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Performance Analysis in the BIST Transportation and Storage Sector Using the Entropy-Weighted MOORA Method from a Cost–Revenue Perspective

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ABSTRACT

Purpose – The aim of this study is to determine the performance of companies operating in the Borsa İstanbul (BIST) Transportation and Storage Sector.

Design/methodology/approach – Using the data of the companies for the period 2020–2024, the criteria were weighted through the Entropy method. Subsequently, employing these criterion weights, the companies were ranked using the MOORA analysis method.

Findings – The analysis results revealed that, in the entropy method, marketing and distribution expenses (0.15), cost of sales (0.11), and financial expenses (0.10) had relatively high average weights among the entropy weights. CLEBI consistently demonstrated strong performance, ranking among the top three in all periods. PGSUS rose from the lowest ranks to first place, becoming the highest-performing company. THYAO exhibited the lowest performance throughout all periods, ranking last.

Discussion – The analysis provided an evaluation of the companies in terms of costs and revenues, identifying the significance level of various expense or revenue items in company performance. Considering entropy weights, effective cost–revenue management can enhance company performance.

1. Introduction

With liberalization, particularly over the last fifty years, national and international trade and competition have increasingly taken on a global dimension, enabling consumers through technology to easily access all products of any company. In the delivery of orders from different parts of the world to customers, local and global logistics management has come to the forefront. Companies that can manage the transfer of production factors and products effectively and efficiently will gain a competitive advantage through cost efficiency. Moreover, in today’s market, competition encompasses not only price advantages but also non-price factors such as customer satisfaction and prompt delivery. In this regard, Türkiye holds a unique position suitable for all modes of transportation. With its geopolitical location and status as a secure region, it serves as a significant intersection point for road, sea, air, and pipeline transportation. Additionally, its role as a bridge between continents and its proximity to production and consumption locations contribute to its logistical advantages. When this potential is effectively utilized, it is undeniable that the logistics sector will be among the leading sectors in the national economy.

Today, logistics activities begin with the transportation of a product, still in its raw material form, to the production facility before manufacturing and continue until it reaches the final consumer, extending even further with reverse logistics activities. Through reverse logistics—covering the return of goods, as well as the handling of recyclable materials such as packaging and waste—contributions are made to the circular economy by reducing the use of environmental resources such as water, energy, and trees, thereby preventing the depletion of these resources in the short term. In addition, carbon emissions are reduced, contributing to the preservation of the natural balance. Logistics activities not only play a role in production processes but also constitute an important process for improving and protecting the environment in which people live and for leaving a habitable world for future generations. For instance, the collection, sorting, and reprocessing of household or industrial waste will both ensure a cleaner environment and contribute to the economy.

ETHICAL APPROVAL: This study used secondary data and therefore did not require ethics committee approval.

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Therefore, logistics activities take place within a continuous and long-term cycle, proceeding without interruption.

In this study, the five-year performance (2020–2024) of ten companies operating in the BIST Transportation and Storage Sector was comparatively determined using the MOORA (Multi-Objective Optimization by Ratio Analysis) method, with the criteria weighted through the Entropy method. The analysis considered the amounts for cost of sales, gross profit, general administrative expenses, marketing and distribution expenses, other income from main activities, other expenses from main activities, profit before tax, operating profit, and net profit. Through the Entropy method, the importance (weights) of income and expense items were calculated, identifying which of these items should be prioritized. Based on the results, comparisons were made among alternative decision-making units, and inferences were drawn. The identification in the literature review that there are relatively few studies employing Entropy and MOORA methods together also served as a source of motivation for conducting this research.

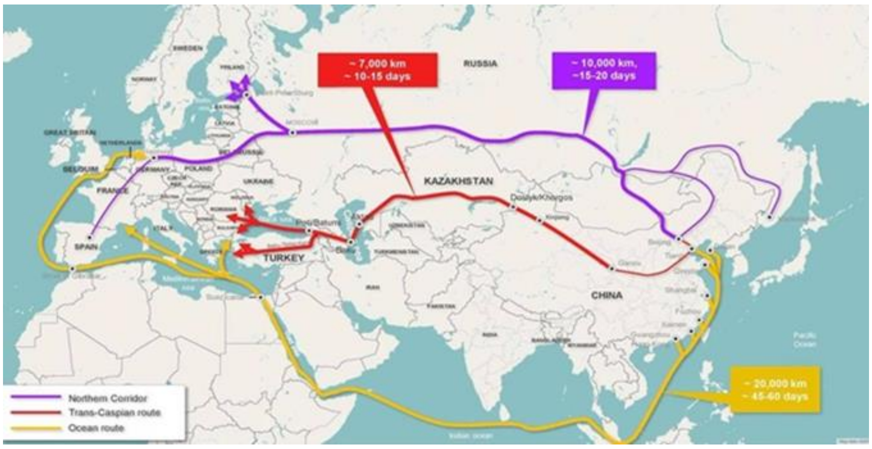


Figure 1. Transportation Routes from the Far East to Europe

Source: https://bakuresearchinstitute.org/en/the-trans-caspian-corridor-the-shortest-path-or-a-difficult-bridge-between-east-and-west-2/

If there are no adequate and secure logistics options for distributing products manufactured in the country—especially to global consumers—then, regardless of how high the quality or desirability of the products may be, problems in delivery to consumers may cause demand to shift easily toward other companies and products. Consequently, sales will decline, customer satisfaction will decrease, costs will become unsustainable, and the company may reach the point of bankruptcy.

According to figure 1, a shipment departing from China would reach Europe in approximately 45 to 60 days if using the southern corridor, and in about 15 to 20 days if using the northern corridor. However, if the Middle Corridor (Trans-Caspian), which also includes Türkiye, is used, it could reach Europe in 10 to 15 days. The Middle Corridor is about three times more advantageous than the southern corridor, which involves maritime transportation, and approximately 50% more advantageous than the northern corridor. Since the reduction in distance is directly proportional to transportation time, transportation and storage costs would also decrease significantly. On the other hand, in the northern route, the Russia–Ukraine war, sanctions imposed on Russia, and Russia's restrictions on energy and goods trade with Europe, and in the southern route, occasional piracy activities in the Suez Canal, along with tensions and wars in the Middle East, have caused commercial routes to shift toward the Middle Corridor. The uncertainty over when these instabilities in the north and south will end—and the likelihood that they will not be resolved in the short term—places Türkiye at an important crossroads.

2. Literature Review

Brauers et al. (2008) ranked 15 construction companies (contractors) using the MOORA method. Ten contractors ranked low, while the fourth contractor maintained its normal position with an average ranking. The best contractors ranked lower in terms of high costs. From the perspective of both contractors and customers, size, experience, and quality were identified as the main factors determining housing prices.

Chakraborty (2011) analyzed six decision-making alternatives using the MOORA method, including the selection of the most appropriate non-traditional machining process, rapid prototyping process, and automated inspection system for a given combination of work material and shape feature, as well as industrial robots, flexible manufacturing systems, and computer numerical control machines. The results obtained were found to be almost identical to those of previous research.

Zhang et al. (2014). To address the limitations of the conventional entropy weight method, an enhanced entropy weight assessment model was developed to evaluate eco-environmental vulnerability. This model was subsequently implemented to analyze the eco-environmental vulnerability of Western Jilin Province, China. The application of this refined approach yielded more robust evaluation criteria and achieved highly satisfactory results, demonstrating its superior analytical capacity.

Bakır and Atalık (2018) analyzed the service quality of the 11 airlines carrying the highest number of passengers in 2006 using the Entropy and ARAS methods. As a result, they determined that ANA Airlines provided the best service quality.

Şimşek and Çatır (2020) attempted to determine product selection for a hotel in the province of Uşak in terms of price, quality, delivery, relationship, and service using the MOORA method. They concluded that both quality and service criteria were the best criteria.

Petrov (2022) In this study, a hybrid approach was employed for the multi-criteria evaluation of student performance, developing three preference scenarios where theoretical learning, practical skills, and final examinations were incorporated with varying weights. It was concluded that the Multiple Assessment Integration of evaluation values from TOPSIS, MOORA, and WPM contributed to the consolidation of final results, providing a more holistic and personalized perspective of the educational process for each student.

Coşkun and Çetiner (2022) evaluated the performance of tourism companies traded on BIST between 2014 and 2021 using the price-to-sales and enterprise value-to-sales ratios, along with market-to-book value and Tobin’s q, with importance levels determined via the Entropy method and performance rankings determined via MOORA analysis. The analysis results showed that the importance weights of price-to-sales and enterprise value-to-sales ratios were high, and Tek-Art and Kuştur Tourism exhibited good performance in all years.

Gümrah (2022) analyzed the impact of logistics costs on the financial performance of 12 companies operating in the BIST food sector in 2020 and 2021 using Data Envelopment Analysis (DEA) and the MOORA method. The analysis results indicated that companies that were efficient in the DEA method also received the highest scores in the MOORA analysis, while those that were inefficient in DEA received low performance scores.

Gül and Erdem (2022) analyzed the performance of companies engaged in food retailing and traded on BIST for the period 2013–2020 using 20 financial and 3 non-financial variables via the Entropy-weighted TOPSIS method. They concluded that companies with high return on equity, a large number of branches, and good inventory management showed strong performance.

Kadooğlu Aydın et al. (2023) analyzed the performance of the seven largest and three medium-sized deposit banks in Türkiye for the years 2012–2021 using 19 ratios with the Multi-MOORA method. They found that Ziraat Bank, Türkiye İş Bank, and Yapı Kredi Bank were the highest-performing banks during the analyzed periods, whereas Denizbank and QNB Finansbank were the lowest-performing.

Beller Dikmen (2023) analyzed the performance of the railway freight transport sector between 2009 and 2020 using the Entropy-based TOPSIS method. The results revealed that the sector achieved its best performance in 2018 and its lowest performance in 2009.

Singh et al. (2024) This study presents a comprehensive and systematic literature review focusing on the MOORA method and its fuzzy extensions. The research categorizes the analyzed publications based on title, year of publication, journal name, application field, and type of fuzzy extension. The findings reveal that 76.28% of all MOORA-related studies employ standalone or hybrid approaches, whereas 23.72% utilize MOORA within a fuzzy logic environment.

Keskin (2024) analyzed the 2023 performance of 14 companies operating in the BIST 100 retail trade sector using 10 financial criteria weighted via the Entropy method and ranked them using the MOORA method. It was found that GMTAS had the highest performance and TKNSA the lowest. The study concluded that determining criterion weights via the Entropy method has a functional role in evaluating financial performance, and the MOORA method is useful for identifying high-performing companies.

Marlinda & Dewi (2024) In this research, the Entropy weighting and MOORA methods were employed to evaluate the selection of electric bicycles among teenagers based on various criteria. The 'Commuter Electric Bike' emerged as the leading alternative, achieving the highest MOORA score. The study concludes that electric bicycles represent an effective solution for mitigating environmental impacts and reducing urban traffic congestion.

Fettahlıoğlu and Çakıroğlu (2025) evaluated the performance of a food company between 2019 and 2023 in terms of number of employees, production, sales, and operating profit, weighted via the Entropy method, using both the TOPSIS and Multi-MOORA methods. They found that the company's performance increased each year under both analysis methods.

Arslan and Keskin (2025) determined the 2023 performance of 100 companies operating in the BIST stone and clay-based manufacturing sector using the Entropy and MOORA methods. They concluded that Bobet, Nuhcm, and Lmkdc had the highest performance, while Kutpo, Usak, and Quagr had the lowest.

Özbek and Aydın (2025) ranked the 2023 performance of foreign-capital banks established in Türkiye using the Entropy and ARAS methods. They found that Garanti Bank had the highest performance, while ICBC Turkey Bank had the lowest.

3. Methodology

This section includes the data of the research, the classification and evaluation of the data, the interpretation of the results obtained through the applied methods.

3.1. Data

Decision-making is a process that continues throughout an individual's life, completed by selecting the most appropriate alternative for the intended purpose, or according to criteria determined by the decision-maker, from among different alternatives. Decisions taken regarding encountered situations often involve objectives or criteria that conflict with each other. Multi-Criteria Decision-Making (MCDM) is the process of making a selection from a finite or infinite number of options based on at least two criteria (Ersöz & Kabak, 2010: 98–99). For every business, costs are important—indeed, vital—expenses for ensuring continuity and competitive advantage. Since increasing revenues is possible through effective cost management, determining the weight and potential impact of each income and expense item is a significant issue in financial management.

In this study, the performance of companies in the BIST Transportation and Storage Sector was evaluated in terms of cost–revenue, and inferences were made regarding their effects on both the national economy and the companies themselves. In this context, the performances of 10 companies operating in the BIST Transportation and Storage Sector, whose data were fully accessible, were examined for the period 2020–2024. The Microsoft Excel software suite was utilized for the classification, organization, and statistical analysis of the data obtained within the scope of this study. Since analyses conducted with different methods, different data, or different time periods may yield different results, these limitations should be considered when interpreting the results of this research.

Table 1. Companies Included in the Research

Companies (Alternatives)	BIST Code
Beyaz Filo Car Rental Inc.	BEYAZ
Çelebi Aviation Services Inc.	CLEBI
GSD Shipping Real Estate Construction Industry and Trade Inc.	GSDDE
Gür-Sel Tourism Transportation and Service Trade Inc.	GRSEL
Pasifik Eurasia Logistics Foreign Trade Inc.	PASEU
Pegasus Airlines Inc.	PGSUS
Reysaş Transportation and Logistics Trade Inc.	RYSAS
Trabzon Port Management Inc.	TLMAN
Tureks Tourism Transportation Inc.	TUREX
Turkish Airlines Inc.	THYAO

Source: Created by the author using www.kap.org.tr data.

The research analyzed the 2020–2024 performance of 10 companies, whose data were fully accessible for the analysis periods, out of the 12 companies traded in the BIST Transportation and Storage Sector, using the Entropy-weighted MOORA Reference Point method. The relevant period data were obtained from the Public Disclosure Platform (PDP), fintables.com, and the companies' official websites.

Table 2. Financial Data Used in the Analysis

Criteria	Code	Criterion Direction
Cost of Sales	CS	Minimum (Cost)
Gross Profit	GP	Maximum (Revenue)
General Administrative Expenses	GAE	Minimum (Cost)
Marketing and Distribution Expenses	MDE	Minimum (Cost)
Other Income from Main Activities	OIMA	Maximum (Revenue)
Other Expenses from Main Activities	OEMA	Minimum (Cost)
Financial Expenses	FE	Minimum (Cost)
Profit Before Tax	PBT	Maximum (Revenue)
Operating Profit	OP	Maximum (Revenue)
Net Profit for the Period	NPP	Maximum (Revenue)

The analyses were conducted by taking into account the costs and revenues of the relevant companies. In the analyses, the weights of the above financial data were first calculated using the Entropy method, and then the companies' performances were determined using the MOORA Reference Point method.

3.2. Entropy Method

Entropy is a thermodynamic concept generally used to measure the degree of systemic disorder (Zhang et al., 2014: 2). The concept of entropy has a complex history. It was first introduced in 1865 by R. Clausius in thermodynamics to define the measure of irreversible energy dispersion, which indicates the deviation of a real process from the ideal one. Over the following 150 years, it has become widely used in various scientific fields (Petrov, 2022: 7). Originating in the fields of thermodynamics and physics, the concept of entropy was adapted by Claude Shannon in 1948 as a statistical parameter in the field of communication. Its purpose of use is to measure the level of useful information obtained from a large set of data. Therefore, entropy has emerged as a technique for making objective weighting in terms of measuring the degree to which useful information can be extracted from data (Keskin, 2024: 99). In the entropy method, which is an objective weighting method, no additional data input is required for weighting the criteria; the weighting process can be carried out using the initial matrix. For this reason, it is widely preferred (Özyalçın & Bircan, 2023: 9). Compared to various subjective weighting models, the greatest advantage of the entropy method is that it minimizes the human factor in determining the weights of indicators, thereby increasing the objectivity of comprehensive evaluation results (Zhu et al., 2020: 1).

In addition, the entropy method contains a logarithmic function, and when the data contain negative numbers or zeros during the analysis, a data transformation is required. However, since proportional differentiation cannot be preserved during this transformation, it may cause problems. Although there is no universally accepted method in the literature to overcome this problem, linear normalization transformation can be applied (Apan & Öztel, 2020: 174; Karakaş & Öztel, 2020: 551). In this study, a linear normalization transformation was performed for numbers that were negative or zero.

3.3. MOORA Method

In 2006, Brauers and Zavadskas developed a new method for multi-objective optimization called MOORA. MOORA is a ratio system in which the responses of each alternative for each objective are compared with the square root of the sum of the squares of the responses. In the MOORA method, multiple objectives are replaced by a single super-objective, and intermediate alternatives do not appear in the top rankings. In this respect, it has been proven to be superior to other ratio systems (Brauers & Zavadskas, 2006: 463).

Compared to other multi-criteria decision-making methods such as AHP, TOPSIS, ELECTRE, VIKOR, PROMETHEE, and GRA, the MOORA method is simple to understand and apply. Since this method is based on simple ratio analysis, it requires less mathematical computation and less time. Another advantage is that no additional parameters need to be added during the calculation process (for example, "v" in the VIKOR method or "ξ" in the GRA method). For these reasons, the MOORA method is a highly stable analysis method for various decision-making problems (Chakraborty, 2022: 1164).

The concept of utility has always been an important point in the decision-making process. The utility process can be reduced to four solution steps:
a) selection of a unit per objective,
b) normalization,
c) optimization,
d) assigning importance to an objective.

By fulfilling all these conditions, the MOORA method can serve as a fully functional form of analysis for multi-objective optimization. MOORA is supported by the Reference Point method, which has a maximum target reference point and can verify and confirm the results of MOORA. Research has found that ratios containing the sum of the responses of alternatives per objective in the denominator can also serve as a control method. For both MOORA and the Reference Point method, square root ratios are the most appropriate (Brauers & Zavadskas, 2006: 465).

Table 3. Comparison of Some Commonly Used MCDM Methods

Method	Calculation Time	Mathematical Calculations	Simplicity	Reliability	Data Type
MOORA	Very Low	Very Low	Very Simple	Good	Numerical
AHP	Very High	Very High	Very Critical	Weak	Mixed
TOPSIS	Average	Medium	Moderately Difficult	Medium	Numerical
VIKOR	Low	Medium	Simple	Medium	Numerical
ELECTRE	High	Medium	Moderately Difficult	Medium	Mixed
PROMETHEE	High	Medium	Moderately Difficult	Medium	Mixed

Source: Chakraborty, 2011: 1165

The superior features of the MOORA method compared to other methods are as follows (Keskin, 2024: 101):
a) the algorithm used contains an objective rather than a subjective characteristic,
b) it performs an objective weighting,
c) it can simultaneously evaluate the interactions between both the alternatives and the objectives,
d) it can evaluate by taking all objectives into consideration.

In the MOORA importance coefficient approach, the determined weight coefficients are multiplied by the performance scores. The maximization criteria among the alternatives are summed, while the minimization criteria are subtracted, and by obtaining normalized values according to the importance coefficients and objectives, the ranking is performed (Ertuğrul & Deniz, 2018: 249).

4. Findings

Through the analysis conducted, 10 companies operating in the BIST Transportation and Storage Sector during the period covering the years 2020–2024 were examined. For the analyses, the amounts for cost of sales, gross profit, general administrative expenses, marketing and distribution expenses, other expenses and income from main activities, financial expenses, profit before tax, operating profit, and net profit for the period were used. First, the weights were determined using the Entropy method, and then the companies were ranked using the MOORA method.

Table 4. Construction of the Decision Matrix for Entropy and MOORA

Firms–Data	CS	GP	GAE	MDE	OIMA	OEMA	FE	PBT	OP	NPP
BEYAZ	14.808.519.067	345.446.063	116.415.380	122.190.578	23.049.844	128.883.057	94.718.361	-32.862.334	1.006.892	-37.853.286
CLEBİ	13.176.597.415	6.001.408.997	1.684.998.263	0	213.015.904	270.262.660	669.985.570	4.274.622.451	4.259.163.978	3.588.308.926
GSDDE	353.358.000	196.533.000	49.322.000	0	137.634.000	37.744.000	53.154.000	-21.815.000	247.098.000	-34.559.000
GRSEL	5.867.801.905	2.461.540.725	243.418.121	6.018.410	173.487.552	143.664.354	391.610.450	1.789.587.855	2.241.927.392	1.744.446.786
PASEU	1.172.105.296	318.097.923	89.863.184	16.221.630	111.397.135	72.537.982	43.834.600	246.521.064	250.872.262	205.241.173
PGSUS	86.596.697.071	25.225.825.207	3.315.359.966	2.167.241.251	1.374.533.380	310.536.395	12.835.462.663	11.922.457.931	20.807.220.975	13.285.437.677
RYSAS	5.436.103.737	5.712.974.396	765.763.829	21.068.423	507.292.474	248.055.494	3.228.880.233	2.393.481.485	5.185.379.123	2.522.976.843
TLMAN	440.153.055	151.408.518	13.864.002	724.596	15.664.607	38.358.938	12.331.505	174.334.277	114.125.589	117.219.455
TUREX	4.477.852.000	833.081.000	303.339.000	0	97.251.000	88.901.000	223.049.000	693.177.000	538.092.000	213.606.000
THYAO	602.522.000.000	142.908.000.000	18.675.000.000	60.283.000.000	20.286.000.000	3.843.000.000	50.335.000.000	121.421.000.000	80.393.000.000	113.357.000.000

The analysis began with the creation of the decision matrix, which shows the alternatives and criteria, as the first stage of the Entropy method.

Table 5. Positive Decision Matrix for Entropy

Firms	CS	GP	GAE	MDE	OIMA	OEMA	FE	PBT	OP	NPP
BEYAZ	0,024005	0,001359	0,005495	0,002027	0,000364	0,023951	0,001637	0,000010	0,000010	0,000010
CLEBİ	0,021295	0,040979	0,089552	0,000010	0,009736	0,061105	0,013069	0,035466	0,052967	0,031978
GSDDE	0,000010	0,000316	0,001900	0,000010	0,006017	0,000010	0,000811	0,000091	0,003061	0,000029
GRSEL	0,009158	0,016182	0,012301	0,000100	0,007786	0,027835	0,007537	0,015005	0,027875	0,015718
PASEU	0,001360	0,001168	0,004073	0,000269	0,004723	0,009144	0,000626	0,002300	0,003108	0,002144
PGSUS	0,143221	0,175645	0,176918	0,035951	0,067037	0,071688	0,254818	0,098435	0,258810	0,117495
RYSAS	0,008441	0,038958	0,040292	0,000349	0,024254	0,055269	0,063918	0,019977	0,064489	0,022583
TLMAN	0,000144	0,00001	0,000010	0,000012	0,000010	0,000162	0,000010	0,001706	0,001407	0,001368
TUREX	0,006849	0,004775	0,015512	0,000010	0,004025	0,013444	0,004187	0,005978	0,006681	0,002218
THYAO	1,000000	1,000000	1,000000	1,000000	1,000000	1,000000	1,000000	1,000000	1,000000	1,000000

Due to the presence of negative values in the aforementioned table, the matrix was positive-transformed using the following formula. During this process, the minimum value within the relevant criterion becomes "0," while the maximum value becomes "1". Since the logarithm function is undefined for "0," this value has been assigned as "0.00001" (Apan & Öztel, 2020:7).

$$x'_{21} = \frac{x_{21-min_{i\epsilon\iota}\ x_{i18}}}{max_{i\epsilon\iota\, x_{i18}} - min_{i\epsilon\iota\, x_{i18}}}$$

$$= \frac{14.808.519.067 - 353.358.000}{602.522.000.000 - 353.358.000}$$

$$= \frac{14.455.161.067}{602.168.642.000}$$

$$= 0{,}024005171$$

Table 6. Normalized Decision Matrix for Entropy

Firms	CS	GP	GAE	MDE	OIMA	OEMA	FE	PBT	OP	NPP
BEYAZ	0,01977	0,00106	0,00408	0,00195	0,00032	0,01897	0,00122	0,00001	0,00001	0,00001
CLEBİ	0,01753	0,03203	0,06653	0,00001	0,00866	0,04840	0,00970	0,03008	0,03734	0,02679
GSDDE	0,00001	0,00025	0,00141	0,00001	0,00535	0,00001	0,00060	0,00008	0,00216	0,00002
GRSEL	0,00754	0,01265	0,00914	0,00010	0,00693	0,02205	0,00560	0,01273	0,01965	0,01317
PASEU	0,00112	0,00091	0,00303	0,00026	0,00420	0,00724	0,00046	0,00195	0,00219	0,00180
PGSUS	0,11793	0,13729	0,13143	0,03461	0,05964	0,05678	0,18923	0,08349	0,18246	0,09844
RYSAS	0,00695	0,03045	0,02993	0,00034	0,02158	0,04377	0,04747	0,01694	0,04547	0,01892
TLMAN	0,00012	0,00001	0,00001	0,00001	0,00001	0,00013	0,00001	0,00145	0,00099	0,00115
TUREX	0,00564	0,00373	0,01152	0,00001	0,00358	0,01065	0,00311	0,00507	0,00471	0,00186
THYAO	0,82340	0,78162	0,74291	0,96271	0,88972	0,79201	0,74260	0,84820	0,70502	0,83784

In the decision matrix, normalization was carried out by dividing the value in each cell by the sum of its respective column. Before performing this process, a transformation to positive values was applied for the negative data in the decision matrix. Through the normalization process, the data took values between 0 and 1.

Table 7. Entropy Values

Firms	CS	GP	GAE	MDE	OIMA	OEMA	FE	PBT	OP	NPP
BEYAZ	-0,07756	-0,00727	-0,02246	-0,01217	-0,00260	-0,07521	-0,00816	-0,00010	-0,00008	-0,00010
CLEBİ	-0,07090	-0,11022	-0,18030	-0,00011	-0,04114	-0,14656	-0,04498	-0,10540	-0,12277	-0,09698
GSDDE	-0,00010	-0,00205	-0,00926	-0,00011	-0,02800	-0,00009	-0,00447	-0,00073	-0,01325	-0,00026
GRSEL	-0,03685	-0,05528	-0,04291	-0,00089	-0,03444	-0,08410	-0,02902	-0,05554	-0,07722	-0,05702
PASEU	-0,00761	-0,00639	-0,01755	-0,00214	-0,02299	-0,03569	-0,00357	-0,01217	-0,01342	-0,01136
PGSUS	-0,25209	-0,27261	-0,26671	-0,11642	-0,16816	-0,16287	-0,31503	-0,20731	-0,31041	-0,22822
RYSAS	-0,03453	-0,10632	-0,10503	-0,00269	-0,08278	-0,13696	-0,14466	-0,06910	-0,14052	-0,07507
TLMAN	-0,00107	-0,00009	-0,00009	-0,00013	-0,00010	-0,00115	-0,00009	-0,00946	-0,00686	-0,00776
TUREX	-0,02920	-0,02087	-0,05144	-0,00011	-0,02017	-0,04837	-0,01795	-0,02679	-0,02524	-0,01168
THYAO	-0,16000	-0,19258	-0,22078	-0,03659	-0,10396	-0,18468	-0,22099	-0,13965	-0,24643	-0,14824
ej	**0,29094**	**0,33600**	**0,39804**	**0,07442**	**0,21904**	**0,38030**	**0,34263**	**0,27198**	**0,41527**	**0,27650**

In the fourth step of the analysis, the entropy value (ej) is calculated using the follwing formula. At this stage, the data also take values between 0 and 1.

$$e_j = -\frac{1}{\ln(m)} \sum_{i=1}^{m} r_{ij} \ln r_{ij}$$

Table 8. Degree of Diversification for Entropy

	CS	GP	GAE	MDE	OIMA	OEMA	FE	PBT	OP	NPP
dj	0,70906	0,66400	0,60196	0,92558	0,78096	0,61970	0,65737	0,72802	0,58473	0,72350

In the fifth stage, the degrees of diversification are calculated using the following formula.

$$d_j = 1 - e_j$$

Table 9. Entropy Weight Values for Entropy

	CS	GP	GAE	MDE	OIMA	OEMA	FE	PBT	OP	NPP

wj	0,10137	0,09493	0,08606	0,13232	0,11165	0,08859	0,09398	0,10408	0,08359	0,10343

In the final stage, using the following formula, the entropy weight values of each criterion are calculated by dividing each degree of diversification by the total degree of diversification.

$$w_j = \frac{d_j}{\sum_{p=1}^{n}(d_j)}$$

Table 10. Weight Values Calculated According to the Entropy Method

Years	CS	GP	GAE	MDE	OIMA	OEMA	FE	PBT	OP	NPP
2020	0,14926	0,01826	0,13386	0,19675	0,13712	0,11624	0,13999	0,01036	0,08795	0,01022
2021	0,11067	0,14225	0,10225	0,15190	0,11576	0,06311	0,11112	0,10167	0,07622	0,02505
2022	0,10605	0,10345	0,08244	0,13351	0,09421	0,08016	0,08946	0,10622	0,09762	0,10689
2023	0,09836	0,09780	0,08131	0,13239	0,11098	0,09445	0,08547	0,10327	0,09020	0,10577
2024	0,10137	0,09493	0,08606	0,13232	0,11165	0,08859	0,09398	0,10408	0,08359	0,10343
Average	0,11314	0,09134	0,09718	0,14938	0,11394	0,08851	0,10400	0,08512	0,08712	0,07027

As the entropy value increases, the importance of the corresponding value also increases (Wu & Lin, 2012: 1335). According to the table above, the weights of the financial data have varied over the periods examined. The most notable financial data are the weights of gross profit, profit before tax, and net profit for the period. These weights, i.e., levels of importance, were approximately 0.01 in 2020 but exceeded 0.10 in the following years, thereby increasing their importance levels. The importance level of gross profit showed the greatest increase particularly in 2021. Overall, marketing, sales, and distribution expenses stand out as the most important financial data across all periods.

Table 11. Ranking of Entropy Weights According to Average Value

Criterias	**Average Entropy Value**	**Ranking by Average**
MDE	0,14938	1
OIMA	0,11394	2
CS	0,11314	3
FE	0,10400	4
GAE	0,09718	5
GP	0,09134	6
OEMA	0,08851	7
OP	0,08712	8
PBT	0,08512	9
NPP	0,07027	10

According to the averages of the entropy weights for the years 2020–2024, the criterion with the highest degree of importance is marketing, sales, and distribution expenses, while net profit for the period is the criterion with the least importance. Marketing, sales, and distribution expenses, cost of sales, financial expenses, and general administrative expenses are among the top five criteria with the highest importance levels. Among the income items, only the criterion of other income from main activities ranks second in terms of importance. From the perspective of costs and revenues, the expense items are significant for companies and are criteria that require close attention. In short, although it may seem like a traditional approach, it can be concluded that reducing expenses has special importance for increasing revenues. However, in order to achieve high-quality and sustainable production, it may not be possible to reduce production expenses such as raw materials, labor, maintenance and repair, electricity, water, and gas. It is not possible to produce or provide services with low-quality raw materials, cheap labor, and equipment that has not been maintained. With effective and efficient cost management, expenses should be kept at an optimum level. For this purpose, by differentiating production or service methods, paying attention to stock turnover time, and managing waste and residuals, innovative management approaches can be adopted to achieve effective cost management.

Once the weights of the criteria were determined, the relevant criteria were included in the analysis using the MOORA method. The processes related to the 2024 MOORA performance analysis are given in the tables below.

In the first stage, the standard decision matrix is created. Since the standard decision matrix is provided in Table 4, it has not been reproduced here.

Table 12. Normalized Decision Matrix for MOORA

Firms	CS	GP	GAE	MDE	OIMA	OEMA	FE	PBT	OP	NPP
BEYAZ	0,02431	0,00238	0,00611	0,00203	0,00113	0,03322	0,00182	-0,00027	0,00001	-0,00033
CLEBİ	0,02163	0,04128	0,08840	0,00000	0,01047	0,06966	0,01287	0,03500	0,05110	0,03141
GSDDE	0,00058	0,00135	0,00259	0,00000	0,00677	0,00973	0,00102	-0,00018	0,00296	-0,00030
GRSEL	0,00963	0,01693	0,01277	0,00010	0,00853	0,03703	0,00752	0,01465	0,02690	0,01527
PASEU	0,00192	0,00219	0,00471	0,00027	0,00548	0,01870	0,00084	0,00202	0,00301	0,00180
PGSUS	0,14217	0,17352	0,17393	0,03593	0,06757	0,08004	0,24659	0,09763	0,24965	0,11630
RYSAS	0,00892	0,03930	0,04017	0,00035	0,02494	0,06393	0,06203	0,01960	0,06222	0,02209
TLMAN	0,00072	0,00104	0,00073	0,00001	0,00077	0,00989	0,00024	0,00143	0,00137	0,00103
TUREX	0,00735	0,00573	0,01591	0,00000	0,00478	0,02291	0,00429	0,00568	0,00646	0,00187
THYAO	0,98919	0,98301	0,97971	0,99935	0,99726	0,99051	0,96701	0,99429	0,96458	0,99235

In the second stage, the criteria values are normalized using the following formula for each alternative by dividing each criterion by the square root of the sum of squares of the corresponding criterion.

$$r_{ij} = \frac{h_{ij}}{\sqrt[2]{\sum_{k=1}^{m} x^2{}_{kj}}}$$

Table 13. Weighted Normalized Decision Matrix for MOORA

	MİN	MAX	MİN	MİN	MAX	MİN	MİN	MAX	MAX	MAX
Firms	CS	GP	GAE	MDE	OIMA	OEMA	FE	PBT	OP	NPP
BEYAZ	0,00246	0,00023	0,00053	0,00027	0,00013	0,00294	0,00017	-0,00003	0,00000	-0,00003
CLEBİ	0,00219	0,00392	0,00761	0,00000	0,00117	0,00617	0,00121	0,00364	0,00427	0,00325
GSDDE	0,00006	0,00013	0,00022	0,00000	0,00076	0,00086	0,00010	-0,00002	0,00025	-0,00003
GRSEL	0,00098	0,00161	0,00110	0,00001	0,00095	0,00328	0,00071	0,00153	0,00225	0,00158
PASEU	0,00020	0,00021	0,00041	0,00004	0,00061	0,00166	0,00008	0,00021	0,00025	0,00019
PGSUS	0,01441	0,01647	0,01497	0,00475	0,00754	0,00709	0,02317	0,01016	0,02087	0,01203
RYSAS	0,00090	0,00373	0,00346	0,00005	0,00278	0,00566	0,00583	0,00204	0,00520	0,00228
TLMAN	0,00007	0,00010	0,00006	0,00000	0,00009	0,00088	0,00002	0,00015	0,00011	0,00011
TUREX	0,00075	0,00054	0,00137	0,00000	0,00053	0,00203	0,00040	0,00059	0,00054	0,00019
THYAO	0,10027	0,09331	0,08431	0,13224	0,11134	0,08775	0,09088	0,10348	0,08063	0,10264
Reference Point	0,00006	0,09331	0,00006	0,00000	0,11134	0,00086	0,00002	0,10348	0,08063	0,10264

By multiplying each value in the normalized decision matrix by the corresponding entropy weight value, the matrix in Table 13 is obtained. Depending on whether a criterion is to be minimized or maximized, the smallest or largest value in the corresponding criterion's column is identified as the reference point. The following formula was used fort his calculation.

$$y_i *= \sum_{j=1}^{g} h_{ij}{}^* - \sum_{j=g+1}^{n} h_{ij}{}^*$$

Table 14. Normalized Decision Matrix According to the Tchebycheff Algorithm for MOORA

	MİN	MAX	MİN	MİN	MAX	MİN	MİN	MAX	MAX	MAX
Firms	CS	GP	GAE	MDE	OIMA	OEMA	FE	PBT	OP	NPP
BEYAZ	0,00241	0,09309	0,00046	0,00027	0,11122	0,00208	0,00015	0,10351	0,08063	0,10268
CLEBİ	0,00213	0,08939	0,00754	0,00000	0,11017	0,00531	0,00119	0,09984	0,07636	0,09939
GSDDE	0,00000	0,09319	0,00016	0,00000	0,11059	0,00000	0,00007	0,10350	0,08038	0,10267
GRSEL	0,00092	0,09171	0,00104	0,00001	0,11039	0,00242	0,00068	0,10196	0,07838	0,10106
PASEU	0,00014	0,09311	0,00034	0,00004	0,11073	0,00079	0,00006	0,10327	0,08038	0,10246
PGSUS	0,01435	0,07684	0,01491	0,00475	0,10380	0,00623	0,02315	0,09332	0,05976	0,09061
RYSAS	0,00085	0,08958	0,00339	0,00005	0,10856	0,00480	0,00581	0,10144	0,07543	0,10036
TLMAN	0,00001	0,09321	0,00000	0,00000	0,11126	0,00001	0,00000	0,10334	0,08052	0,10253
TUREX	0,00069	0,09277	0,00131	0,00000	0,11081	0,00117	0,00038	0,10289	0,08009	0,10245
THYAO	0,10021	0,00000	0,08425	0,13224	0,00000	0,08689	0,09086	0,00000	0,00000	0,00000

With the Tchebycheff algorithm using the following formula, the absolute difference between the reference point in each column of Table 12 and the criterion values in the corresponding column is calculated.

$$min_i\{max_j\left(\left|r_j - h_{ij}\right|\right)\}$$

Table 15. Ranking of Alternatives for 2024 for MOORA

Alternatives	Scores	Ranking
PGSUS	0,10380	1
RYSAS	0,10856	2
CLEBİ	0,11017	3
GRSEL	0,11039	4
GSDDE	0,11059	5
PASEU	0,11073	6
TUREX	0,11081	7
BEYAZ	0,11122	8
TLMAN	0,11126	9
THYAO	0,13224	10

In the final stage, the maximum distances of the alternatives from the reference point are determined. For this, the largest value in the relevant row of each alternative is selected, and the alternatives are ranked accordingly. In the reference point approach, the smaller value indicates the best alternative, as it is closer to the reference point and shows the least deviation.

Table 16. MOORA Method Analysis Results for 2020–2024

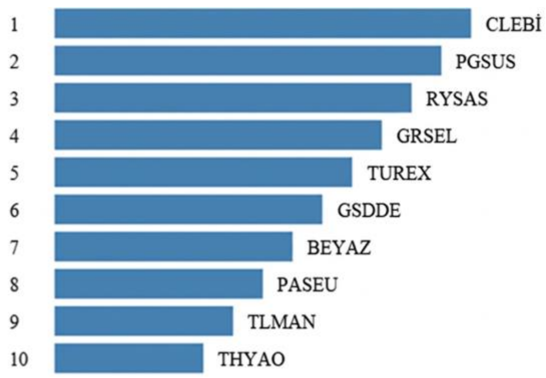
Years	**2020**		**2021**		**2022**		**2023**		**2024**	
Alternatives	Score	Rank	Score	Rank	Score	Rank	Score	Rank	Score	Rank
BEYAZ	0,13391	7	0,14176	7	0,10548	6	0,11056	8	0,11122	8
CLEBİ	0,11312	1	0,13679	1	0,10310	2	0,10680	2	0,11017	3
GSDDE	0,13379	6	0,14139	4	0,10554	8	0,11028	6	0,11059	5
GRSEL	0,13272	4	0,14148	5	0,10498	4	0,10846	3	0,11039	4
PASEU	0,13399	8	0,14191	9	0,10551	7	0,10973	4	0,11073	6
PGSUS	0,11413	2	0,14137	3	0,09174	1	0,11058	9	0,10380	1
RYSAS	0,13225	3	0,14002	2	0,10489	3	0,10565	1	0,10856	2

TLMAN	0,13410	9	0,14180	8	0,10524	5	0,10979	5	0,11126	9
TUREX	0,13360	5	0,14152	6	0,10563	9	0,11031	7	0,11081	7
THYAO	0,19661	10	0,1518	10	0,13340	10	0,13233	10	0,13224	10

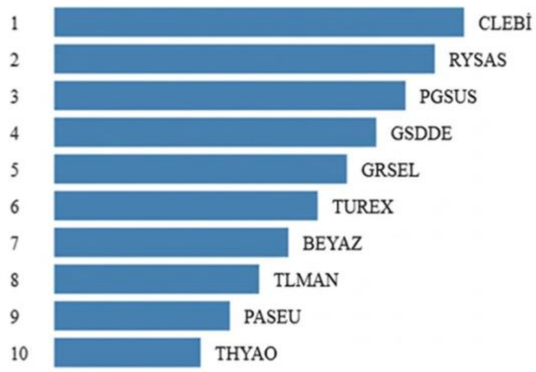
In all the periods examined, CLEBI ranked among the top three, standing out as the company with the highest performance. The fact that the entropy weight of marketing, sales, and distribution expenses was the highest and that Çelebi had zero marketing, sales, and distribution expenses in all periods may have played an influential role in its high performance. Although PGSUS ranked 9th in 2023, showing low performance, it rose to 1st place in 2020, 2021 and 2024 with the highest performance. TUREX, which ranked 5th in 2020, showed a decline over the years, ranking 7th. The other companies exhibited an almost stable performance.

THYAO ranked last with the lowest performance values It is observed that THYAO's expenses are higher than its revenues. In the conducted analysis, the relatively high importance weights assigned to the expense items emerged as a decisive factor in the calculation of the low performance score. This finding indicates that the company's cost structure exerts a negative and statistically significant effect on overall performance.

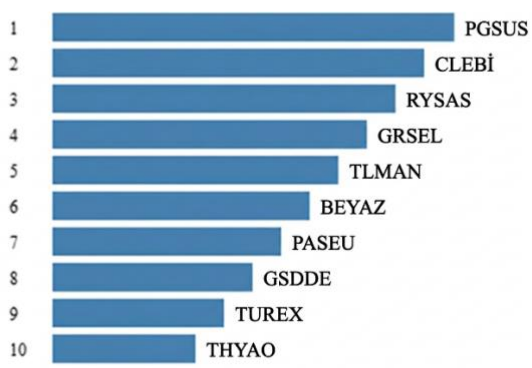
2020 Performances



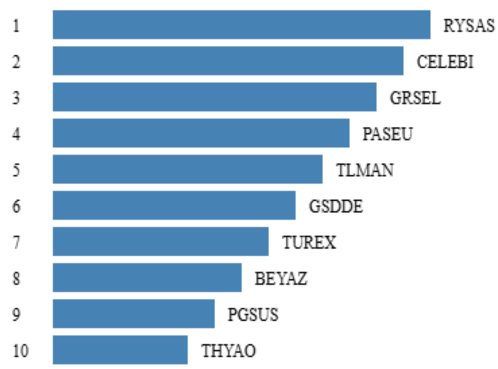
2021 Performances



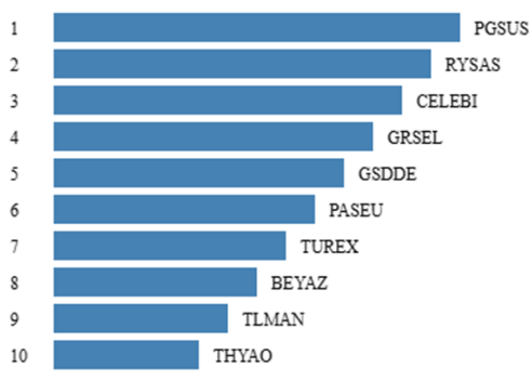
2022 Performances



2023 Performances



2024 Performances



In general, CLEBI, RYSAS, and PGSUS mostly demonstrated high performance during the years examined, often ranking among the top three. While CLEBI's cost of sales in 2020 was four times higher than its gross profit, in the following years, the cost of sales decreased to approximately twice the gross profit, and the absence of marketing, sales, and distribution expenses positively influenced the company's performance. GSDDE, PASEU, and TLMAN generally showed little change in performance. BEYAZ fell to the lower ranks due to the very high cost of sales relative to its gross profit and its low profitability. While TUREX had relatively low costs and expenses in the early years, the increase in expenses, especially from 2022 onward, may have caused a decline in its performance. For THYAO, the high ratio of expenses to revenues played a significant role in its low performance.

5. DISCUSSIONS AND CONCLUSIONS

In this study, the performance of 10 companies operating in the BIST Transportation and Storage Sector during the years 2020–2024 was evaluated in terms of their costs and revenues. The data used included cost of sales, gross profit, general administrative expenses, marketing and distribution expenses, other income from main activities, other expenses from main activities, financial expenses, profit before tax, operating profit, and net profit for the period. For the analysis, the data were weighted using the Entropy method and then ranked using the MOORA reference point method.

As a result of the analysis, it was determined that in the Entropy method, marketing and distribution expenses (0.15), cost of sales (0.09), and financial expenses (0.10) had high average weights among the entropy weights. The high weight of these expenses indicates that they require extra attention and that effective cost management should be planned. The high weight of these expenses can be considered an important criterion in financial performance indicators. CLEBI and RYSAS demonstrated very strong performance throughout all periods, ranking among the top three. The most remarkable company, PGSUS, rose from the bottom ranks to first place, becoming the highest-performing company in 2024. GRSEL generally maintained its 3rd place ranking. TUREX, which ranked 4th in 2020, showed a slight decline over the years, ranking 7th. While TUREX's costs and expenses were relatively low in the early years, the increase in expenses, especially from 2022 onward, may have caused a decline in its performance. GSDDE, PASEU, and TLMAN generally showed little change in performance. BEYAZ fell to the lower ranks due to its very high cost of sales relative to gross profit and low profitability.

THYAO ranked last in all periods, with its higher expenses compared to revenues explaining its low performance. As a result of the performance evaluation, it is observed that THYAO's operational expenses followed a higher trajectory relative to its revenues. The analysis reveals that the high importance levels (weight coefficients) assigned to expense items emerged as the primary determinant in suppressing the company's overall performance score. This situation demonstrates that the existing cost structure exerts a significant negative impact on corporate performance. In particular, the fact that unit costs exceed the rate of revenue generation constitutes the core rationale behind the low performance score calculation. Based on the results of the analysis, the following strategic steps are recommended to improve performance:

1.Digital Cost Auditing: Real-time oversight of expense items should be ensured through the digitalization of accounting processes and the integration of AI-powered analytical tools.

2. Operational Efficiency: Process optimizations focused on savings and productivity-enhancing investments should be prioritized for major expense items, such as fuel and personnel.

3. Revenue-Expense Balance: To improve the performance score, policies should be developed to gain control over critical cost items with high impact weights on performance, rather than focusing on lower-weighted expense categories.

The performance of a company largely depends on the weight of its income and expense items. Increasing revenues and reducing expenses constitute an important policy for all companies, particularly for those listed on the stock exchange. Millions of domestic and foreign investors trade on Borsa Istanbul (BIST). The fact that the companies under analysis are publicly traded closely concerns not only investors but also stakeholders directly or indirectly related to these companies. In this respect, the analysis provides an evaluation of companies in terms of costs and revenues. It has been determined which expense or income items have greater weight in company performance. By considering entropy-based weights and adopting effective cost-revenue management, company performance can be enhanced. Moreover, the implementation of accounting policies that increase revenues and reduce expenses may improve profitability. For example, the choice of depreciation method, inventory valuation method, or revaluation method of tangible fixed assets may lead to differences in income or expenses. Companies should continuously conduct cost analyses and develop strategies to increase revenues. Investors, on the other hand, should examine and compare companies' financial statements and accounting policies before making investment decisions. In this way, company performance will improve, and investors will be able to make decisions in a more secure manner. On the other hand, it should be taken into consideration that if companies, company data, or the examined years are diversified, different results may be obtained; thus, the findings of the analysis do not represent absolute conclusions.

It is anticipated that the operationalization of the Middle Corridor (Trans-Caspian East-West-Middle Corridor) will create a multiplier effect on Turkey's economy and foreign trade projections. Turkey's status as a strategic transit route between Asia and Europe will enhance operational efficiency in logistical processes, yielding significant savings in both time and cost. This optimization within the global supply chain will establish a foundation for domestic logistics firms to benefit from economies of scale and achieve a sustainable growth momentum by increasing their international competitiveness. Furthermore, integrated infrastructure investments, such as Marmaray and the Baku-Tbilisi-Kars (BTK) railway, will reinforce Turkey's role as a 'central actor' in this trade route, contributing to the qualitative development of foreign trade volume.

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