the current study examines LPI data alongside innovation-focused indicators.

The Global Innovation Index (GII) is an important annual report published by the World Intellectual Property Organization (WIPO). It provides comprehensive data on innovation capacity and performance. The index systematically analyses innovation indicators for 139 countries at different income and development levels, providing a comparative assessment. The GII considers various sub-indicators to measure countries' ability to generate scientific, technological, and economic innovation, thereby enabling the performance of innovation ecosystems to be monitored globally. According to the 2025 GII report, Switzerland retains its position as the world's most innovative country. The following countries are Sweden, the United States, the Republic of Korea, and Singapore. These countries stand out due to their substantial research and development (R&D) expenditures, strong university–industry partnerships, and innovative infrastructure. Another notable development by 2025 was China's entry into the top 10 countries in the GII ranking for the first time. This demonstrates that China has systematically increased its innovation capacity and strengthened its global competitiveness in recent years.

Additionally, emerging nations such as India, Türkiye, Vietnam, the Philippines, Indonesia, and Morocco have exhibited significant improvements in their innovation performance, earning a spotlight in the report. The steady increase in these countries' innovation indicators over time reveals the effective implementation of innovation-focused policies and investments. Ultimately, GII data serves as a strategic tool for monitoring global innovation trends (GII, 2025).

GII is considered an important reference document that guides policymakers in strategic decision-making processes (Kazemzadeh et al., 2025). As shown in studies by Kurmanov et al. (2019), Brás (2023), and Abduvaliyev (2022), the GII serves not only as a strategic guide for policymakers but also as a reliable and comprehensive dataset for academic research. This index is a crucial resource for scientific studies, as it contains indicators that facilitate the analysis of the multidimensional structure of innovation.

The LPI, published by the World Bank, facilitates a comparative assessment of logistics system efficiency across different countries. The index analyzes countries' logistics performance based on various criteria. These include customs procedures efficiency, infrastructure quality, ease of international shipments, adequacy of logistics services, shipment traceability, and delivery timeliness. Countries are scored separately for each criterion, and these scores are averaged to calculate the overall LPI score. This method provides a valuable foundation for comparative analyses aimed at identifying disparities in logistics capacity and performance across countries (Rezaei et al., 2018; Wiederer et al., 2021; LPI, 2025).

2.2. Research on Logistics Performance and Innovation

The concepts of logistics performance and innovation are frequently discussed together in academic literature, and their relationship is examined using various methods. For example, Wan et al. (2022) investigated the link between logistics performance and green innovation from a sustainability perspective. According to their research findings, a significant relationship exists between logistics performance and environmental sustainability. The study emphasises that green innovation promotes environmentally friendly practices and suggests that governments should support technology-based innovations to maximise their effectiveness. A second study (Ibrahim et al., 2024) views innovation as a key driver of sustainable logistics. A third study (Nguyen & Le, 2024) considers the impact of financial crises on logistics performance. The research findings indicate that all types of financial crisis hurt logistics performance.

Unlike the above examples, this study adopts a comprehensive, country-level approach to examining the relationship between logistics performance and innovation. Various studies in the literature have examined this relationship at the country level. Examples of these studies are provided below.

This study adopts a comprehensive, country-level approach to the relationship between logistics performance and innovation. Several studies in the literature examine the relationship between logistics performance and innovation at the national level. Examples of these studies are provided below:

Loucanova et al. (2022) investigated the relationship between innovation levels and business logistics performance across European Union countries. The study uses cluster analysis to group countries based on their similarities. This enables researchers to make comparative assessments by grouping countries with similar structural and performance indicators within the same cluster. The analysis revealed that the highest-performing cluster included Germany, Sweden, Belgium, Austria, the Netherlands, Denmark, Finland, France, Spain, and Italy.

Li and Guangwen (2025) examined the relationship between logistics performance and innovation among a group of G20 countries. The study focused particularly on artificial intelligence technologies and their impact on logistics performance. The research findings revealed that artificial intelligence is a key factor in improving logistics performance. It enables businesses to more easily identify and capitalise on opportunities within their operational processes. It also facilitates the restructuring of logistics operations within a rapidly evolving technological landscape. The findings demonstrate that artificial intelligence applications add greater value to logistics operations, particularly in economically developed countries. This is because the innovation infrastructure in these countries is more advanced. Therefore, innovation-based improvements to logistics performance can be achieved more easily and effectively in these countries thanks to their strong infrastructure.

Kálmán and Tóth (2021) analysed the Visegrad Group countries using data from the Global Competitiveness Index (published by the World Economic Forum) and the LPI (provided by the World Bank). First, the study examined the correlation between the two datasets. Subsequently, structural equation modelling was employed to further evaluate these relationships. The findings suggest that information technology and innovation are key factors in logistics performance. Furthermore, the analysis revealed that Poland and the Czech Republic have higher logistics performance rankings than Slovakia and Hungary.

Logistics performance is a key factor in achieving competitive advantage and sustainable growth in global markets, which has led to increased interest in scientific research. Furthermore, innovation is increasingly important to the effectiveness of logistics processes in today's business world. Examining logistics alongside innovation allows us to assess operational efficiency, organizational agility, and innovation capacity. The literature review reveals a limited number of studies that address these two concepts holistically using MCDM methods. This study employs an analytical approach to examine the relationship between logistics performance and innovation, using MCDM to address the existing gap in this area. The method enhances the theoretical depth of the findings by providing decision-makers with a systematic perspective in multidimensional assessments. Furthermore, the integration of SWARA-MEREC-EDAS, a hybrid methodological approach proposed for the first time in the literature, enables a holistic assessment of both subjective and objective weights in the decision-making process. Thus, the study makes an original contribution from both theoretical and methodological perspectives.

2.3. Research on Logistics Performance and Innovation with MCDM Method

MCDM methods are frequently employed in academic research to evaluate logistics performance and innovation data. In the first example, Chejarla and Vaidya (2024) utilized the CRITIC and MULTIMOORA methods to analyze the logistics performance of OECD countries. In the second study, Kara et al. (2022) jointly examined logistics and innovation data, applying the Entropy and CoCoSo methods. The dataset used in their research included the GII and the Agility Emerging Markets Logistics Index for selected countries. The study by Kara et al. (2022) served as a source of inspiration for the present research, particularly regarding the integrated use of logistics and innovation data. In the third example, Yıldırım and Adıgüzel Mercangöz (2020) evaluated the LPI data of OECD countries. The evaluation was conducted using the Analytic Hierarchy Process (AHP) and the ARAS-G methods.
In the accessible literature, no study has been found that examines G7 and BRICS countries using the SWARA–MEREC-based EDAS method in conjunction with the dataset employed in this research. This highlights the significance and contribution of the present study to the existing body of literature. Accordingly, a novel model is proposed that encompasses both the methodology and the dataset. This model underscores the research's originality.

3. Methodology

In this study, a new hybrid MCDM model is proposed to evaluate the innovative logistics performance of the G7 and BRICS countries. In this context, two weighting methods, SWARA and MEREC, were used to calculate the criteria weights. The ranking of countries (i.e., the alternatives) was performed using the EDAS method. The steps of the methods used in this study are presented below.

3.1. SWARA

The Stepwise Weight Assessment Ratio Analysis (SWARA) methodology was defined by Keršuliene et al. in 2010. In this methodology, which is predicated on weightings, the decision-maker assigns relative significance and preliminary priority to each attribute. Subsequently, it ascertains the relative weight of each attribute. The SWARA method can be used in any environment as a subjective decision-support system to resolve practical and scientific debates over conflicting objectives (Šarić & Abramović, 2025). The procedural steps of the SWARA methodology are delineated as follows (Keršuliene et al., 2010; Alinezhad & Khalili, 2019):
Step 1. The Initial Prioritization of Attributes
Initially, the attributes are ranked in terms of relative significance as determined by the decision-makers.
Step 2. The Coefficient (K)
The coefficient (K) of an attribute for each decision-maker is computed utilizing Eq. (1).

$$\mathrm{K_j} = \begin{cases} 1 & \text{if} \quad \mathrm{j} = 1 \\ \mathrm{S_j} + 1 & \text{if} \quad \mathrm{j} > 1 \end{cases} \quad ; \qquad (1)$$
j=1,……………..,n

Step 3. The Initial Weight
At this step, Eq. (2) is employed to ascertain the initial weight of an attribute for each decision-maker.

$$\mathrm{K_j} = \begin{cases} \dfrac{1}{\mathrm{q_j}} \quad \text{if} \quad \mathrm{j} = 1 \\ \dfrac{}{K_\mathrm{j} \quad \text{if} \quad \mathrm{j} > 1} \end{cases} \quad ; \qquad (2)$$
j=1,……………..,n

Step 4. The Relative Weight
Eq. (3) is utilized to ascertain the relative weight of an attribute for each decision-maker.

$$\mathrm{w_j} = \frac{\mathrm{q_j}}{\sum_{\mathrm{j}=1}^{\mathrm{n}} \mathrm{q}_i} \qquad (3)$$

Step 5. The Final Ranking of Attributes
By determining the relative weight of each attribute, the values are organized in descending order, thereby yielding the final ranking.

3.2. MEREC

The Method based on the Removal Effects of Criteria (MEREC) methodology represents an efficacious objective approach for resolving complex decision-

making dilemmas by facilitating the involvement of experts with varying levels of expertise (Kara et al., 2024). The procedural steps of the MEREC methodology are defined below (Keshavarz-Ghorabaee et al., 2021; Keshavarz-Ghorabaee, 2021).
Step 1. A decision matrix is organized. The decision matrix is presented below.

$$X = \left[x_{ij}\right]_{mxn} \tag{4}$$

Step 2. The decision matrix is normalized with Eq. (5) and (6).

$$v_{ij} = \frac{x_{ij}}{\max_i x_{ij}} \text{ if } j \in NB \tag{5}$$

$$v_{ij} = \frac{\min_i x_{ij}}{x_{ij}} \text{ if } j \in NB \tag{6}$$

B and NB are shown in the equations, signifying Beneficial and Non-Beneficial, respectively.
Step 3. The overall performance (T_i) of the alternatives is computed.

$$T_i = \ln\left(1 + \left(\frac{1}{m}\sum_j \left|\ln(v_{ij})\right|\right)\right) \tag{7}$$

Step 4. The performance of alternatives (T'_{ij}) is computed by excluding each criterion.

$$T'_{ij} = \ln\left(1 + \left(\frac{1}{m}\sum k, k \neq j\left|\ln(v_{ij})\right|\right)\right) \tag{8}$$

Step 5. The summation of absolute deviations (Y_j) is obtained as follows.

$$Y_j = \sum_i \left|T'_{ij} - T_i\right| \tag{9}$$

Step 6. The weights (w_j) of criteria are computed with Eq. (10)

$$w_j = \frac{Y_j}{\sum_k Y_k} \tag{10}$$

3.3. EDAS

The Evaluation based on Distance from Average Solution (EDAS) method, formulated by Keshavarz-Ghorabaee et al. (2015), constitutes a MCDM approach grounded in the fundamental distance measurements of Positive Deviation from the Mean and Negative Deviation from the Mean to evaluate decision alternatives. The EDAS method encompasses a six-step implementation process (Keshavarz & Ghorabaee et al., 2015, p. 439; Ulutaş, 2017, p. 172). These steps are listed below.
Step 1. Forming the Decision Matrix (X) as Described Below:
The decision matrix is shown in Eq. (11). X_{ij} in the equation represents the performance of the ith alternative on the jth criterion.

$$X = \left[X_{ij}\right]_{n\,x\,m} = \begin{bmatrix} X_{11} & X_{12} & \cdots & X_{1m} \\ X_{21} & X_{22} & \cdots & X_{2m} \\ \vdots & \vdots & \vdots & \vdots \\ X_{n1} & X_{n2} & \cdots & X_{nm} \end{bmatrix} \tag{11}$$

Step 2. In normalization, the average solution is determined by considering all criteria.

$$AV_j = \frac{\sum_{i=1}^{n} X_{ij}}{n}. \tag{12}$$

Step 3. PDA and NDA values, the key indicators in the EDAS method, are calculated based on the type of criteria. These values are obtained using Equations (13)-(14) for benefit criteria, and Equations (15)-(16) for cost criteria.

$$PDA_{ij} = \frac{\max\left(0, \left(X_{ij} - AV_j\right)\right)}{AV_j} \tag{13}$$

$$NDA_{ij} = \frac{\max\left(0, \left(AV_j - X_{ij}\right)\right)}{AV_j} \tag{14}$$

$$PDA_{ij} = \frac{\max\left(0, \left(AV_j - X_{ij}\right)\right)}{AV_j} \tag{15}$$

$$NDA_{ij} = \frac{\max\left(0, \left(X_{ij} - AV_j\right)\right)}{AV_j} \tag{16}$$

Step 4. Determining the Weighted Total of PDA and NDA Values for All Alternatives:

$$SP_i = \sum_{J=1}^{M} w_j PDA_{ij}\,; \tag{17}$$

$$SN_i = \sum_{J=1}^{M} w_j NDA_{ij}\,; \tag{18}$$

w_j represents the weight of the jth criterion.
Step 5. Normalization of SP_i and SN_i Values of All Alternatives:

$$NSP_i = \frac{SP_i}{max_i(SP_i)} \tag{19}$$

$$NSN_i = 1 - \frac{SN_i}{max_i(SN_i)} \tag{20}$$

Step 6. Calculating the Evaluation Score (AS_i) of Each Alternative:

$$AS_i = \frac{1}{2}(NSP_i + NSN_i) \tag{21}$$

3.4. Calculation of the Aggregated Weighting Method

By employing Eq. (22), the cumulative weight is calculated (Ighravwe & Babatunde, 2018; Ali et al., 2020).

$$W_{Aggregated} = \Delta W_{sj} + (1-\Delta)W_{oj} \tag{22}$$

where W_{sj} and W_{oj} represent the subjective and objective weights of the criteria respectively and Δ signifies the contribution factor. Keshavarz Ghorabaee et al. (2017) proposed utilizing values of Δ ranging from 0 to 1. For this study, Δ = 0.5 was chosen, similar to the approach adopted by Özekenci (2023).

4. Dataset and application

The proposed research framework employs a systematic, multi-stage approach that integrates SWARA, MEREC, and EDAS techniques for a comprehensive evaluation. The flowchart of the proposed model is presented in Fig. 1.
The definitions of the criteria used in this study are shown in Table 1. These criteria reveal the potential outcomes resulting from the combination of logistics performance and innovation capacity for a specific group of countries.

4.1. Results Obtained from the SWARA

The SWARA survey was completed by four decision-makers with expertise in the field of logistics (a logistics academic, a manager at an international logistics company, an international customs officer, and an import/export officer). All four experts had more than ten years of professional experience in their respective fields and covered different operational aspects of logistics processes. This selection aligns with recent MCDM applications, where more than ten years of industry experience is considered an appropriate criterion for ensuring decision reliability and expert competence (Ayadi et al., 2021; Šarić & Abramović, 2025; Duan et al., 2025). Furthermore, these expert profiles were carefully selected to represent different aspects of the logistics processes covered in the study, ensuring sectoral representation despite the limited size of the panel. Many studies in the literature indicate that four decision-makers are sufficient (Ighravwe & Mashao, 2023; Sahoo et al., 2024; Gong et al., 2021). Table 2 presents the initial ranking of features obtained from the experts' evaluations.

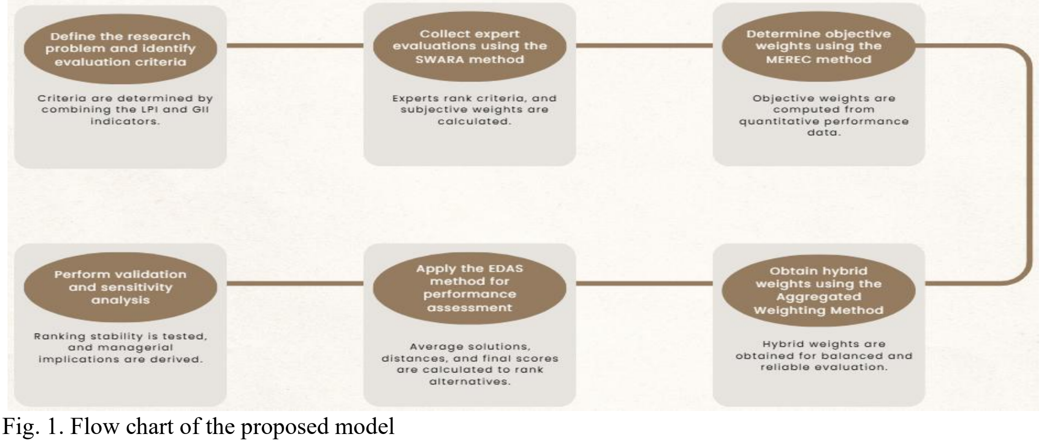

Fig. 1. Flow chart of the proposed model

Table 1. Criteria List

ILP Criteria	Source	Definitions
C1-Customs	LPI 2023	Efficiency of customs and border-management clearance procedures, including speed, simplicity, and predictability.
C2-Infrastructure	LPI 2023	Quality and availability of trade and transport infrastructure such as ports, airports, roads, and railways.
C3-International Shipments	LPI 2023	Easy and affordability of arranging competitively priced international shipments.
C4-Logistics Competence and Quality Score	LPI 2023	Competence, reliability, and quality of logistics services, including freight forwarders and carriers.
C5-Timeliness	LPI 2023	Frequency with which shipments reach consignees within the scheduled or expected delivery times.
C6-Tracking and Tracing	LPI 2023	Ability to track and trace consignments across the supply chain.
C7-Institutions	GII 2024	Political, legal, and regulatory framework, including governance quality, stability, and rule of law.
C8-Human capital and research	GII 2024	Education levels, R&D activity, research outputs, and availability of skilled human resources.
C9-Infrastructure	GII 2024	ICT access and use, energy systems, and other infrastructure supporting innovation and sustainability.
C10-Market sophistication	GII 2024	Development of financial systems, investment opportunities, market size, and openness to trade.
C11-Business sophistication	GII 2024	Firms' innovation capacity, knowledge absorption, networks, and industry–academia linkages.
C12-Knowledge and technology outputs	GII 2024	Innovation outputs such as patents, scientific publications, and high-technology exports.
C13-Creative outputs	GII 2024	Cultural goods, creative industries, branding, design, and other creative economic outputs.

Table 2. The Initial Prioritization Matrix

Criteria	Decision Maker (DM)								Average Importance Scores
	DM1	DM2	DM3	DM4	DM1	DM2	DM3	DM4	
C1	3	2	1	2	0,846	0,923	1	0,923	0,923
C2	6	6	5	6	0,615	0,615	0,692	0,615	0,634
C3	4	5	3	1	0,769	0,692	0,846	1	0,827
C4	1	4	7	7	1	0,769	0,538	0,538	0,711
C5	2	1	4	3	0,923	1	0,769	0,846	0,885
C6	5	3	6	4	0,692	0,846	0,615	0,769	0,731
C7	7	7	2	5	0,538	0,538	0,923	0,692	0,673
C8	8	10	11	10	0,462	0,308	0,231	0,308	0,327
C9	9	11	10	11	0,385	0,231	0,308	0,231	0,289
C10	12	9	8	9	0,154	0,385	0,462	0,385	0,347
C11	11	8	9	8	0,231	0,462	0,385	0,462	0,385
C12	10	12	12	12	0,308	0,154	0,154	0,154	0,193
C13	13	13	13	13	0,077	0,077	0,077	0,077	0,077

The consistency of expert judgments was assessed by comparing the rankings of four decision-makers' criteria. The overall rankings indicate strong consensus among experts. Most experts rated criteria C1–C5 as the most important and C9–C13 as the least important. While minor differences were observed, they did not affect the overall trend. The preliminary and comparative weights for each decision-maker were calculated, and the results are presented in Table 3.

Table 3. The Final Weights of SWARA

Criteria	Average Importance Scores	s_j	K_j	q_j	w_j
C1	0,923	0,0000	1,0000	1,0000	0,1073
C5	0,885	0,0385	1,0385	0,9629	0,1033
C3	0,827	0,0578	1,0578	0,9104	0,0977
C6	0,731	0,0963	1,0963	0,8304	0,0891
C4	0,711	0,0192	1,0193	0,8147	0,0874
C7	0,673	0,0385	1,0385	0,7845	0,0842
C2	0,634	0,0385	1,0385	0,7555	0,0811
C11	0,385	0,2493	1,2493	0,6047	0,0649
C10	0,347	0,0385	1,0385	0,5823	0,0625
C8	0,327	0,0193	1,0193	0,5713	0,0613
C9	0,289	0,0385	1,0385	0,5501	0,0590
C12	0,193	0,0963	1,0963	0,5018	0,0539
C13	0,077	0,1155	1,1155	0,4499	0,0483

4.2. Results Obtained from the MEREC

The decision matrix for evaluating the innovative logistics performance of G7 and BRICS countries is shown in Table 4.

The performance of the alternatives (T_{ij}), obtained by removing each criterion, is presented in Table 5. The final weights of the criteria are summarized in Table 6.

Table 4. Decision Matrix

Country	C1	C2	C3	C4	C5	C6	C7	C8	C9	C10	C11	C12	C13
Canada	4,0	4,3	3,6	4,2	4,1	4,1	78,2	58,4	54,7	67,2	56,8	41,4	44,1
France	3,7	3,8	3,7	3,8	4,1	4,0	67,5	54,4	54,9	60,9	55,5	43,6	60,8
Germany	3,9	4,3	3,7	4,2	4,1	4,2	73,5	61,4	52,9	56,4	55,3	53,9	58,6
Italy	3,4	3,8	3,4	3,8	3,9	3,9	51,2	45,4	52,5	43,1	38,7	41,4	47,5
Japan	3,9	4,2	3,3	4,1	4,0	4,0	71,2	52,9	56,3	61,5	62,5	49,7	45,1
UK	3,5	3,7	3,5	3,5	3,7	4,0	69,9	60,6	55	68,7	56,4	58,7	61,3
USA	3,7	3,9	3,4	3,9	3,8	4,2	74,9	56,7	52,3	81,5	70,6	60,2	54,9
Brazil	2,9	3,2	2,9	3,3	3,5	3,2	31,8	33,9	45,5	38,2	36,2	24,5	32,3
Russia	2,4	2,7	2,3	2,6	2,9	2,5	19,1	41,1	36,9	36,1	29,8	23,7	30,1
India	3,0	3,2	3,5	3,5	3,6	3,4	51,5	34,8	39	52,3	28,1	38,8	32,1
China	3,3	4,0	3,6	3,8	3,7	3,8	57,6	50,3	62,4	55,8	58	61,7	50
South Africa	3,3	3,6	3,6	3,8	3,8	3,8	36,5	26,8	37,1	37,8	28,6	21,4	25,3

Table 7. The values of T_{ij}

Country	C1	C2	C3	C4	C5	C6	C7	C8	C9	C10	C11	C12	C13
Canada	0,448	0,451	0,452	0,450	0,457	0,449	0,403	0,435	0,454	0,443	0,439	0,441	0,446
France	0,439	0,444	0,437	0,442	0,444	0,438	0,397	0,426	0,441	0,435	0,427	0,425	0,417
Germany	0,466	0,467	0,466	0,466	0,472	0,464	0,423	0,449	0,472	0,468	0,456	0,444	0,448
Italy	0,353	0,353	0,351	0,351	0,356	0,348	0,318	0,343	0,353	0,362	0,355	0,336	0,338
Japan	0,442	0,444	0,448	0,443	0,450	0,443	0,400	0,432	0,445	0,439	0,426	0,424	0,437
UK	0,455	0,458	0,453	0,459	0,462	0,451	0,409	0,433	0,454	0,442	0,439	0,424	0,430
USA	0,478	0,481	0,480	0,479	0,486	0,474	0,432	0,463	0,482	0,459	0,454	0,449	0,461
Brazil	0,190	0,191	0,187	0,187	0,190	0,186	0,169	0,187	0,189	0,198	0,186	0,193	0,186
Russia	0,057	0,057	0,057	0,057	0,057	0,057	0,057	0,025	0,057	0,057	0,053	0,050	0,044
India	0,264	0,267	0,252	0,259	0,264	0,259	0,217	0,261	0,274	0,255	0,277	0,242	0,263

Table 8. The Final Weights of MEREC

	C1	C2	C3	C4	C5	C6	C7	C8	C9	C10	C11	C12	C13
Y_j	0,591	0,575	0,610	0,590	0,540	0,620	0,977	0,717	0,551	0,629	0,664	0,779	0,702
w_j	0,069	0,067	0,071	0,069	0,063	0,073	0,114	0,084	0,064	0,074	0,078	0,091	0,082
Rank	9	11	8	10	13	7	1	3	12	6	5	2	4

4.3. Results Obtained from the Aggregated Weighting Method

Using Eq. (22), the total weights were derived. Table 9 shows the SWARA and MEREC weights, as well as the total results.

Table 9. Final Criteria Weights

Criteria	SWARA	MEREC	Aggregated Weighting Method
C1	0,1073	0,069	0,0882
C2	0,0811	0,067	0,0741
C3	0,0977	0,071	0,0844
C4	0,0874	0,069	0,0782
C5	0,1033	0,063	0,0832
C6	0,0891	0,073	0,0811
C7	0,0842	0,114	0,0991
C8	0,0613	0,084	0,0727
C9	0,0590	0,064	0,0615
C10	0,0625	0,074	0,0683
C11	0,0649	0,078	0,0715
C12	0,0539	0,091	0,0725
C13	0,0483	0,082	0,0652

The results show that "Institutions" is the most important criteria of innovative logistics performance, followed by "Customs", "International Shipments", "Timeliness", "Tracking and Tracing", and "Logistics Competence and Quality Score". Criteria of moderate importance include "Infrastructure" (both indicators), "Human capital and research", "Knowledge and technology outputs", "Business sophistication", and "Market sophistication", whereas "Creative outputs" has the lowest importance. Overall, the pattern highlights the importance of institutional quality and trade facilitation capabilities, reinforced by traceability and timeliness, in shaping innovative logistics performance. Fig. 2 compares the three weighting approaches.

4.4. Results Obtained from the EDAS

The ranking of the alternatives was obtained directly through the decision matrix in Table 10 and using the resulting criterion weights.

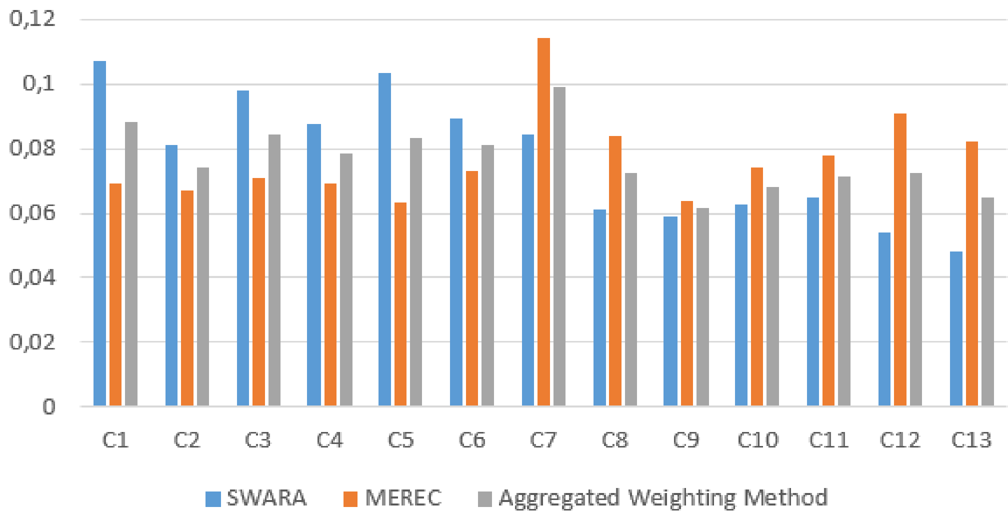

Fig. 2. Results of Criteria Weights Based on Three Weighting Approaches

Table 10. The Initial Matrix

	C1	C2	C3	C4	C5	C6	C7	C8	C9	C10	C11	C12	C13
Weights	0,08815	0,07405	0,08435	0,0782	0,08315	0,08105	0,0991	0,07265	0,0615	0,06825	0,07145	0,07245	0,06515
Canada	4,0	4,3	3,6	4,2	4,1	4,1	78,2	58,4	54,7	67,2	56,8	41,4	44,1
France	3,7	3,8	3,7	3,8	4,1	4,0	67,5	54,4	54,9	60,9	55,5	43,6	60,8
Germany	3,9	4,3	3,7	4,2	4,1	4,2	73,5	61,4	52,9	56,4	55,3	53,9	58,6
Italy	3,4	3,8	3,4	3,8	3,9	3,9	51,2	45,4	52,5	43,1	38,7	41,4	47,5
Japan	3,9	4,2	3,3	4,1	4,0	4,0	71,2	52,9	56,3	61,5	62,5	49,7	45,1
UK	3,5	3,7	3,5	3,5	3,7	4,0	69,9	60,6	55	68,7	56,4	58,7	61,3
USA	3,7	3,9	3,4	3,9	3,8	4,2	74,9	56,7	52,3	81,5	70,6	60,2	54,9
Brazil	2,9	3,2	2,9	3,3	3,5	3,2	31,8	33,9	45,5	38,2	36,2	24,5	32,3
Russia	2,4	2,7	2,3	2,6	2,9	2,5	19,1	41,1	36,9	36,1	29,8	23,7	30,1
India	3,0	3,2	3,5	3,5	3,6	3,4	51,5	34,8	39	52,3	28,1	38,8	32,1
China	3,3	4,0	3,6	3,8	3,7	3,8	57,6	50,3	62,4	55,8	58	61,7	50
South Africa	3,3	3,6	3,6	3,8	3,8	3,8	36,5	26,8	37,1	37,8	28,6	21,4	25,3

After calculating the average solutions (AV_j), the PDA and NDA values are derived, followed by the weighted and normalized distances and final assessment scores. Table 11 summarizes the G7 and BRICS rankings obtained using the EDAS method.

5. Sensitivity Analysis

Sensitivity analysis is a common core component of MCDM (Demir et al., 2024). In MCDM, sensitivity analysis is crucial for assessing the robustness of results by examining how changes in input data or weights impact decision outcomes (Demir et al., 2024; Więckowski & Sałabun, 2023). This study employed the sensitivity analysis logic developed by Roy and Shaw (2021). The weights of each criterion were increased by 10% and decreased by 20%, respectively. The effects of these weight changes on the innovative logistics performance values and corresponding rankings of all G7 and BRICS countries were then observed. A total of 52 scenarios (four experiments for each criterion) were run. Fig. 3 shows the results of the sensitivity analysis.

The sensitivity analysis results, as shown in the radar chart, demonstrate the robustness of the MCDM model. Fifty-two scenarios were examined as part of the sensitivity analysis. The analysis results indicate that no changes occurred in the country rankings. This finding demonstrates that the model is highly robust to changes in the criteria weights. Even changes made to the logistics-focused criteria (C1, C2, C9, C3, C4) did not affect the country performance rankings. Similarly, changes made to the institutional and innovation-based criteria (C7, C8, C12, C13) did not affect the results. This demonstrates that the results obtained in the study are reliable and consistent.

Table 11. The Result of the EDAS

	SP_i	NSP_i	SN_i	NSN_i	AS_i	Rank
Canada	0,1440	0,7914	0,0046	0,9863	0,8889	3
France	0,1071	0,5889	0,0000	1,0000	0,7944	6
Germany	0,1617	0,8891	0,0000	1,0000	0,9445	2
Italy	0,0165	0,0909	0,0461	0,8646	0,4777	8
Japan	0,1210	0,6650	0,0020	0,9942	0,8296	5
UK	0,1369	0,7526	0,0064	0,9813	0,8669	4
USA	0,1819	1,0000	0,0000	1,0000	1,0000	1
Brazil	0,0000	0,0000	0,2212	0,3506	0,1753	11
Russia	0,0000	0,0000	0,3406	0,0000	0,0000	12
India	0,0031	0,0172	0,1392	0,5913	0,3042	9
China	0,0876	0,4813	0,0045	0,9868	0,7340	7
South Africa	0,0092	0,0505	0,2045	0,3996	0,2251	10

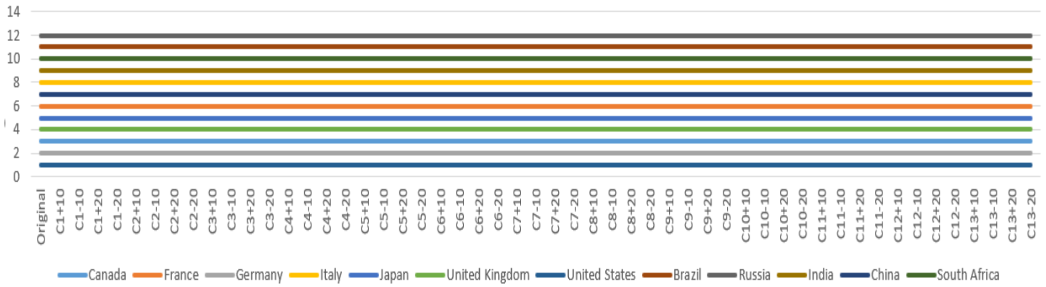

Fig. 3. Sensitivity Analysis by Changing Each Main Criteria Weight +/− 10%, +/− 20% on Ranking

6. Discussion

According to the weighting analysis, the most important criterion is "Institutions," which highlights the critical role of political, legal, and regulatory frameworks in shaping logistics and innovation performance. Factors directly related to logistics, such as Customs, International Shipments, Timeliness, and Tracking and Tracing, also have high weights, highlighting their significant impact on operational efficiency. The efficiency and effectiveness of customs services are crucial for reducing clearance times and strengthening national competitiveness (Kilibarda et al., 2017). Similarly, reliable and timely shipments together with advanced tracking systems enhance supply-chain reliability and facilitate higher trade volumes (Shikur, 2022). Interestingly, "Logistics Infrastructure" received a slightly lower weight than expected, indicating that while physical infrastructure is important, institutional and procedural efficiency may have a greater impact. In contrast, the innovation and creativity-related criteria, "Human Capital and Research," "Knowledge and Technology Outputs," "Business Sophistication," and "Creative Outputs," received lower weights, indicating their more indirect role in logistics performance. Overall, the analysis prioritizes core system functionality through governance and operational efficiency, while viewing innovation-focused factors as complementary elements of this approach. The United States, Germany, and Canada stand out as top performers in logistics performance and innovation, thanks to their strong institutional frameworks, efficient logistics operations, and advanced infrastructure. Conversely, Russia, Brazil, and South Africa rank lowest, indicating significant challenges in logistics capabilities and institutional development that need to be addressed to improve their overall performance. These results clearly demonstrate the critical role of strong governance and effective logistics processes in enhancing national competitiveness.

The findings of this study contribute significantly to the existing literature by reinforcing the critical role of institutional quality in shaping both logistics and innovation performance. Consistent with previous research (e.g., Arvis et al., 2018), the dominant weight assigned to "Institutions" emphasizes that policy stability and regulatory quality are fundamental to effective logistics systems. This finding is consistent with recent research demonstrating that strengthening organizations' institutional structures through shared values and formal rules creates stability, predictability, and legitimacy, and enhances logistics efficiency in dynamic environments (Coşkun & Erturgut, 2025). Furthermore, the quality of institutions is a key determinant of national logistics performance, as a well-functioning public sector ensures government stability and the efficient development of transport infrastructure (Rakauskienė & Petkevičiūtė-Stručko, 2022). Similarly, the high rankings of the United States, Germany, and Canada reflect the synergistic effect of strong institutions and logistics capabilities, a phenomenon also observed in OECD reports and World Bank analyses. In particular, the relatively lower weighting of innovation-focused indicators, such as “Creative Outputs” and “Human Capital and Research,” may reflect a temporal lag between innovation policy inputs and their tangible impact on logistics performance. This discrepancy challenges overly technocratic innovation policies and highlights the need for holistic, phased approaches. Countries like Russia and Brazil, which underperform on both logistics and institutional metrics, illustrate how fragmented policy design can hinder systemic efficiency.

7. Conclusion

In today's economy, where global competition is intensifying, logistics and innovation are strategic factors that enhance business competitiveness and support economic development. Logistics, in particular, is at the heart of modern production and distribution systems, laying the foundation for economic growth (Halaszovich & Kinra, 2018). Logistics and innovation are interconnected concepts that play a vital role in increasing supply chain efficiency and competitiveness. Therefore, because logistics innovation combines new technologies and strategies to improve operational performance, they should be examined together (Tang, 2024). Numerous studies examining logistics performance exist in the literature. However, research examining logistics and innovation together is quite limited. This study evaluates the innovative logistics performance of G7 and BRICS countries using integrated MCDM methods. In this context, the Innovative Logistics Performance (ILP) index is proposed by combining the LPI and GII indices.

The results show that "Institutions" is the most important criterion determining innovative logistics performance, followed by Customs, International Shipments, Timeliness, Tracking and Tracing, and Logistics Competence and Quality. The United States, Germany, and Canada achieved the highest performance levels, demonstrating the strong link between institutional quality and logistics efficiency.

This study aims to fill a significant gap in the existing literature by examining the relationship between logistics performance and innovation using the MCDM approach. Innovative applications in logistics processes have become as critical as process efficiency in enhancing business competitiveness. However, the scarcity of studies in the literature that address these two areas holistically and systematically is striking.

In this context, the research contributes to the literature from both theoretical and methodological perspectives. The proposed integrated model combines subjective (SWARA) and objective (MEREC) weighting methods with EDAS, enabling the objective analysis of complex, multidimensional assessments and guiding both academic studies and practitioners in decision-making.

7.1. Policy Recommendations

This study highlights the strategic importance of integrating logistics performance and innovation using an MCDM approach. Policymakers are encouraged to support data-driven decision-making tools, such as MCDM, to design evidence-based policies that foster innovation in logistics. Investments in intelligent infrastructure, digitalization, and research and development can significantly enhance national and regional competitiveness.

For industry stakeholders, adopting MCDM-based evaluation frameworks can improve strategic decision-making in areas such as supply chain management, resource allocation, and technology adoption. Innovation should be approached holistically-not only through technological upgrades but also via process redesign and cross-sector collaboration. Companies are advised to develop interdisciplinary teams combining logistics, data analytics, and innovation management to generate integrated solutions. Overall, the study provides a practical and analytical foundation for aligning innovation strategies with logistics performance goals, enabling both the public and private sectors to make informed, high-impact decisions in increasingly complex operating environments.

7.2. Limitations of the Study

One of the main limitations of this study is that the analysis is limited to the G7 and BRICS countries. While these two groups hold significant weight in terms of the global economy, trade, and innovation, they do not represent the full spectrum of logistics structures and development levels worldwide. Specifically, this analysis excludes developing countries, small and open economies, and regions undergoing rapid transformation in their logistics infrastructures. This reduces the generalizability of the findings and hinders the drawing of more comprehensive global conclusions. Therefore, the study's findings should be interpreted only within the context of the G7 and BRICS countries, and direct inferences should not be drawn about other country groups.

Another limitation of this study is that the data set is limited to country-level indicators for a specific period, which may not capture firm-level or dynamic changes in logistics performance and innovation capacity.

The final limitation is that the implemented MCDM framework relies on expert judgment and weighting, which inherently involves some subjectivity.

7.3. Future Research Recommendations

Future research could expand the scope of the study by including a broader range of countries in the analysis. For example, comparing countries such as the G20, OECD, and ASEAN with the G7 and BRICS could provide more general and universal findings regarding the relationship between logistics performance and innovation. Furthermore, incorporating macro-level factors such as the impact of policies, environmental factors, and digital transformation into the analysis would enhance the academic and practical value of future studies. Future studies could expand the dataset, add additional criteria, and compare hybrid weighting approaches using alternative MCDM techniques. This would increase the method's generalizability and more comprehensively test its applicability in various decision-making environments.

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