Research Article

Financial and Environmental Performance Analysis of Logistics Company on the Fortune 500 By MEREC-based AROMAN Methods

Emre Kadir ÖZEKENCİ[1]

[1]Assist. Prof., International Trade and Logistics, Cag University, ekadirozekenci@cag.edu.tr, ORCID: 0000-0001-6669-0006

Abstract: This study aims to examine the financial and environmental performance of a logistics company listed in the Fortune 500 Türkiye over the years. The current study is carried out within the scope of Ekol Logistics, one of Türkiye's leading logistics companies. The data is obtained from the Fortune 500 Türkiye and Ekol's Sustainability reports. In this study, a hybrid model integrating the method based on the removal effects of criteria (MEREC) and alternative ranking order method accounting for two-step normalization (AROMAN) method is employed. The MEREC findings showed that net sales change was the most significant criterion, while equity was the least significant criterion in the assessment of financial performance. Moreover, number of vehicles equipped with EURO 6 technology was the most significant criterion, while water consumption was the least significant criterion in the assessment of environmental performance. The AROMAN findings pointed out that Ekol's achieved the most outstanding financial results in the years 2020, 2021, and 2022. Additionally, Ekol achieved notable environmental performance in 2022. Moreover, sensitivity and comparative analysis are conducted to observe the validity of the results.

Keywords: Logistics, Fortune 500, Ekol, MEREC, AROMAN

Jel Codes:: C02, R11, L90

Fortune 500'de Yer Alan Lojistik Şirketinin MEREC Tabanlı AROMAN Yöntemiyle Finansal ve Çevresel Performans Analizi

Öz: Bu çalışma, Fortune 500 Türkiye listesinde yer alan bir lojistik şirketinin yıllar içindeki finansal ve çevresel performansını incelemeyi amaçlamaktadır. Mevcut çalışma, Türkiye'nin önde gelen lojistik şirketlerinden biri olan Ekol Lojistik kapsamında gerçekleştirilmiştir. Veriler, Fortune 500 Türkiye ve Ekol'ün Sürdürülebilirlik raporlarından elde edilmiştir. Bu çalışmada, kriterlerin etkilerinin kaldırılmasına dayalı yöntem (MEREC) ve iki aşamalı normalizasyonu hesaba katan alternatif sıralama yöntemi (AROMAN) entegre edilerek hibrit bir model uygulanmıştır. MEREC bulguları, finansal performansın değerlendirilmesinde net satış değişiminin en önemli kriter olduğunu, özkaynağın ise en az önemli kriter olduğunu göstermiştir. Ayrıca, çevresel performansın değerlendirilmesinde EURO 6 teknolojisine sahip araç sayısının en önemli kriter, su tüketiminin ise en az önemli kriter olduğu belirlenmiştir. AROMAN bulguları, Ekol'un 2020, 2021 ve 2022 yıllarında en üstün finansal sonuçlara ulaştığını ortaya koymuştur. Ayrıca, Ekol 2022 yılında dikkate değer çevresel performans elde etmiştir. Sonuçların geçerliliğini gözlemlemek için duyarlılık ve karşılaştırmalı analizler gerçekleştirilmiştir.

Anahtar Kelimeler: Lojistik, Fortune 500, Ekol, MEREC, AROMAN

Jel Kodları: C02, R11, L90

1. Introduction

The logistics industry is one of the most important performers in both national and global economies. The efficiency of companies in the logistics industry plays a critical role in the development of nations. Logistics companies' success not only captures the interest of investors but also capture the curiosity of researchers analyzing their financial performance (Cakır & Percin, 2013; Alaca & Ulutas, 2022). Performance measurement has been the subject of intense debate for several decades; however, it remains a hot topic. For instance, a significant number of studies on performance measurement has published over the years on the Web of Science platform. Sustaining interest in these research subjects is justified due to the lack of a consensus on how to define and evaluate financial performance. Performance evaluation can differ based on the company's structure and industry. Nevertheless, one of the most favored methods to assess company performance is by analyzing financial indicators such as total assets, equity, net sales, export, earnings before interest and sales. The financial performance of a company is determined by how efficiently and effectively it utilizes its resources. Moreover, financial performance demonstrates a firm's capacity to generate economic value and to entice and generate profits for shareholders (Tudose, 2022, p. 122). Due to increasing environmental concerns in recent years, the evaluation of environmental performance of companies has become as important as financial performance. The concept of sustainability has gained significant importance globally, especially with the cause of economic globalization and the rise of the environmental social movement. In the past, decision-makers primarily focused on the economic factors when making decisions. However, this trend has changed significantly in recent years. Today, the focus is projected towards the establishing sustainable practices that address the objectives of the three sustainability aspects namely, economic, environment, and social. Thus, numerous companies have either established or reassessed their business model according to sustainable practices (Janmontree & Zadek, 2020, p. 4). At this point, measuring the environmental performance of companies in the logistics industry remains to be one of the crucial issues in order to create sustainable logistics.

The main motivation of this study stems from the increasing need to performance measurement of logistics company, highlighting the importance of sustainable practices in driving long-term success. Correspondingly, the current study aims to examine the financial and environmental performance of a logistics company listed on the Fortune 500 Türkiye using hybrid Multi-Criteria Decision Making (MCDM) methods. The current study is carried out within the scope of Ekol, one of Türkiye's leading logistics companies. For this investigation, Ekol was selected due to its prominent position in the Turkish logistics sector, its innovative strategies regarding sustainable practices, and its significant impact on both economic performance and environmental responsibility. Ekol was established in 1990; it is an integrated logistics company operating in 15 countries with a various service approach in the fields of logistics, foreign trade, customs and supply chain management. Ekol is one of Europe's major logistics providers, boasting distribution centers with 1 000 000 square meters of total indoor space in Turkey, Germany, Italy, Greece, France, Ukraine, Bosnia-Herzegovina, Romania, Hungary, Spain, Poland, Czechia, Bulgaria, Slovenia and Sweden, in addition to allowing for Intermodal transportation with the utilization of its 2 Ro-Ro vessels, 52 block trains per week, 6,000 vehicles, a network of agencies in more than 900 locations in 150 countries, with almost 8.000 staff members (Ekol, 2024a). Additionally, Ekol was honored with an award in the Carbon Management category at the Sustainable Business Awards hosted by the Sustainability Academy for its innovative intermodal transportation approach within its industry (Ekol, 2024b). In light of this information, it is important to evaluate the financial and environmental performance of Ekol. Accordingly, this paper investigates the performance of a logistics company concerning the financial and environmental using a hybrid MCDM methods. Due to the lack of data, the financial and environmental performance of Ekol is evaluated for specific years. Ekol's financial performance is

evaluated for the period of 2012 and 2022, and its environmental performance is analyzed for the 2020 and 2022. The data is obtained from the Fortune 500 Türkiye and Ekol's Sustainability reports. In this study, a hybrid model integrating the method based on the removal effects of criteria (MEREC) and alternative ranking order method accounting for two-step normalization (AROMAN) method is employed. The selection of this hybrid model can be outlined as follows: (i) The methods are characterized by its simplicity, as it can be applied with straightforward procedures and does not involve complex calculations. (ii) The MEREC approach employs a categorical-based evaluation approach, effectively incorporating decision-makers' intuitive approaches to evaluating criteria. (iii) The AROMAN approach incorporates two distinct normalization process, which not only enhance the normalization process but also enable sensitivity analysis (Kara et al., 2024a).

The rest of the paper is structure as follows: section two provides a literature review on the performance evaluation of companies in the Fortune 500. Section three describes the methodology employed for assessing the financial and environmental performance of the selected logistics company. Section four demonstrates the results of the analysis obtained from the MEREC-based AROMAN methods. Additionally, the results of sensitivity and comparative analysis is presented in section four. In conclusion, the fifth section provides a summary of the main findings and offers suggestions for managerial and academic implications for future research.

2. Literature Review

Today, the MEREC and AROMAN methods have been applied across various fields, such as transportation (Bakır & İnce, 2024; Dobrodolac et al., 2024), sustainable development (Kahreman, 2024), sustainable competitiveness (Kara et al., 2024a), energy (Kara et al., 2024b), optimization (Raj et al., 2024) and economy (Lukić, 2023). Apart from this, the number of research on the performance measurement of companies has increased significantly in the last decades. Many research has been carried out utilizing diverse criteria and methodologies to assess the performance of companies operating within a particular industry during a specified timeframe. In such studies, financial indicators such as net sales, total assets, equity and export are mainly used in performance evaluation. Additionally, over the past decades, extensive research has been conducted on the performance measurement of companies included on the Fortune 500. Table 1 provides an overview of studies on performance measurement of Fortune 500 companies.

Table 1. Summary of Previous Research on Performance Evaluation

Author(s)	Year	Methods	Topic
Cakır & Percin	2013	CRITIC-SAW-VIKOR-TOPSIS	Performance measurement of logistics companies on the Fortune 500 Türkiye list
Ersoy	2017	TOPSIS-MAUT-SAW	Examining the performance of retail companies on the Fortune 500 Türkiye list
Özbek	2018	SWARA-COPRAS-GRA-TOPSIS	Evaluation of the logistics companies on the Fortune 500 Türkiye list
Ulutas	2018	ENTROPY-EDAS	Performance analysis of logistics companies on the Fortune 500 Türkiye list
Cınaroğlu	2019	SWARA-COPRAS	Examining the performance of automotive companies on the Fortune 500 Türkiye list
Ulutas & Karaköy	2019	CRITIC-ROV	Evaluation of the cargo company on the Fortune 500 Türkiye list
Topal	2021	ENTROPY-CoCoSo	Financial performance measurement of electricity companies on the Fortune Türkiye list
Cevik Aka	2021	SWARA-GRA	Performance measurement of automotive companies on the Fortune 500 Türkiye list
Erdoğan & Kırbac	2021	ENTROPY-WASPAS	Financial performance measurement of logistics companies on the Fortune Türkiye list
Alaca & Ulutas	2022	SWARA-ENTROPY-CODAS	Evaluation of the logistics companies on the Fortune 500 Türkiye list
Isık	2022	Gray ENTROPY-FUCOM-EDASM	Performance analysis of logistics companies on the Fortune 500 Türkiye list
Toslak et al.	2022	MEREC-WEDBA	Evaluation of the performance of a logistics company on the Fortune 500 Türkiye list
Ersoy	2023	IDDWS-CoCoSo	Financial performance measurement of Fortune Global 500 list
Yürüyen et al.	2023	SD-MEREC-CRITIC-LOPCOW-MACONT	Performance measurement of logistics companies on the Fortune 500 Türkiye list
Akdemir & Simsek	2023	CRITIC-COPRAS-ARAS-SAW-BORDA	Financial performance evaluation of a company on the Fortune Global 500 list: A case of Amazon
Arıkan Kargı	2024	ENTROPY-GRA	Examining the performance of electricity companies on the Fortune 500 Türkiye list

It can be seen above; a significant amount of research has been published on performance measurement of companies in the Fortune 500 using different MCDM methods. For instance, logistics (Cakır & Percin, 2013; Özbek, 2018; Ulutas, 2018; Erdoğan & Kırbac, 2021; Toslak et al., 2022; Yürüyen et al., 2023), retail (Ersoy, 2017), automotive (Cınaroğlu, 2019), electricity (Topal, 2021; Arıkan Kargı, 2024) companies have been investigated by many researchers. As a result of growing concern and consciousness regarding environmental issues, some researchers have focused on assessing towards the environmental performance of companies (Acar et al., 2015; Kolak & Feyzioglu, 2016; Aktas & Demirel, 2021; Ersoy & Taslak, 2023; Özdağoğlu et al., 2024). Previous studies have also indicated that a limited number of research have examined the evaluation of company performance by years (Ulutas & Karaköy, 2019; Toslak et al., 2022; Akdemir & Simsek, 2023). However, no studies have been found that evaluate the financial and environmental performance of a logistics company on the Fortune 500 Türkiye list using the MEREC-based AROMAN methods. Accordingly, this study aims to contribute to existing literature by investigating the financial and environmental performance of a logistics company on the Fortune 500 Türkiye by years.

3. Methodology

3.1. MEREC

Method based on the Removal Effects of Criteria (MEREC) method was developed by Keshavarz-Ghorabaee et al. in 2021. It's a new objective weighting method for calculating the criteria weights. It utilizes each criterion's removal effect on the performance of alternatives to calculate the criteria weights. The steps of the MEREC method are as follows (Keshavarz-Ghorabaee et al., 2021):

Step 1. The decision matrix is constructed.
Step 2. The decision matrix is normalized using Eqs. (1-2).

$$N_{ij} = \left\{ \frac{\underset{k}{min_{x_{kj}}}}{x_{ij}} \right\} \; if \; j \in B \quad \text{for beneficial/maximum set of criteria} \tag{1}$$

$$N_{ij} = \left\{ \frac{x_{ij}}{\underset{k}{max_{x_{kj}}}} \right\} \; if \; j \in B \, \text{for non-beneficial/minimum set of criteria} \tag{2}$$

Step 3. The overall performance of the alternatives *(S_i)* is calculated based on Eq. (3).

$$S_i = \ln\left(1 + \left(\frac{1}{m} \sum_j |\ln(N_{ij})| \right) \right) \tag{3}$$

Step 4. According to Eq. (4), the performance of the alternatives by removing each criterion is computed.

$$S'_{ij} = \ln\left(1 + \left(\frac{1}{m} \sum_{k, k \neq j} |\ln(N_{ij})| \right) \right) \tag{4}$$

Step 5. The summation of absolute deviations is calculated by Eq. (5).

$$E_j = \sum_i |S'_{ij} - S_i| \tag{5}$$

Step 6. The final weights of criteria are determined using Eq. (6).

$$w_i = \frac{E_i}{\sum_K E_k} \tag{6}$$

3.2. AROMAN

An Alternative Ranking Order Method Accounting for Two-Step Normalization (AROMAN) method was proposed by Bošković et al. in 2023. It's a novel approach to determine the final ranking of alternatives. This method consists of two types of normalization, and the obtained normalized values are aggregated into the averaged normalized decision-making matrix. The steps of the AROMAN method can be described as follows (Bošković et al., 2023):

Step 1. The initial decision matrix is formed.

Step 2. The decision matrix is normalized based on two types of normalization equations (7) and (8).

Step 2.1. *Normalization 1 (Linear)*

$$t_{ij=} \frac{x_{ij} - x_{ij}}{x_{ij} - x_{ij}} \; i = 1,2,3,\ldots.m; \; j = 1,2,3,\ldots.n \tag{7}$$

Step 2.2. Normalization 2 (Vector)

$$t_{ij}^* = \frac{x_{ij}}{\sqrt{\sum_{i=1}^m x_{ij}^2}}; i = 1,2,\ldots\ldots,m \; j = 1,2,\ldots\ldots n; \tag{8}$$

The normalization methods employed in the step 2 are utilized for both types of criteria (minimum and maximum).

Step 2.3. *Aggregated Averaged Normalization*

The aggregated averaged normalization is computed by Eq. (9).

$$t_{ij}^{norm} = \frac{\beta t_{ij} + (1 - \beta)t_{ij}^*}{2}; i = 1,2, \dots \dots, m; \quad j = 1,2, \dots \dots n; \tag{9}$$

β is a weighting factor ranging from 0 to 1. In this scenario, the value of β was considered as 0.5.

Step 3. Eq. (10) is used to multiply the aggregated averaged normalization decision-matrix with the criteria weights to obtain a weighted DM matrix.

$$t_{ij}^{\wedge} = W_{ij}.t_{ij}^{norm}; i = 1,2, \dots \dots m; \quad j = 1,2, \dots \dots n; \tag{10}$$

Step 4. Separately summarize the normalized weighted values of the criteria type min ($L_{\dot{I}}$) and the normalized weighted values of the max type ($A_{\dot{I}}$).

This can be calculated using Eq. (11) and (12).

$$L_{\dot{I}} = \sum_{j=1}^{n} \widehat{t_{\dot{I}J}}^{(min)} ; \quad \dot{I} = 1,2, \dots \dots m; j = 1,2, \dots \dots n; \tag{11}$$

$$A_{\dot{I}} = \sum_{j=1}^{n} \widehat{t_{\dot{I}J}}^{(max)} ; \quad \dot{I} = 1,2, \dots \dots m; j = 1,2, \dots \dots n; \tag{12}$$

Step 5. Eq. (13) is utilized to determine the final ranking of the alternatives (R_i).

$$R_i = L_{\dot{I}}^{\lambda} + A_{\dot{I}}^{(1-\lambda)}; \quad \dot{I} = 1,2, \dots \dots m; \tag{13}$$

where R_i is the label of the ranked alternatives and λ represents the coefficient degree of the criterion type. Since this study includes both criterion types (beneficial and non-beneficial), parameter λ can be considered 0.5. However, there is a possibility to make variations of the parameter λ when considering the criteria type. For instance, if the decision-making problem has two criteria of type min and 1 criterion of type max, this means that the coefficient λ should be 2/3. In this study, the decision-making problem has five criteria of type min, and nine criterion of type max, this means that the coefficient λ should be 5/14.

4. Results

In this study, the performance evaluation of a logistics company on the Fortune 500 Türkiye was conducted using fourteen criteria. Six of these criteria, namely, number of Euro 6 vehicles, education on sustainability, carbon footprint, energy consumption, hazardous and non-hazardous waste and water consumption are associated with environmental performance, while the remaining criteria, namely, net sales, net sales changes, earnings before interest and sales, earnings before interest and sales change, total assets, equity, export amount and number of employees are related to financial performance. The criteria were determined based on literature review (Handfield et al., 2002; Pavlovskaia, 2014; Özbek, 2018; Ulutaş & Karaköy, 2019; Topal, 2021; Isık, 2022; Shulla & Leal-Filho, 2023; Arıkan Kargı, 2024). Data was gathered from the Fortune Türkiye 500 report (https://www.fortuneturkey.com/fortune500) and Ekol's sustainability report (https://www.ekol.com/en/corporate/sustainability/reports/). Firstly, the weights of the criteria were computed using the MEREC methods. Afterwards, the financial and environmental performance of Ekol was ranked by years using the AROMAN method. Table 2 and 3 demonstrates an overview of criteria and decision matrix, respectively.

Table 2. Characteristics of Criteria

Criteria	Abbrev.	Unit	Optimization	Period	Source
Number of Vehicles (EURO 6)	VEC	Vehicle	Benefit		
Education on Sustainability	EDU	Person	Benefit		
Carbon Footprint	CFP	CO_2	Cost		
Energy Consumption	EC	MWh	Cost	2020-2022	Ekol Sustainability Report (2024c)
Waste (hazardous and non-hazardous)	WST	Tones	Cost		
Water Consumption	WC	m³	Cost		
Net Sales	NS	TL	Benefit		
Net Sales Change	NSC	%	Benefit		
Earnings Before Interest and Sales	EBIT	TL	Benefit		
Earnings Before Interest and Sales Change	EBITC	%	Benefit	2012-2022	Fortune 500 Türkiye Report (2024)
Total Assets	TA	TL	Benefit		
Equity	EQ	TL	Benefit		
Export Amount	EXP	TL	Benefit		
Number of Employees	EMP	Person	Cost		

Table 3. Decision Matrix

Year / Criteria	2011	2012	2013	2014	2015	2016
NS	509.199.165,00	629.374.958,00	918.880.247,71	1.165.174.538,00	1.512.011.385,90	1.880.452.807,90
NSC	62.65	27.73	41.90	26.80	29.76	24.36
EBIT	8.715.719,00	12.798.185,00	11.332.614,19	33.439.051,00	49.112.114,18	50.263.958,27
EBITC	5.14	46.84	91.19	195.1	46.87	2.34
TA	323.696.292,00	361.700.526,00	670.784.360,24	696.645.914,00	1.023.182.757,72	1.318.687.488,69
EQ	149.018.889,00	154.790.029,00	191.434.273,01	180.867.267,00	199.662.614,86	247.043.820,95
EXP	138.282.291,00	152.663.304,00	234.048.165,22	313.188.884,00	380.475.336,30	857.582.948,46
EMP	2130	2351	4710	5576	6580	7055

Year / Criteria	2017	2018	2019	2020	2021	2022
NS	2.465.900.679,30	3.329.325.175,74	3.341.637.376,00	3.900.651.680,90	5.991.283.662,02	12.055.140.002,73
NSC	31.13	35.01	0.3698	16.72	53.59	101.2
EBIT	25.120.100,48	113.663.193,83	79.717.128,00	272.825.746,34	488.427.353,22	927.845.576,87
EBITC	70.06	55.70	-29.86	242.24	79.02	90
TA	1.680.906.559,56	2.543.748.100,61	2.813.050.112,00	3.551.160.275,83	6.419.490.024,29	9.209.501.707,89
EQ	321.199.930,96	442.006.011,52	468.627.424,00	768.933.278,61	1.521.079.173,77	3.102.650.783,07
EXP	1.944.136.610,08	2.666.504.963,55	2.343.131.392,00	3.203.936.672,52	5.163.991.155,97	10.165.833.994,78
EMP	7989	8148	7827	7719	8273	8977

Year / Criteria	2020	2021	2022	-	-	-
VEC	419	709	765	-	-	-
EDU	3.318	4.715	5.837	-	-	-
CFP	312.774	465.612	423.693	-	-	-
EC	133.652	134.007	119.375	-	-	-
WST	4.057	4.109	3.784	-	-	-
WC	104.938	109.727	119.630			

4.1. The results obtained from the MEREC method

In order to carry out the normalization procedure, it is essential that all values in the decision matrix are positive. Nevertheless, upon reviewing Table 3, it was noted that there was a negative value in the decision matrix. Thus, the negative value was transformed into positive value using *Z*-score standardization process. *Z*-score (standard score) standardization method is well adapted for the discrete data, in which the maximum and maximum are not clear or the value exceeds a certain range (Zhang et al., 2014). Following this, the criteria were normalized based on their benefit and cost optimization using Eqs. (1-2) and the normalized decision matrix is demonstrated in Table 4.

Table 4. The Normalized Decision Matrix

Year / Criteria	NS	NSC	EBIT	EBITC	TA	EQ	EXP	EMP
2011	1,0000	0,0059	1,0000	0,0007	1,0000	1,0000	1,0000	1,0000
2012	0,8091	0,0133	0,6810	0,6375	0,8949	0,9627	0,9058	0,9060
2013	0,5542	0,0088	0,7691	0,3274	0,4826	0,7784	0,5908	0,4522
2014	0,4370	0,0138	0,2606	0,1530	0,4646	0,8239	0,4415	0,3820
2015	0,3368	0,0124	0,1775	0,6371	0,3164	0,7464	0,3634	0,3237
2016	0,2708	0,0152	0,1734	0,0024	0,2455	0,6032	0,1612	0,3019
2017	0,2065	0,0119	0,3470	0,4262	0,1926	0,4639	0,0711	0,2666
2018	0,1529	0,0106	0,0767	0,5361	0,1273	0,3371	0,0519	0,2614
2019	0,1524	1,0000	0,1093	1,0000	0,1151	0,3180	0,0590	0,2721
2020	0,1305	0,0221	0,0319	0,1233	0,0912	0,1938	0,0432	0,2759
2021	0,0850	0,0069	0,0178	0,3779	0,0504	0,0980	0,0268	0,2575
2022	0,0422	0,0037	0,0094	0,3318	0,0351	0,0480	0,0136	0,2373

Year / Criteria	VEC	EDU	CFP	EC	WST	WC	-	-
2020	1,0000	1,0000	0,6717	0,9974	0,9873	0,8772		
2021	0,5910	0,7037	1,0000	1,0000	1,0000	0,9172		
2022	0,5477	0,5684	0,9100	0,8908	0,9209	1,0000		

According to Eq. (3), the overall performance of the alternatives (S_i) was computed and illustrated in Table 5.

Table 5. The values of S_i

Financial Performance	2011	2012	2013	2014	2015	2016
S_i	0,9349	0,5242	0,6898	0,7792	0,7664	1,0909
Financial Performance	2017	2018	2019	2020	2021	2022
S_i	0,8991	1,029	0,7497	1,1504	1,2533	1,3797
Environmental Performance	2020	2021	2022			
S_i	0,0821	0,1490	0,1954			

Afterwards, the overall performance of the alternatives by removing each criterion (S_{ij}) was calculated using Eq. (4) and demonstrated in Table 6.

Table 6. The values of S_{ij}

Year / Criteria	NS	NSC	EBIT	EBITC	TA	EQ	EXP	EMP
2011	0,9349	0,6447	0,9349	0,4956	0,9349	0,9349	0,9349	0,9349
2012	0,5084	0,1393	0,4954	0,4903	0,5159	0,5214	0,5259	0,5259
2013	0,6520	0,3379	0,6732	0,6172	0,6430	0,6739	0,6913	0,6745
2014	0,7306	0,4973	0,6989	0,6653	0,7342	0,7680	0,8036	0,7954
2015	0,7011	0,4721	0,6605	0,7398	0,6972	0,7492	0,7909	0,7843
2016	1,0345	0,8976	1,0145	0,7988	1,0302	1,0695	1,0723	1,0987
2017	0,8154	0,6435	0,8437	0,8547	0,8115	0,8592	0,8177	0,8881
2018	0,9414	0,8018	0,9071	1,0008	0,9324	0,9792	0,9131	0,9911
2019	0,6319	0,7497	0,6096	0,7497	0,6131	0,6796	0,5887	0,6895
2020	1,0664	0,9870	1,0039	1,0640	1,0509	1,0833	1,0176	1,0682
2021	1,1612	1,0577	1,0981	1,2179	1,1405	1,1667	1,1149	1,1284
2022	1,2749	1,1855	1,2209	1,3444	1,2684	1,2794	1,2345	1,2222

Year /Criteria	VEC	EDU	CFP	EC	WST	WC	-	-
2020	0,0821	0,0821	0,0191	0,0455	0,0439	0,0626		
2021	0,0704	0,0972	0,1490	0,1490	0,1490	0,1365		
2022	0,1092	0,1148	0,1823	0,1794	0,1807	0,1921		

Based on Eqs. (5-6), the removal effect of each criterion on the overall performance of the alternatives based on the standard deviation and each criterion's weight was calculated, respectively. Table 7 presents the results of the MEREC method.

Table 7. The final weights

Criteria	NS	NSC	EBIT	EBITC	TA	EQ	EXP	EMP
E_j	0,6810	2,4457	0,9328	0,6238	0,7527	0,4393	0,8081	0,5327
W_j	0,0944	0,3389	0,1293	0,0864	0,1043	0,0609	0,1120	0,0738
Rank	5	1	2	6	4	8	3	7
Criteria	VEC	EDU	CFP	EC	WST	WC		
E_j	0,1647	0,1324	0,0760	0,0526	0,0529	0,0353		
W_j	0,3205	0,2577	0,1480	0,1023	0,1029	0,0686		
Rank	1	2	3	5	4	6		

The MEREC findings indicated that net sales change (NSC) was the most significant criterion, while equity (EQ) was the least significant criterion in the assessment of financial performance. Moreover, number of vehicles equipped with EURO 6 technology (VEC) was the most significant criterion, while water consumption (WC) was the least significant criterion in the assessment of environmental performance.

4.2. The results obtained from the AROMAN method

According to Eqs. (7-8), the decision matrix was normalized based on two types of normalization. The values of normalization type 1 (linear) and normalization type 2 (vector) is presented in Table 8 and 9, respectively.

Table 8. Normalization Type 1

Year / Criteria	NS	NSC	EBIT	EBITC	TA	EQ	EXP	EMP
2011	1,0000	0,0000	0,0171	0,0001	0,6357	0,2927	0,2716	0,0000
2012	1,0000	0,0000	0,0203	0,0000	0,5747	0,2459	0,2426	0,0000
2013	1,0000	0,0000	0,0123	0,0000	0,7300	0,2083	0,2547	0,0000
2014	1,0000	0,0000	0,0287	0,0000	0,5979	0,1552	0,2688	0,0000
2015	1,0000	0,0000	0,0325	0,0000	0,6767	0,1321	0,2516	0,0000
2016	1,0000	0,0000	0,0267	0,0000	0,7013	0,1314	0,4561	0,0000
2017	1,0000	0,0000	0,0102	0,0000	0,6817	0,1303	0,7884	0,0000
2018	1,0000	0,0000	0,0341	0,0000	0,7640	0,1328	0,8009	0,0000
2019	1,0000	0,0000	0,0239	0,0000	0,8418	0,1402	0,7012	0,0000
2020	1,0000	0,0000	0,0699	0,0000	0,9104	0,1971	0,8214	0,0000
2021	0,9333	0,0000	0,0761	0,0000	1,0000	0,2369	0,8044	0,0000
2022	1,0000	0,0000	0,0770	0,0000	0,7639	0,2574	0,8433	0,0000
Year / Criteria	VEC	EDU	CFP	EC	WST	WC	-	-
2020	0,0000	0,0093	1,0000	0,4265	0,0116	0,3346		
2021	0,0000	0,0086	1,0000	0,2867	0,0073	0,2345		
2022	0,0000	0,0120	1,0000	0,2804	0,0071	0,2811		

Table 9. Normalization Type 2

Year / Criteria	NS	NSC	EBIT	EBITC	TA	EQ	EXP	EMP
2011	0,7997	0,0000	0,0137	0,0001	0,5083	0,2340	0,2172	0,0000
2012	0,8305	0,0000	0,0169	0,0000	0,4773	0,2042	0,2014	0,0000
2013	0,7806	0,0000	0,0096	0,0000	0,5698	0,1626	0,1988	0,0000
2014	0,8291	0,0000	0,0238	0,0000	0,4957	0,1287	0,2229	0,0000
2015	0,8059	0,0000	0,0262	0,0000	0,5453	0,1064	0,2028	0,0000
2016	0,7630	0,0000	0,0204	0,0000	0,5351	0,1002	0,3480	0,0000
2017	0,6895	0,0000	0,0070	0,0000	0,4700	0,0898	0,5436	0,0000
2018	0,6676	0,0000	0,0228	0,0000	0,5100	0,0886	0,5347	0,0000
2019	0,6711	0,0000	0,0160	0,0000	0,5649	0,0941	0,4705	0,0000
2020	0,6266	0,0000	0,0438	0,0000	0,5704	0,1235	0,5146	0,0000
2021	0,5810	0,0000	0,0474	0,0000	0,6226	0,1475	0,5008	0,0000
2022	0,6500	0,0000	0,0500	0,0000	0,4966	0,1673	0,5481	0,0000
Year / Criteria	VEC	EDU	CFP	EC	WST	WC	-	-
2020	0,0012	0,0093	0,8786	0,3754	0,0114	0,2948		
2021	0,0014	0,0095	0,9372	0,2697	0,0083	0,2209		
2022	0,0017	0,0128	0,9287	0,2617	0,0083	0,2622		

At first, the aggregated averaged normalized values were computed by Eq. (9) and illustrates in Table 10. In this study, the value of β was considered as 0.5. Then, the

aggregated averaged normalized matrix multiply with the criteria weights (Eq. 10), and the aggregated averaged weighted normalized matrix is presented in Table 11.

Table 10. Aggregated Averaged Normalization (*β*=0.5)

Year / Criteria	NS	NSC	EBIT	EBITC	TA	EQ	EXP	EMP
2011	0,6999	0,0000	0,0120	0,0001	0,4449	0,2048	0,1901	0,0000
2012	0,7076	0,0000	0,0144	0,0000	0,4067	0,1740	0,1716	0,0000
2013	0,6951	0,0000	0,0086	0,0000	0,5075	0,1448	0,1771	0,0000
2014	0,7073	0,0000	0,0203	0,0000	0,4229	0,1098	0,1901	0,0000
2015	0,7015	0,0000	0,0228	0,0000	0,4747	0,0926	0,1765	0,0000
2016	0,6907	0,0000	0,0185	0,0000	0,4844	0,0907	0,3150	0,0000
2017	0,6724	0,0000	0,0068	0,0000	0,4583	0,0876	0,5301	0,0000
2018	0,6669	0,0000	0,0228	0,0000	0,5095	0,0885	0,5341	0,0000
2019	0,6678	0,0000	0,0159	0,0000	0,5621	0,0936	0,4682	0,0000
2020	0,6566	0,0000	0,0459	0,0000	0,5978	0,1294	0,5394	0,0000
2021	0,6119	0,0000	0,0499	0,0000	0,6556	0,1554	0,5274	0,0000
2022	0,6625	0,0000	0,0510	0,0000	0,5061	0,1705	0,5587	0,0000
Year / Criteria	**VEC**	**EDU**	**CFP**	**EC**	**WST**	**WC**	-	-
2020	0,0003	0,0070	0,7196	0,3071	0,0087	0,2410		
2021	0,0004	0,0067	0,7343	0,2108	0,0057	0,1725		
2022	0,0004	0,0092	0,7322	0,2056	0,0056	0,2061		

Table 11. Aggregated Averaged Weighted Normalized Matrix

Year / Criteria	NS	NSC	EBIT	EBITC	TA	EQ	EXP	EMP
2011	0,0661	0,0000	0,0015	0,00000	0,0464	0,0125	0,0213	0,0000
2012	0,0668	0,0000	0,0019	0,0000	0,0424	0,0106	0,0192	0,0000
2013	0,0656	0,0000	0,0011	0,0000	0,0529	0,0088	0,0198	0,0000
2014	0,0668	0,0000	0,0026	0,0000	0,0441	0,0067	0,0213	0,0000
2015	0,0662	0,0000	0,0029	0,0000	0,0495	0,0056	0,0198	0,0000
2016	0,0652	0,0000	0,0024	0,0000	0,0505	0,0055	0,0353	0,0000
2017	0,0635	0,0000	0,0009	0,0000	0,0478	0,0053	0,0594	0,0000
2018	0,0629	0,0000	0,0029	0,0000	0,0532	0,0054	0,0598	0,0000
2019	0,0630	0,0000	0,0021	0,0000	0,0586	0,0057	0,0524	0,0000
2020	0,0620	0,0000	0,0059	0,0000	0,0624	0,0079	0,0604	0,0000
2021	0,0578	0,0000	0,0064	0,0000	0,0684	0,0095	0,0591	0,0000
2022	0,0625	0,0000	0,0066	0,0000	0,0528	0,0104	0,0626	0,0000
Year / Criteria	**VEC**	**EDU**	**CFP**	**EC**	**WST**	**WC**	-	-
2020	0,0001	0,0018	0,1065	0,03142	0,0009	0,0165		
2021	0,0001	0,0017	0,1087	0,02156	0,0006	0,0118		
2022	0,0001	0,0024	0,1084	0,02104	0,0006	0,0141		

Based on Eqs. (11-12), L_i and A_i values were calculated. In order to determine the final ranking of the alternatives, the R_i values were computed by Eq. (13). In this study, the parameter λ was considered as 5/14 since five criteria of type min, and nine criterion of type max**.** Table 12 shows the results of the AROMAN method.

Table 12. Final Ranking

Year	Sum of all min criteria (Lᵢ)	Sum of all max criteria (Aᵢ)	R_i	Rank
2011	0,0000	0,14778	0,1877	9
2012	0,0000	0,14088	0,1800	12
2013	0,0000	0,14829	0,1882	8
2014	0,0000	0,14146	0,1806	11
2015	0,0000	0,14407	0,1836	10
2016	0,0000	0,15891	0,2000	7
2017	0,0000	0,17685	0,2196	6
2018	0,0000	0,18424	0,2276	4
2019	0,0000	0,18186	0,2250	5
2020	0,0000	0,19855	0,2430	2
2021	0,0000	0,20111	0,2458	1
2022	0,0000	0,19486	0,2391	3
Year	Sum of all min criteria (Lᵢ)	Sum of all max criteria (Aᵢ)	R_i	Rank
2020	0,1554	0,0019	0,1237	2
2021	0,1427	0,0018	0,1225	3
2022	0,1441	0,0025	0,1359	1

The AROMAN findings showed that Ekol's achieved the most outstanding financial results in the years 2020, 2021, and 2022. In contrast, Ekol experienced its worst financial performance in the years 2012, 2014, and 2015. Additionally, Ekol achieved notable environmental performance in 2022.

4.3. Sensitivity and Comparative Analysis

Kumar et al. (2021); Aydin and Gümüs (2022) pointed out that a sensitivity and comparative analysis is important to observe similarities and differences among MCDM methods. Furthermore, decision-makers can confirm the robustness and validity of the results obtained from the proposed model. Firstly, the stability of the AROMAN method is verified through sensitivity analysis. Author assesses the method's stability by observing variations in the aggregated normalized matrix. Introducing a trade-off parameter β (0-1) when combining two normalization techniques, the original case assumed a trade-off parameter of β = 0.5. However, the model is tested under different scenarios with an incremental value of 0.1. The results of the sensitivity analysis to changes in the trade-off parameter β are presented in Figure 1 and 2.
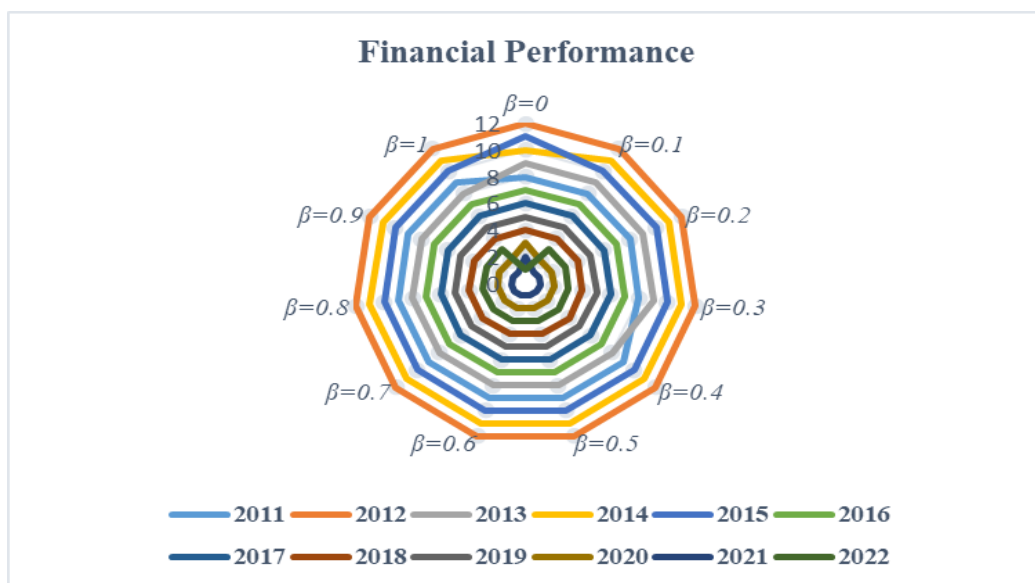
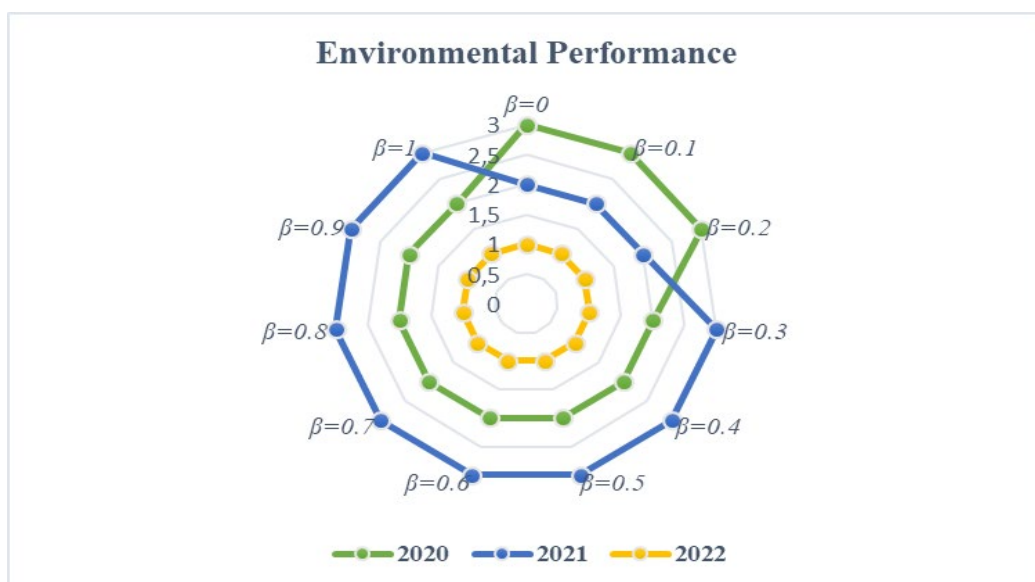**Figure 1.** Sensitivity analysis (Financial Performance)

Figure 2. Sensitivity analysis (Environmental Performance)

It can be seen above, almost the same ranking was obtained under different scenarios with an incremental value of 0.1. Thus, it can be concluded that the results are stable to changes in the trade-off parameter of β. Afterwards, the robustness of the model is tested with various MCDM methods, namely TOPSIS, WASPAS, EDAS, MARCOS and ARAS. For comparative analysis, the financial performance ranking was tested due to the availability of a more series of data covering a broader range of years. Figure 3 summarizes the ranking results obtained from the other MCDM methods.
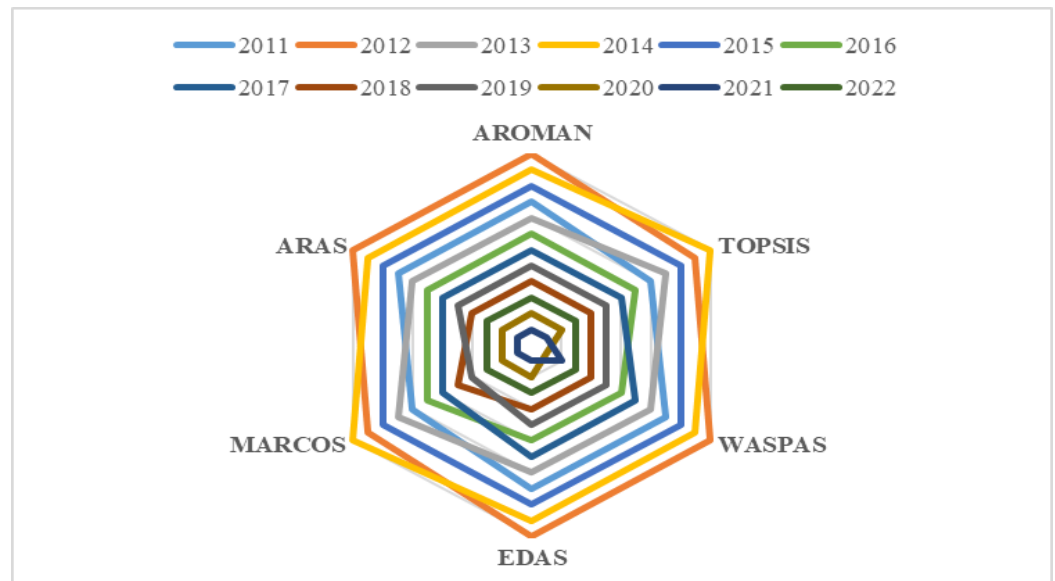
Figure 3. Comparative analysis

It can be seen above, almost the same ranking was obtained from the different MCDM methods. Thus, it can be concluded that the validity of the ranking results is confirmed.

5. Discussion and Conclusion

This paper investigates the financial and environmental performance of logistics company listed on the Fortune 500 Türkiye list. Since the assessment of performance is influenced by various factors, the hybrid MCDM method was employed in this research. The MEREC-based AROMAN method was applied to analyze how the company's performed over the years. This study was carried out within the scope of Ekol, one of Türkiye's prominent logistics companies. Ekol's financial performance was assessed from 2012 to 2022, while its environmental performance was analyzed for the years 2020 to 2022. The examined periods were determined based on the data availability. At first, the weight of the criteria was computed using the MEREC method. The MEREC findings indicated that net sales change (NSC) was the most significant criterion, while equity (EQ) was the least significant criterion in the assessment of financial performance. Moreover, number of vehicles equipped with EURO 6 technology (VEC) was the most significant criterion, while water consumption (WC) was the least significant criterion in the assessment of environmental performance. Once the weight of the criteria was determined, then the financial and environmental performance of Ekol's was evaluated with the AROMAN method. The AROMAN findings showed that Ekol's achieved the most outstanding financial results in the years 2020, 2021, and 2022. In contrast, Ekol experienced its worst financial performance in the years 2012, 2014, and 2015. These findings may help us to understand that Ekol's financial performance has increased notably between 2018 and 2022. It is evident from these findings that the Covid-19 pandemic has had a positive impact on the company's financial performance. This is supported by the fact that the highest financial performance coincided with the peak of the Covid-19 pandemic from 2020 and 2022. Indeed, these findings were anticipated as logistics industry plays a crucial role during the Covid-19 pandemic. Moreover, the results highlighted that Ekol achieved notable environmental performance in 2022. Ekol has made significant advancements in reducing its environmental footprint. Strategies such as embracing eco-friendly logistics methods, investing in energy-saving technologies, publishing sustainability report, and establishing thorough waste management programs have contributed to its environmental sustainability. Additionally, the present findings seem to be consistent with another research (Toslak et al., 2022) which found that Ekol's

achieved its highest financial performance in 2020. However, no research has been found that analyze the environmental performance of logistics companies on the Fortune 500 Türkiye. Moreover, sensitivity and comparative analysis were carried out to test the validity of the results. Based on sensitivity and comparative analysis, it can be concluded that the validity of the results is confirmed.

The findings from this study provide some academic and managerial contributions to the financial and environmental performance evaluation literature. Firstly, the use of the MEREC and AROMAN techniques in performance assessment offers a comprehensive framework that integrates various criteria, enhancing the robustness of performance evaluation. This methodological approach has the potential to be applied in forthcoming studies in various industries and regions. From a managerial perspective, the determination of net sales change as a key financial indicator, managers should focus on strategies that drive sales growth, such as expanding service offerings, improving customer service, and utilizing technology to streamline operations. The importance of incorporating EURO 6 technology-equipped vehicles in enhancing environmental performance underscores the necessity of investing in sustainable technologies. It is advisable for managers to incorporate a higher number of eco-friendly vehicles in their fleets and implement sustainable logistics practices to minimize their environmental impact. This is not only complying with regulatory standards but also increase the company's image among environmentally aware customers. Besides that, it is important to enhance export/green export activities. To achieve this, concentrate on education and training related to sustainability might be beneficial for improving the company's financial performance and reduce its carbon footprint in the long term. Overall, it is believed that the findings obtained from this study will provide insights especially to other logistics companies operating in Türkiye or to decision makers who plan to invest in the field of logistics in Türkiye in the future.

While the current study provides valuable insights into the performance of Ekol, some limitations need to be acknowledged. Although performance evaluation was carried out by 14 criteria, with 6 criteria related to environmental performance and 8 on financial performance, it may not encompass all aspects of performance evaluation. Additional criteria including customer satisfaction, operational efficiency, technological innovation might be considered for the future research. Moreover, this study concentrated solely on Ekol, a prominent player in the Turkish logistics sector and a part of the Fortune 500 Türkiye. Although this case study provides deep evaluation of one company, it limits the generalizability of the findings to other companies or industries. Finally, the environmental performance was evaluated for the years of 2020, 2021 and 2022, based on data availability. Extending the time period for assessing environmental performance would lead to a more thorough understanding.

References

Acar, E., Kılıç, M., & Güner, M. (2015). Measurement of Sustainability Performance in Textile Industry by Using a Multi-Criteria Decision-Making Method. *Textile and Apparel*, *25*(1), 3-9.

Akdemir, D. M., & Şimşek, O. (2023). A Financial Performance Evaluation via Hybrid MCDM methods: A case of Amazon. com Inc. *Istanbul Business Research*, *52*(1), 199-232.

Aktas, N., & Demirel, N. (2021). A Hybrid Framework for Evaluating Corporate Sustainability Using Multi-Criteria Decision Making. *Environment, Development and Sustainability*, *23*(10), 15591-15618.

Alaca, D., & Ulutas, A. (2022). Bütünleşik Çok Kriterli Karar Verme Modeli ile Lojistik Firmalarının Performanslarının Ölçümü. *Gümüşhane Üniversitesi Sosyal Bilimler Dergisi*, *13*(3), 1027-1045.

Arıkan Kargı, V. S. (2024). Evaluation of the Financial Performance of Electricity Generation Companies Using the Grey Relational Analysis Method. *Omer Halisdemir Universitesi Iktisadi ve Idari Bilimler Fakültesi Dergisi*, *17*(2).

Aydin, F., & Gümüs, B. (2022). Comparative Analysis of Multi-Criteria Decision-Making Methods for the Assessment of Optimal SVC Location. *Bulletin of the Polish Academy of Sciences. Technical Sciences*, *70*(2).

Bakır, M., & İnce, F. (2024). Havayolu İşletmelerinde Yolcu Memnuniyetinin LOPCOW-AROMAN Modeliyle Analizi: Star Alliance Stratejik Ortaklığı Uygulaması. *Dumlupınar Üniversitesi Sosyal Bilimler Dergisi*, (81), 168-189.

Bošković, S., Švadlenka, L., Jovčić, S., Dobrodolac, M., Simić, V., & Bacanin, N. (2023). An Alternative Ranking Order Method Accounting for Two-Step Normalization (AROMAN)—A Case Study of the Electric Vehicle Selection Problem. *IEEE Access*, *11*, 39496-39507.

Cakır, S., & Percin, S. (2013). Çok Kriterli Karar Verme Teknikleriyle Lojistik Firmalarinda Performans Ölçümü. *Ege Akademik Bakis*, *13*(4), 449.

Cevik Aka, D. (2021). Fortune 500 Türkiye Raporunda Açıklanan Otomotiv Firmalarının Performans Değerlendirilmesi. *İzmir İktisat Dergisi*, *36*(4). 745-757

Cınaroğlu, E. (2019). Fortune 500 Listesinde Yer Alan Otomotiv Sektörü Firmalarının SWARA Destekli COPRAS Yöntemi ile Değerlendirilmesi. *Çankırı Karatekin Üniversitesi İktisadi ve İdari Bilimler Fakültesi Dergisi*, *9*(2), 593-611.

Dobrodolac, M., Bošković, S., Jovčić, S., & Lazarević, D. (2024). Sustainable Delivery Model Selection Using AROMAN Approach. *Decision Making Advances*, *2*(1), 73-82.

Ekol. (2024a). Ekol's Corporate Identity. Retrieved from: https://www.ekol.com/en/corporate/ (26.06.2024)

Ekol. (2024b). Ekol's Intermodal Transport Model Wins Sustainability Award. Retrieved from: https://www.ekol.com/tr/ekolun-intermodal-tasimacilik-modeli-surdurulebilirlik-odulu-aldi/ (27.06.2024)

Ekol. (2024c). Entegre, Esnek, Etkin: Sürdürülebilirlik Raporu 2022. Retrieved from: https://www.ekol.com/tr/kurumsal/surdurulebilirlik/raporlar/ (07.06.2024)

Erdoğan, H, H., & Kırbac, G. (2021). Financial Performance Measurement of Logistics Companies Based on Entropy and Waspas Methods, *Journal of Business Research-Turk*, *13*(2), 1093-1106.

Ersoy, N. (2017). Performance Measurement in Retail Industry by Using a Multi-Criteria Decision-Making Methods. *Ege Academic Review*, *17*(4), 539-551.

Ersoy, N. (2023). Applying An Integrated Data-Driven Weighting System – CoCoSo Approach for Financial Performance Evaluation of Fortune 500 Companies. *E&M Economics and Management*, *26*(3), 92–108.

Ersoy, N., & Taslak, S. (2023). Comparative Analysis of MCDM Methods for the Assessment of Corporate Sustainability Performance in Energy Sector. *Ege Academic Review*, *23*(3), 341-362.

Fortune 500. (2024). Fortune 500 Türkiye List. Retrieved from: https://www.fortuneturkey.com/fortune500 (07.06.2024)

Handfield, R., Walton, S. V., Sroufe, R., & Melnyk, S. A. (2002). Applying Environmental Criteria to Supplier Assessment: A Study in the Application of the Analytical Hierarchy Process. *European Journal of Operational Research*, *141*(1), 70-87.

Isık, Ö. (2022). Gri entropi, FUCOM ve EDAS-M Yöntemleriyle Türk Lojistik Firmalarının Çok Kriterli Performans Analizi. *Yaşar Üniversitesi E-Dergisi*, *17*(66), 472-489.

Janmontree, J., & Zadek, H. (2020). Development of Sustainability Performance Measurement Framework for Measuring Complex Sustainability Impacts in the Manufacturing Industry. In *Data Science in Maritime and City Logistics: Data-driven Solutions for Logistics and Sustainability. Proceedings of the Hamburg International Conference of Logistics (HICL), Vol. 30* (pp. 3-31). Berlin: epubli GmbH.

Kahreman, Y. (2024). AB Ülkeleri İçin 2008 Krizi Sonrasi ESG Kapsamında Sürdürülebilir Kalkınma Performansının Değerlendirilmesi. *Uluslararası İktisadi ve İdari İncelemeler Dergisi*, (43), 73-90.

Kara, K., Yalçın, G. C., Acar, A. Z., Simic, V., Konya, S., & Pamucar, D. (2024a). The MEREC-AROMAN Method for Determining Sustainable Competitiveness Levels: A Case Study for Turkey. *Socio-Economic Planning Sciences*, *91*, 101762.

Kara, K., Yalçın, G. C., Simic, V., Yıldırım, A. T., Pamucar, D., & Siarry, P. (2024b). A Spherical Fuzzy-Based DIBR II-AROMAN Model for Sustainability Performance Benchmarking of Wind Energy Power Plants. *Expert Systems with Applications*, 124300.

Keshavarz-Ghorabaee, M., Amiri, M., Zavadskas, E. K., Turskis, Z., & Antucheviciene, J. (2021). Determination of Objective Weights Using a New Method Based on the Removal Effects of Criteria (MEREC). *Symmetry*, *13*(4), 525.

Kolak, O. I., & Feyzioglu, O. (2016). Sustainability Performance Evaluation of Transportation Networks Using MCDM Analysis. In *Proceedings of the World Congress on Engineering* (Vol. 1).

Kumar, R., Dubey, R., Singh, S., Singh, S., Prakash, C., Nirsanametla, Y., ... & Chudy, R. (2021). Multiple-Criteria Decision-Making and Sensitivity Analysis for Selection of Materials for Knee Implant Femoral Component. *Materials*, *14*(8), 2084.

Lukić, R. (2023). Analysis of the Performance of the Serbian Economy Based on the MEREC-WASPAS Method. *MARSONIA: Časopis za društvena i humanistička istraživanja*, *2*(1), 39-52.

Özbek, A. (2018). Fortune 500 Listesinde Yer Alan Lojistik Firmalarin Değerlendirilmesi. *Afyon Kocatepe Üniversitesi İktisadi ve İdari Bilimler Fakültesi Dergisi, 20*(1), 13-26.

Özdağoğlu, A., Acar, E., Güner, M., & Çetmeli Bakadur, A. (2024). Applications of MCDM Methods for the Assessment of Sustainable Development: A Case Study of Fashion Textile Group. *Management of Environmental Quality: An International Journal.*

Pavlovskaia, E. (2014). Sustainability Criteria: Their Indicators, Control, and Monitoring (With Examples from the Biofuel Sector). *Environmental Sciences Europe, 26*, 1-12.

Raj, D., Maity, S. R., & Das, B. (2024). Optimization Of Process Parameters of Laser Cladding on AISI 410 Using MEREC Integrated MABAC Method. *Arabian Journal for Science and Engineering, 49*(8), 10725-10739.

Shulla, K., & Leal-Filho, W. (2023). Achieving the UN Agenda 2030: Overall Actions for the Successful Implementation of the Sustainable Development Goals Before and After the 2030 Deadline. *European Union Parliament.*

Topal, A. (2021). Çok Kriterli Karar Verme Analizi ile Elektrik Üretim Şirketlerinin Finansal Performans Analizi: Entropi Tabanlı CoCoSo Yöntemi. *Business & Management Studies: An International Journal, 9*(2), 532-546.

Toslak, M., Aktürk, B., & Ulutas, A. (2022). MEREC ve WEDBA Yöntemleri İle Bir Lojistik Firmasının Yıllara Göre Performansının Değerlendirilmesi. *Avrupa Bilim ve Teknoloji Dergisi*, (33), 363-372.

Tudose, M. B., Rusu, V. D., & Avasilcai, S. (2022). Financial Performance–Determinants and Interdependencies between Measurement Indicators. *Business, Management and Economics Engineering, 20*(1), 119-138.

Ulutas, A. (2018). Entropi Tabanli Edas Yöntemi ile Lojistik Firmalarinin Performans Analizi. *Uluslararası İktisadi ve İdari İncelemeler Dergisi*, (23), 53-66.

Ulutas, A., & Karaköy, Ç. (2019). CRITIC ve ROV Yöntemleri ile Bir Kargo Firmasının 2011-2017 Yılları Sırasındaki Performansının Analiz Edilmesi. *MANAS Sosyal Araştırmalar Dergisi, 8*(1), 223-230.

Yürüyen, A. A., Ulutas, A., & Özdağoğlu, A. (2023). Lojistik Işletmelerinin Performansının Bir Hibrit ÇKKV Modeli ile Değerlendirilmesi. *Business & Management Studies: An International Journal, 11*(3), 731-751.

Zhang, X., Wang, C., Li, E., & Xu, C. (2014). Assessment Model of Ecoenvironmental Vulnerability Based on Improved Entropy Weight Method. *The Scientific World Journal, 2014*(1), 797814.