Cilt: 10 Sayı:3, 2023, ss. 745-759
PAMUKKALE ÜNİVERSİTESİ
İŞLETME ARAŞTIRMALARI DERGİSİ (PIAR)
Pamukkale University Journal of Business Research
https://dergipark.org.tr/tr/pub/piar

Evaluation of the Financial Performances of BIST IT Sector by CILOS Based CoCoSo Method

CILOS Tabanlı CoCoSo Yöntemi ile BIST Bilişim Sektörünün Finansal Performanslarının Değerlendirilmesi

Simge YENİLMEZEL ALICI [1*] **İrfan ERTUĞRUL** [2]

[1] Pamukkale Üniversitesi, simgeyen@gmail.com, ORCID: 0000-0002-1097-9131
[2] Pamukkale Üniversitesi, iertugrul@pau.edu.tr, ORCID: 0000-0002-5283-191X
* Yazışılan Yazar/Corresponding author

Makale Geliş/Received: 12.09.2023 Makale Kabul/Accepted: 20.10.2023

Araştırma Makalesi / Research Paper DOI: 10.47097/piar.1359342

Abstract

Today, companies that are under intense competition have needed to ensure the flow of information, use and store information effectively with the development of technology. Since these needs are met through IT, the IT sector is becoming increasingly important. The formation of many IT companies in the sector requires investors, lending institutions and shareholders to follow the market. In doing so, it is possible to utilize Multi-Criteria Decision Making (MCDM) methods. By using MCDM methods, it is possible to see and evaluate the changes in the financial performance of different companies in the same sector over the years. In this study, it is aimed to evaluate the financial performance of 8 companies that have gained a place in the IT sector in 2021 under 8 criteria. In this evaluation, the criteria weights were determined by the CILOS method, one of the objective criteria weighting methods, and the ranking of the alternatives was done by the CoCoSo method. As a result of the procedures, the most important criterion is K1 Current Ratio and the company with the best performance among the alternatives is A1 FONET. The fact that the two methods chosen are new methods makes the study original.

Keywords: *MCDM, CILOS, CoCoSo, Informatics Sector, Financial Performance Analysis.*

Jel Codes: *C02, C44, C61.*

Öz

Günümüzde yoğun rekabet altında olan şirketler, teknolojinin gelişmesiyle bilgi akışını sağlama, bilgiyi etkin bir şekilde kullanma ve depolama ihtiyacı duymuşlardır. Bu ihtiyaçların karşılanması bilişim ile gerçekleştiğinden bilişim sektörü gün geçtikçe önemli hale gelmektedir. Sektörde birçok bilişim şirketinin oluşması yatırımcıların, kredi verecek kurumların ve ortakların piyasayı takip etmesini gerektirmektedir. Bunu yaparken Çok Kriterli Karar Verme (ÇKKV) yöntemlerinden yararlanmak mümkündür. ÇKKV yöntemlerini kullanarak aynı sektördeki farklı firmaların finansal performanslarının yıllar içindeki değişimini görmek ve değerlendirmek mümkündür. Bu çalışmada günümüzde bilişim sektöründe yer edinmiş 8 şirketin 8 kriter altında 2021 yılında gösterdikleri finansal performansları değerlendirilmek istenmiştir. Bu değerlendirme yapılırken kriter ağırlıkları objektif kriter ağırlıklandırma yöntemlerinden olan CILOS yöntemi ile belirlenirken alternatiflerin sıralanması CoCoSo yöntemi ile yapılacaktır. Yapılan işlemler sonucunda en önemli kriter K1 Cari Oran ve alternatifler arasından en iyi performansa sahip şirket A1 FONET olarak belirlenmiştir. Seçilen iki yöntemin de yeni yöntemler olması çalışmayı orijinal kılmaktadır.

Anahtar Kelimeler: *ÇKKV, CILOS, CoCoSo, Bilişim Sektörü, Finansal Performans Analizi.*

Jel Kodları: *C02, C44, C61.*

1. INTRODUCTION

Determining the operating and financial structure characteristics of an enterprise by utilizing its accounting and financial statements is defined as financial performance analysis (Meydan et al., 2016: 148). Performance analysis provides the management effectiveness, operational efficiency, liabilities, profitability and evaluation of past performance and prediction of future performance (Çanakçıoğlu, 2020: 177).

Today, companies that want to survive in an intensely competitive environment have to work towards customer satisfaction, low costs and improving processes. In doing so, it sets goals for itself with the help of financial statements. On the other hand, there are interest groups that want to know the position and status of the business in the sector. At this point, performance measurement provides competitive advantage as well as seeing the current position (Çakır and Perçin, 2013: 449). Financial performance results are very effective in the decision-making of government agencies, lending institutions, shareholders, managers, internal and external stakeholders and investors (Tufan and Kılıç, 2019: 121).

Informatics is a concept that is formed with the help of the results that occur with the use of technology and information together (Başdar, 2018: 43). In general terms, the concept of informatics can be defined as processing, storing and storing information, transmitting information to technical tools in the fastest and easiest way and ensuring the flow of information (Kök, 2006: 125). The information sector is a sector formed by smartphones, tablets, televisions, computers, hardware, software and telecommunication companies that provide the flow of information used by most businesses (Kaygın, 2020: 530). Creating, storing, organizing and transmitting information to people is possible thanks to information technologies (Başdar, 2018: 2).

The unpredictable change trend in technology has led to an increase in the impact of the IT sector on financial markets (Kaygın, 2020: 530). The formation of many IT firms in the sector requires investors, shareholders and lending institutions to follow the market. Since the IT sector is developing day by day and many companies are entering the sector, the study aims to address the IT sector. Multi-criteria decision-making methods can be utilized in this monitoring and evaluation. MCDM methods enable to determine the most appropriate one among the alternatives under the specified criteria and can be applied to most problems in daily life. In this study, it is aimed to evaluate the financial performance of the companies in the IT sector traded in BIST in 2021. During the evaluation, 8 criteria that are used and determinative in financial performance evaluation processes and 8 alternative companies known in the sector were selected. While determining the criteria, the sector and the literature were utilized. Criterion weighting process was performed with the Criterion Impact Lose (CILOS) method, which is one of the objective weighting methods since there is no subjective data, and the alternatives were ranked with the Combined Compromise Solution (CoCoSo) method. The reason for choosing CILOS and CoCoSo methods among multi-criteria decision making methods is that there are not many studies in the literature. In this way, the study maintains its originality.

2. LITERATURE REVIEW

When the literature is examined, most of the sectors traded in BIST have been evaluated their financial performance by using CRM methods, but there is no study in which CILOS and CoCoSo methods, which will be used in this study, are used together. For this reason, an extensive literature review was conducted by including studies on the IT sector, financial performance evaluation and the methods to be used in the study.

Table 1. CILOS and CoCoSo Method Literature Review

Studies with CILOS Method
Podvezko et al. (2017) used the IDOCRIW method to evaluate the performance of construction sectors in the Baltic countries and Poland. Since the IDOCRIW method includes the CILOS method, the study also includes CILOS steps.
Paradowski et al. (2021) conducted a similarity analysis of methods for the objective determination of weights in multi-criteria decision support systems. In this study, Entropy, CILOS, CRITIC and IDOCRIW methods are discussed and their values are compared.
Studies with CoCoSo Method
Yazdani et al. (2018) conducted a study on logistics provider selection with CoCoSo method.
Özdağoğlu et al. (2020) applied CoCoSo and MARCOS methods in ranking Turkish universities.
Stanujkic et al. (2020), Entropy-based CoCoSo method evaluated the progress of EU countries towards achieving the sustainable development goals of the 2030 agenda.
Topal (2021) evaluated the financial performance analysis of electricity generation companies with the Entropy-based CoCoSo method.
Çiftçi et al. (2021) integrated CoCoSo and CRITIC method to evaluate the financial performance of energy companies traded in BIST based on cash flow ratios.
Altıntaş (2021) analyzed the information performance of G7 countries using the CoCoSo method.
Pala (2021) used CCSD and CoCoSo methods to analyze the financial performances of BIST construction index.

Kaygın (2020) evaluated the financial performance of companies traded in the BIST IT sector with the MOORA method. Başdar (2018), wrote his doctoral thesis evaluating the BIST IT sector using TOPSIS and ELECTRE methods. Karaoğlan and Şahin (2018) conducted a study by integrating AHP, VIKOR, TOPSIS, Gray Relational Analysis and MOORA methods in the evaluation of BIST chemical enterprises. Ersoy (2020) used the Gray Relational Analysis method to evaluate the financial performance of BIST transportation companies. Çanakçıoğlu (2020) made an evaluation by integrating Entropy, WASPAS and Borda methods while evaluating the performance of base metal companies traded in BIST. Akyüz et al. (2018) evaluated the performance of paper and paper products printing and publishing enterprises traded in BIST with TOPSIS, PROMETHEE and COPRAS methods. Tufan and

Kılıç (2019) evaluated the financial performance of logistics enterprises traded in BIST with TOPSIS and VIKOR methods. Çakır and Perçin (2013) examined logistics companies by integrating CRITIC, SAW, TOPSIS, VIKOR and borda counting methods. Deste and Halifeoğlu (2019) used TOPSIS method in the evaluation of enterprises in the retail trade sector. Topal (2021) evaluated the financial performance of electricity generation companies using Entropy-based CoCoSo method. Özçelik and Kandemir (2015) used TOPSIS method in the evaluation of tourism enterprises traded in BIST. Küçükönder and Şişmanoğlu (2020) compared different CRM methods by using Entropy, EATWIOS, MAUT, WASPAS and OCRA methods in the evaluation of enterprises in the BIST textile, leather index. Elmas and Özkan (2021) evaluated enterprises in the transportation and storage sector by integrating SWARA and OCRA methods. Atukalp (2019) analyzed the financial performance of cement factories traded in Borsa Istanbul using MOORA method. Şahin and Karacan (2020) analyzed the performance of BIST construction index firms with entropy-based COPRAS and ARAS methods. Ayçin and Aşan (2018) evaluated the financial performance of IT firms traded in BIST by using Entropy and TOPSIS methods. In the criterion weights obtained by the entropy method, the most important criterion was determined as the profitability of sales. Aydın (2021) analyzed the market performance of insurance companies by integrating the SV method and EDAS method in his evaluation. Uygurtürk and Yıldız (2021) examined the efficiency and financial performance of enterprises in the IT sector. They used Data Envelopment Analysis and Gray Relational Analysis methods. In the study, 14 companies were evaluated under the criteria of total assets, operating expenses, sales costs, sales revenue and profit before tax from continuing operations. Tayyar et al. (2014) used AHP and Gray Relational Analysis methods to analyze the financial performance of enterprises operating in the field of information and technology registered in BIST. They used liquidity ratios, financial structure ratios, activity ratios and profitability ratios. The criterion with the most important weight was profitability ratios. Yılmaz Türkmen and Çağıl (2012) evaluated the performance of 12 firms in the IT sector between 2007 and 2010 under the criteria of current ratio, liquidity ratio, receivables turnover ratio, total asset turnover ratio, leverage ratio, net profit margin, return on equity and return on total assets by using TOPSIS method. Dumanoğlu and Ergül (2010) evaluated the financial performance of technology companies traded on the ISE using the TOPSIS method.

3. METHODS

CILOS and CoCoSo methods were used in an integrated manner in the study to evaluate the financial performance of the firms identified in the BIST IT sector in 2021. Information about the methods is given in the rest of the study.

3.1. CILOS Method

A different method to obtain objective weights is the CILOS method (Zavadskas and Podvezko, 2016: 5). The method evaluates the loss of each criterion until one of the remaining criteria achieves the optimal maximum or minimum value. The algorithm, formalization, description and implementation of the method were presented by Zavadskas and Podvezko in 2016. The logic, basic ideas, steps and a calculation algorithm of the criteria impact loss method are as follows.

Step 1. Transformation of Cost Criteria: In the transformation process, minimized criteria are transformed into maximized criteria so that the largest value of a criterion is optimal. In the case of benefit criteria, no transformation is made. Equation (1) is used for this (Bircan, 2020: 56).

$$\widetilde{x_{ij}} = \frac{minx_{ij}}{x_{ij}} \quad (1)$$

Step 2. Normalizing the Transformation Matrix: Data normalization makes visible the comparison of the losses incurred by each criterion in the method. Using Equation (2), a new matrix is obtained, which can be represented by the expression (n_{ij}).

$$n_{ij} = \frac{\tilde{x}_{ij}}{\sum_{i=1}^{n} \tilde{x}_{ij}} \quad (2)$$

Step 3. Obtaining Square Matrix A: For matrix N, the largest one among the criteria in the column elements is selected. For the maximum value nj = max$_i$ n_{ij} = max$_i$ n_{ij} =n_{kj} j, k_j is the number of the row where column j is located. A matrix A= || a_{ij} || is formed by taking the entire row into account so that the value aki j is taken from the maximum value of the i. criterion N matrix. The diagonal elements of matrix A are defined as a_{ii} =n_i and the other elements are defined as a_{ij} =nki j. Here, the ith row element of matrix A is the element of the kj row of matrix N (Bircan, 2020: 39).

Step 4. Obtaining the Relative Loss Matrix P: For the calculation of impact losses, the matrix P= || pij || is found by Equation (3).

$$p_{ij} = \frac{a_{ii} - a_{ij}}{a_{ii}} \quad (3)$$

Step 5. Determination of the Weight System Matrix F: The sum of each column of the P matrix is found and the negative values of these sums are written on the diagonals of the P matrix to form the F matrix (Ecer, 2020: 109).

$$F = \begin{pmatrix} -\sum_{i=1}^{m} p_{i1} & p_{12} & \cdots & p_{1m} \\ p_{21} & -\sum_{i=1}^{m} p_{i2} & \cdots & p_{2m} \\ \cdots & \cdots & \cdots & \cdots \\ p_{m1} & p_{m2} & \cdots & -\sum_{i=1}^{m} p_{im} \end{pmatrix} \quad (4)$$

Step 6. Solving the Linear Equation System: In the penultimate step, the linear equation system given in Equation (5) is solved with programs such as Excel and MATLAB.

$$Fqt=0 \quad (5)$$

3.2. CoCoSo Method

This method, which has a high stability, robustness and reliability in ranking alternatives, was introduced by Zavadskas, Yazdani, Zarate and Turskis in 2018 (Yazdani et al., 2018). Adding a new alternative to the analyses or removing an existing alternative from the analyses has less impact on the final ranking results obtained with this method compared to the other CRM models. The method first finds the utility values of the alternatives from different perspectives through different aggregation/aggregation operators and then uses an aggregation function to obtain a compromise solution and aggregate the utility values of each alternative (Ecer, 2020: 299). The CoCoSo method is based on the integration of the

weighted sum method and the exponentially weighted product method, the steps of which are given below (Yazdani et al., 2018: 2507-2508):

Step 1 - Creating the Decision Matrix

$$X_{ij} = \begin{bmatrix} x_{11} & x_{12} & \cdots & x_{1n} \\ x_{21} & x_{22} & \cdots & x_{2n} \\ \cdots & \cdots & \cdots & \cdots \\ x_{m1} & x_{m2} & \cdots & x_{mn} \end{bmatrix}; \text{ i= 1, 2, …, m; j= 1, 2, …, n.} \quad (6)$$

Step 2 - Obtaining the Normalized Matrix

$$r_{ij} = \frac{x_{ij} - \min_i x_{ij}}{\max_i x_{ij} - \min_i x_{ij}} \text{ ; fayda kriterleri için} \quad (7)$$

$$r_{ij} = \frac{\max_i x_{ij} - x_{ij}}{\max_i x_{ij} - \min_i x_{ij}} \text{ ; maliyet kriterleri için} \quad (8)$$

Step 3 - The sum of the weighted comparability array and the entire power weight of the comparability arrays for each alternative sum of the weighted comparability array and also the amount of power weight of the comparability arrays for each alternative such as Si and Pi are given in Equations (9) and (10) respectively.

$$S_i = \sum_{j=1}^{n} (w_j r_{ij}) \quad (9)$$

$$P_i = \sum_{j=1}^{n} (r_{ij})^{w_j} \quad (10)$$

Step 4 - The relative weights of the alternatives are calculated using the following aggregation strategies. In this step, three evaluation score strategies are used to generate the relative weights of the other options derived using formulas (11), (12) and (13):

$$k_{ia} = \frac{P_i + S_i}{\sum_{i=1}^{m} (P_i + S_i)} \quad (11)$$

$$k_{ib} = \frac{S_i}{\min_i S_i} + \frac{P_i}{\min_i P_i} \quad (12)$$

$$k_{ic} = \frac{\lambda (S_i) + (1-\lambda)(P_i)}{(\lambda \max_i S_i + (1-\lambda) \max_i P_i)} \text{ ; } 0 \leq \lambda \leq 1 \quad (13)$$

Equation (11) expresses the arithmetic mean of the sums of the scores of S_i and P_i, while Equation (12) expresses the sum of the relative scores of S_i and P_i compared to the best. Equation (13) describes the balanced compromise of the scores of S_i and P_i and is usually chosen by decision makers as λ=0.5.

Step 5- Using Equation (14), the final ranking of the alternatives is obtained.

$$k_i = (k_{ia} k_{ib} k_{ic})^{\frac{1}{3}} + \frac{1}{3} (k_{ia} + k_{ib} + k_{ic}) \quad (14)$$

4. APPLICATION

As mentioned in the previous sections, the subject of the study is the IT sector traded in BIST. For the study, 8 alternative companies in this sector and 8 criteria deemed necessary for this evaluation were determined. The criteria used in the study were determined by utilizing the literature (Yılmaz Türkmen and Çağıl, 2012: 69; Dumanoğlu and Ergül, 2010: 104). After the

weights of the criteria are determined by the CILOS method, the performances of the companies in 2021 will be ranked by the CoCoSo method.

Table 2 shows the criteria to be used in the study.

Table 2. Criteria, Objectives and Codes to be used in the Study

Criteria	Objectives	Codes
Current Ratio	Maximum	K1
Financial Leverage Ratio	Minimum	K2
Liquidity Ratio	Maximum	K3
Return on Equity Ratio	Maximum	K4
Asset Turnover	Maximum	K5
Receivables Turnover Rate	Maximum	K6
Current Assets Turnover Ratio	Maximum	K7
Net Profit Margin	Maximum	K8

Table 3 shows the IT companies included in the study.

Table 3. Companies and Codes to be Evaluated in the Study

IT Companies	Code
Fonet Information Technologies Inc. (FONET)	A1
Arena Computer Industry and Trade Inc. (ARENA)	A2
Karel Electronic Industry and Trade Inc. (KAREL)	A3
Datagate Computer Supplies Inc. (DGATE)	A4
Armada Computer Systems Industry and Trade Inc. (ARMDA)	A5
Despec Computer Marketing and Trade Inc. (DESPC)	A6
Kron Telecommunication Services Inc. (KRONT)	A7
Logo Software Industry and Trade Inc. (LOGO)	A8

4.1. Determination of Criteria Weights with CILOS Method

With the 2020 data, a decision matrix was created and shown in Table 4.

Table 4. Decision Matrix

	K1 MAX	K2 MIN	K3 MAX	K4 MAX	K5 MAX	K6 MAX	K7 MAX	K8 MAX
FONET	2,72	0,3080	2,69	0,0933	0,56	2,72	1,4884	42,50
ARENA	1,26	0,7947	0,95	0,0824	2,15	5,17	1,6347	1,11
KAREL	1,54	0,7073	0,80	0,1166	1,01	3,98	1,0518	6,56
DGATE	1,64	0,7206	1,25	0,1858	3,40	5,58	3,1967	2,78
ARMDA	1,71	0,8058	1,47	-0,0642	1,88	2,86	1,4733	-0,32
DESPC	1,53	0,6501	1,22	0,1044	2,83	5,44	1,9618	5,13
KRONT	1,44	0,4930	1,42	0,2218	0,65	1,57	0,8467	41,54
LOGO	1,07	0,5799	1,06	0,1464	0,60	5,37	0,9755	35,52

With the help of Equation (1), the transformation matrix of the cost criteria is created. The transformation matrix is shown in Table 5.

Table 5. Transformation Matrix

	K1 MAX	K2 MIN	K3 MAX	K4 MAX	K5 MAX	K6 MAX	K7 MAX	K8 MAX
A1	2,72	1,0000	2,69	0,0933	0,56	2,72	1,4884	42,25
A2	1,26	0,3875	0,95	0,0824	2,15	5,17	1,6347	1,11
A3	1,54	0,4355	0,80	0,1116	1,01	3,98	1,0518	6,56
A4	1,64	0,4274	1,25	0,1858	3,40	5,58	3,1967	2,78
A5	1,71	0,3822	1,47	-0,0642	1,88	2,86	1,4733	-0,32
A6	1,53	0,4738	1,22	0,1044	2,83	5,44	1,9618	5,13
A7	1,44	0,6248	1,42	0,2218	0,65	1,57	0,8467	41,54
A8	1,07	0,5311	1,06	0,1464	0,60	5,37	0,9755	35,52

The normalized matrix obtained using Equation (2) is shown in Table 6.

Table 6. Normalizing the Transformation Matrix

	K1 MAX	K2 MIN	K3 MAX	K4 MAX	K5 MAX	K6 MAX	K7 MAX	K8 MAX
A1	0,2107	0,2346	0,2477	0,1052	0,0428	0,0832	0,1179	0,3140
A2	0,0976	0,0909	0,0875	0,0930	0,1644	0,1582	0,1294	0,0082
A3	0,1193	0,1022	0,0737	0,1315	0,0772	0,1217	0,0833	0,0487
A4	0,1270	0,1003	0,1151	0,2096	0,2599	0,1707	0,2531	0,0207
A5	0,1325	0,0897	0,1354	-0,0724	0,1437	0,0875	0,1167	-0,0024
A6	0,1185	0,1112	0,1123	0,1178	0,2164	0,1664	0,1553	0,0381
A7	0,1115	0,1466	0,1308	0,2501	0,0497	0,0480	0,0670	0,3087
A8	0,0829	0,1246	0,0976	0,1652	0,0459	0,1643	0,0772	0,2640

Table 7 was created by selecting the largest one among the criteria in the column elements for the N matrix.

Table 7. Square Matrix (A)

	K1 MAX	K2 MIN	K3 MAX	K4 MAX	K5 MAX	K6 MAX	K7 MAX	K8 MAX
A1	0,2107	0,2346	0,2477	0,1052	0,0428	0,0832	0,1179	0,3140
A2	0,2107	0,2346	0,2477	0,1052	0,0428	0,0832	0,1179	0,3140
A3	0,2107	0,2346	0,2477	0,1052	0,0428	0,0832	0,1179	0,3140
A4	0,1115	0,1466	0,1308	0,2501	0,0497	0,0480	0,0670	0,3087
A5	0,1270	0,1003	0,1151	0,2096	0,2599	0,1707	0,2531	0,0207
A6	0,1270	0,1003	0,1151	0,2096	0,2599	0,1707	0,2531	0,0207
A7	0,1270	0,1003	0,1151	0,2096	0,2599	0,1707	0,2531	0,0207
A8	0,2107	0,2346	0,2477	0,1052	0,0428	0,0832	0,1179	0,3140

Equation (3) was used to construct the relative loss matrix.

Table 8. Relative Loss Matrix (P)

	K1 MAX	K2 MIN	K3 MAX	K4 MAX	K5 MAX	K6 MAX	K7 MAX	K8 MAX
A1	0,0000	0,000	0,0000	0,5795	0,8353	0,5125	0,5344	0,0000
A2	0,0000	0,000	0,0000	0,5795	0,8353	0,5125	0,5344	0,0000
A3	0,0000	0,000	0,0000	0,5795	0,8353	0,5125	0,5344	0,0000
A4	0,4706	0,3752	0,4721	0,0000	0,8088	0,7186	0,7351	0,0168
A5	0,3971	0,5726	0,5353	0,1622	0,0000	0,0000	0,0000	0,9342
A6	0,3971	0,5726	0,5353	0,1622	0,0000	0,0000	0,0000	0,9342

A7	0,3971	0,5726	0,5353	0,1622	0,0000	0,0000	0,0000	0,9342
A8	0,0000	0,0000	0,0000	0,5795	0,8353	0,5125	0,5344	0,0000
TOPLAM	1,6618	2,0929	2,0781	2,8045	4,1500	2,7688	2,8727	2,8194

In the rest of the application, the weighting system matrix is created as in Equation (4).

Table 9. Weight System Matrix

	K1	**K2**	**K3**	**K4**	**K5**	**K6**	**K7**	**K8**
	MAX	**MIN**	**MAX**	**MAX**	**MAX**	**MAX**	**MAX**	**MAX**
A1	-1,6618	0,0000	0,0000	0,5795	0,8353	0,5125	0,5344	0,0000
A2	0,0000	-2,0929	0,0000	0,5795	0,8353	0,5125	0,5344	0,0000
A3	0,0000	0,0000	-2,0781	0,5795	0,8353	0,5125	0,5344	0,0000
A4	0,4706	0,3752	0,4721	-2,8045	0,8088	0,7186	0,7351	0,0168
A5	0,3971	0,5726	0,5353	0,1622	-4,1500	0,0000	0,0000	0,9342
A6	0,3971	0,5726	0,5353	0,1622	0,0000	-2,7688	0,0000	0,9342
A7	0,3971	0,5726	0,5353	0,1622	0,0000	0,0000	-2,8727	0,9342
A8	0,0000	0,0000	0,0000	0,5795	0,8353	0,5125	0,5344	-2,8194

In the last step of the application, the weighting system matrix is analyzed with the help of Equation (5) to determine the criteria weights. Objective criteria weights are given in Table 10.

Table 10. Objective Importance Weights

K1	**K2**	**K3**	**K4**	**K5**	**K6**	**K7**	**K8**
0,1673	0,1329	0,1338	0,1528	0,0798	0,1196	0,1152	0,0986

4.2. Ranking of Alternatives with CoCoSo Method

The decision matrix, which is the first step of the CoCoSo method, is created with the help of Equation (6). The initial decision matrix is given in Table 11.

Table 11. Initial Decision Matrix

	K1	**K2**	**K3**	**K4**	**K5**	**K6**	**K7**	**K8**
	MAX	**MIN**	**MAX**	**MAX**	**MAX**	**MAX**	**MAX**	**MAX**
Weights	**0,1673**	**0,1329**	**0,1338**	**0,1528**	**0,0798**	**0,1196**	**0,1152**	**0,0986**
A1	2,72	0,3080	2,69	0,0933	0,56	2,72	1,4884	42,25
A2	1,26	0,7947	0,95	0,0824	2,15	5,17	1,6347	1,11
A3	1,54	0,7073	0,80	0,1166	1,01	3,98	1,0518	6,56
A4	1,64	0,7206	1,25	0,1858	3,40	5,58	3,1967	2,78
A5	1,71	0,8058	1,47	-0,0642	1,88	2,86	1,4733	-0,32
A6	1,53	0,6501	1,22	0,1044	2,83	5,44	1,9618	5,13
A7	1,44	0,4930	1,42	0,2218	0,65	1,57	0,8467	41,54
A8	1,07	0,5799	1,06	0,1464	0,60	5,37	0,9755	35,52
MIN	1,07	0,3080	0,80	-0,0642	0,56	1,57	0,8467	-0,32
MAX	2,72	0,8058	2,69	0,2218	3,40	5,58	3,1967	42,25

Normalization is performed with the help of Equations (7) and (8). Equation (7) is used for the benefit criteria while Equation (8) is used for the cost criteria.

Table 12. Normalization Matrix

	K1	K2	K3	K4	K5	K6	K7	K8
	MAX	MIN	MAX	MAX	MAX	MAX	MAX	MAX
Weights	**0,1673**	**0,1329**	**0,1338**	**0,1528**	**0,0798**	**0,1196**	**0,1152**	**0,0986**
A1	1,0000	1,0000	1,0000	0,5506	0,0000	0,2868	0,2731	1,0000
A2	0,1152	0,0222	0,0794	0,5127	0,5599	0,8978	0,3353	0,0336
A3	0,2848	0,1979	0,0000	0,6322	0,1585	0,6010	0,0873	0,1616
A4	0,3455	0,1712	0,2381	0,8742	1,0000	1,0000	1,0000	0,0728
A5	0,3879	0,0000	0,3545	0,0000	0,4648	0,3217	0,2666	0,0000
A6	0,2788	0,3127	0,2222	0,5896	0,7993	0,9651	0,4745	0,1280
A7	0,2242	0,6284	0,3280	0,1000	0,0317	0,0000	0,0000	0,9833
A8	0,0000	0,4537	0,1376	0,7365	0,0141	0,9476	0,0548	0,8419

The power weight amount of the comparability sequences for each alternative, i.e. S_i and P_i, are given in Equations (9) and (10) respectively. The S_i values generated with the help of Equation (9) are shown in Table 13.

Table 13. S_i Values

	K1	K2	K3	K4	K5	K6	K7	K8	
	MAX	MIN	MAX	MAX	MAX	MAX	MAX	MAX	
Weights	**0,1673**	**0,1329**	**0,1338**	**0,1528**	**0,0798**	**0,1196**	**0,1152**	**0,0986**	**Total**
A1	0,1673	0,1329	0,1338	0,0841	0,0000	0,0343	0,0315	0,0986	0,6825
A2	0,0193	0,0029	0,0106	0,0784	0,0447	0,1073	0,0386	0,0033	0,3051
A3	0,0477	0,0263	0,0000	0,0966	0,0126	0,0719	0,0101	0,0159	0,2811
A4	0,0578	0,0227	0,0319	0,1336	0,0798	0,1196	0,1152	0,0072	0,5678
A5	0,0649	0,0000	0,0474	0,0000	0,0371	0,0385	0,0307	0,0000	0,2186
A6	0,0466	0,0415	0,0297	0,0901	0,0638	0,1154	0,0547	0,0126	0,4545
A7	0,0375	0,0835	0,0439	0,1528	0,0025	0,0000	0,0000	0,0970	0,4172
A8	0,0000	0,0603	0,0184	0,1125	0,0011	0,1133	0,0063	0,0830	0,3950
General Total									**3,3218**

P_i values generated by Equation (10) are given in Table 14.

Table 14. P_i Values

	K1	K2	K3	K4	K5	K6	K7	K8	
	MAX	MIN	MAX	MAX	MAX	MAX	MAX	MAX	
Weights	**0,1673**	**0,1329**	**0,1338**	**0,1528**	**0,0798**	**0,1196**	**0,1152**	**0,0986**	**Total**
A1	1,0000	1,0000	1,0000	0,9128	0,0000	0,8613	0,8611	1,0000	6,6352
A2	0,6965	0,6029	0,7125	0,9030	0,9548	0,9872	0,8817	0,7156	6,4541
A3	0,8105	0,8064	0,0000	0,9323	0,8633	0,9409	0,7550	0,8355	5,9439
A4	0,8371	0,7910	0,8253	0,9797	1,0000	0,1000	1,0000	0,7723	7,2053
A5	0,8535	0,0000	0,8704	0,0000	0,9407	0,8732	0,8587	0,0000	4,3965
A6	0,8076	0,8569	0,8177	0,9224	0,9823	0,9958	0,9177	0,8165	7,1168
A7	0,7787	0,9401	0,8614	1,0000	0,7593	0,0000	0,0000	0,9983	5,3379
A8	0,0000	0,9003	0,7669	0,9543	0,7117	0,9936	0,7156	0,9832	6,0256
General Total									**49,1154**

The relative weights of the alternatives are calculated using the following aggregation strategies. In this step, three evaluation score strategies are used to generate the relative weights of the other options derived using the formulas in Equations (11), (12) and (13).

Table 15. Values of Evaluation Strategies

ALTERNATIVES	K_{iA}	K_{iB}	K_{iC}
A1	0,1396	4,6313	0,9277
A2	0,1289	2,8639	0,8569
A3	0,1187	2,6361	0,7892
A4	0,1482	4,2361	0,9855
A5	0,0880	2,0000	0,5851
A6	0,1444	3,6978	0,9599
A7	0,1098	3,1227	0,7296
A8	0,1224	3,1775	0,8140

The final ranking of the alternatives is obtained using Equation (14). The rankings are given in Table 16. According to the ranking, the firm with the best financial performance is determined as FONET.

Table 16. Performance Scores and Rankings of Alternatives

ALTERNATIVES	K_i	RANKING
FONET	2,7428	1
ARENA	1,9646	5
KAREL	1,8094	7
DGATE	2,6421	2
ARMDA	1,3598	8
DESPC	2,4010	3
KRONT	1,9507	6
LOGO	2,0529	4

The reliability of the result is tested by performing sensitivity analysis with λ values between 0.0-1.0. Sensitivity analysis results are given in Table 17.

Table 17. Sensitivity Analysis Results

	λ=0,0	**λ=0,1**	**λ=0,2**	**λ=0,3**	**λ=0,4**	**λ=0,5**	**λ=0,6**	**λ=0,7**	**λ=0,8**	**λ=0,9**	**λ=1,0**
A1	1	1	1	1	1	**1**	1	1	1	1	1
A2	5	5	5	5	5	**5**	5	5	5	5	5
A3	7	7	7	7	7	**7**	7	7	7	7	7
A4	2	2	2	2	2	**2**	2	2	2	2	2
A5	8	8	8	8	8	**8**	8	8	8	8	8
A6	3	3	3	3	3	**3**	3	3	3	3	3
A7	6	6	6	6	6	**6**	6	6	6	6	6
A8	4	4	4	4	4	**4**	4	4	4	4	4

According to the results of the sensitivity analysis, there was no change in the ranking of the alternatives. It was determined that the results were consistent.

5. CONCLUSION

Financial performance analysis provides managerial effectiveness, operational efficiency, profitability and future forecasts by utilizing the financial statements of enterprises. In today's competitive environment, financial performance analysis is important for businesses to determine their place and goals in their sector.

Informatics is a concept formed by using technology and information together. The creation, processing and storage of information is provided by information technologies. With the development of technology, the impact of information technologies on financial markets has increased considerably. The formation of many IT firms in the sector has caused investors, shareholders and lending institutions to follow the market. Therefore, the analysis of financial performances has gained importance.

It is possible to make use of CRM methods when analyzing financial performances. Criterion weights can be determined and alternatives can be ranked with CRM methods.

In this study, 8 alternative companies selected from the IT sector traded in BIST were evaluated under 8 criteria. The criteria used in the evaluation were determined by analyzing previous studies in the literature. CILOS method, which is an objective method when there is no need for subjectivity in the evaluation of the criteria, was used. When the criteria weights were analyzed, the criterion with the highest weight was the current ratio and the criterion with the lowest weight was the asset turnover rate. Following the determined criteria weights, the CoCoSo method was used to rank the alternatives. When the result is analyzed, the best performance in 2021 belongs to FONET while the worst performance belongs to ARMADA. When FONET, which has the best performance, is analyzed, it is seen that it has the highest current ratio value.

Since the applied methods are relatively new methods in the literature, the number of studies is small. Therefore, it is thought that the study can fill a gap in the literature. Objective weighting methods have been used in previous studies, but when the weights of the criteria are analyzed, the current ratio still has a significant weight, which increases the consistency of the study. In future studies, the proposed models can be compared by applying different methods in different sectors.

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