JBASS
Journal of Business Administration and Social Studies

ORIGINAL ARTICLE
DOI: 10.5152/JBASS.2022.22005

Measuring the Financial Performances of IT Sector Companies Transacting on Borsa

Borsa İstanbul'da İşlem Gören Bilişim Sektörü Firmalarının Finansal Performanslarının Aras Yöntemi Aracılığı ile Ölçülmesi

Özgür ÖZDEMİR

Department of International Trade and Finance, Trakya University Keşan Yusuf Çapraz School of Applied Sciences, Edirne, Turkey

Abstract

The global world has brought many innovations in the field of informatics and technology, and with these innovations, new risks have emerged. In the risk environment created by the new world, businesses have to use their resources effectively and efficiently in order to continue their activities. With this method, businesses aim to increase their financial performance levels. In this study, it is aimed to examine the financial performance levels of 18 enterprises operating in the Istanbul Stock Exchang (BIST) information sector in light of the data of 2018–2021, after giving a detailed literature analysis of the studies using multicriteria decision-making techniques by using the data of the enterprises in the IT sector. The criteria selected in order to evaluate the financial performance levels were weighted with the ENTROPI method and the financial performances of the enterprises were evaluated with the ARAS (Additive Ratio Assesment Method) method. The financial performance rankings of the enterprises were examined with the ARAS method, and the company with the highest performance in 2018–2020 was INDEX, while the company with the highest performance in 2021 was NETAŞ.

Keywords: financial performance, IT industry, multicriteria decision-making techniques

Öz

Küresel dünya beraberinde bilişim ve teknoloji alanına dair de birçok yenilik getirmiştir ve bu yenilikler ile birlikte yeni riskler de meydana gelmiştir. Yeni dünyanın oluşturduğu risk ortamında işletmeler faaliyetlerine devam edebilmek için kaynaklarını etkin ve verimli bir şekilde kullanmak durumundadırlar. Bu yöntem ile işletmeler finansal performans düzeylerini artırmayı amaç edinmişlerdir. Bu çalışmada bilişim sektöründe yer alan işletmelerin verilerinden yararlanılarak çok kriterli karar verme tekniklerini kullanan çalışmaların detaylı literatür analizinin verilmesi ardından ise BIST bilişim sektöründe faaliyet gösteren 18 adet işletmenin 2018–2021 yıllarına ait verileri ışığında finansal performans düzeylerinin incelenmesi amaçlanmıştır. Finansal performans düzeylerinin değerlendirilmesi adına seçilen kriterler ENTROPI yöntemiyle ağırlıklandırılmış ve işletmelerin finansal performansları ARAS yöntemi ile değerlemeye tabi tutulmuştur. ARAS yöntemi ile işletmelerin finansal performans sıraları incelenmiş ve 2018–2020 yıllarında en yüksek performansa sahip şirket İNDEKS olurken, 2021 yılında en yüksek performansa sahip şirket ise NETAŞ olmuştur.

Anahtar Kelimeler: Bilişim sektörü, finansal performans, çok kriterli karar verme teknikleri

Cite this article as: Özdemir, Ö. (2022). Measuring the financial performances of IT sector companies transacting on Borsa. *Journal of Business Administration and Social Studies,* 6(2), 36-45.

Corresponding author: Özgür Özdemir,
E-mail: ozgurozdemir@trakya.edu.tr

Received: August 22, 2022
Accepted: October 25, 2022

Introduction

The IT sector has grown as a continuous and dynamic structure integrated with the internet and computer technologies that have developed with globalization. The financial performance valuation of IT companies, whose importance in the financial markets is gradually increasing and whose shares have started to be traded in the stock market, has also started to gain importance.

The IT sector is the sector in which hardware, software, and telecommunication companies operate, which enable the communication of products with a high value in terms of technology, such as smart mobile phones, computers, tablets, and televisions, which we use widely in our daily lives.[1] In addition to the importance of financial decision-making today, the financial decision-making process has a very complex structure (Spronk et al., 2005, p. 800). In terms of businesses, it is very important to measure their financial performance in order to examine their financial situation. Since the financial performance of the business affects all people within the boundaries of the enterprise, the failure in the financial forecasts of the financial performance of the enterprise also closely affects the credit institutions, auditors, and the top management of the enterprise (Wilson ve Sharda, 1994, pp. 545–557).

The analysis of the financial statements prepared and presented by the businesses is the process of interpreting the figures in the financial statements in order to obtain real and reliable information about the financial status and performance of the businesses (Ganga et al., 2015, p. 1). Financial performance can be briefly defined as the ability of enterprises to manage and control their own resources. Based on this definition, the capital adequacy, liquidity ratios, solvency, efficiency, leverage ratios, and profitability ratios of the enterprises are used as criteria in the evaluation of the financial performance of the enterprises (Fatihudin et al., 2018, p. 553).

IT sector covers all the elements that collect and store information about computers, software and services, and process and disseminate this stored information, and therefore the information sector has become increasingly important today. With the increase in investments in the IT sector, the measurement of the financial performance of enterprises operating in the IT sector has become an important issue (Lee et al., 2008, p. 98). Measuring the performance of a business is an important consideration for the managers and investors of that business, as well as for all other businesses operating in the same industry (Ertuğrul ve Karakaşoğlu, 2009, p. 702).

Evaluating the financial performance of the business and ranking the businesses according to their financial performance status consists of a complex process that requires simultaneous attention to more than one financial instrument. The analyses made with the data in the financial statements or the analyses based on the statistical data are insufficient according to the changing environmental conditions today (Deng et al., 2000, pp. 963–964). As in this case, the use of multicriteria decision-making methods comes to the fore in analyses where more than one qualitative or quantitative factor and probability is used together.

In the study, analysis was made using the ARAS approach, which is one of the multicriteria decision-making methods in the measurement of financial performance. In terms of application area, financial performance measurement was made by using the 2018–2021 annual data of 18 companies in the BIST informatics sector.

Literature

As can be seen in Table 1, there is detailed information on the literature review of financial performance appraisal studies conducted in the IT sector using GIA ARAS, AHP, MOORA, TOPSIS, VIKOR, ELECTRE, SAW, VZA, and ENTROPI analyses known as multicriteria decision-making methods.

ARAS Method

In the ARAS method developed by Zavadskas and Turksis (2010), unlike other methods, the utility function values of the alternatives are compared with the utility function value of the optimal alternative added to the decision problem by the researcher (Dadelo et al., 2012, p. 68). In the ARAS method, the decision matrix is formed as,

$$X = \begin{bmatrix} x_{01} & x_{02}\ldots & x_{0n} \\ x_{11} & x_{12}\ldots & x_{1n} \\ x_{m1} & x_{m2}\ldots & x_{mn} \end{bmatrix} i = 0,1,2,\ldots,m \quad \text{ve} \quad j = 1,2,\ldots,n \qquad (1)$$

with the number of decision options being the number of criteria and the performance value of alternative *i* according to the j–x_{ij} criterion. When the optimal value (x_{0j}) of the criteria is not known in the decision problem, it is calculated according to the minimum or maximum feature of the criteria;

$$x_{0j} = max_i x_{ij} x_{0j} = min_i x_{ij} h \qquad (2)$$

In order to standardize the criteria of different dimensions, the normalization process is applied to ensure that the criteria take values in the range of [0,1]. If the criteria are minimization (cost) oriented, the normalization process is performed in two stages:

$$x_{ij} = \frac{1}{x_{ij}^{*}}, \quad \bar{x}_{ij} = \frac{x_{ij}}{\sum_{i=0}^{m} x_{ij}} \qquad (3)$$

If the criteria are maximization (utility) oriented, they are standardized as:

$$\bar{x}_{ij} = \frac{x_{ij}}{\sum_{i=0}^{m} x_{ij}} \qquad (4)$$

The normalized decision matrix elements are converted to weighted matrix by multiplying the criteria obtained by entropy method with their weights.

$$\hat{x} = \begin{bmatrix} \hat{x}_{01} & \hat{x}_{02}\ldots & \hat{x}_{0n} \\ \hat{x}_{11} & \hat{x}_{12}\ldots & \hat{x}_{1n} \\ \hat{x}_{m1} & \hat{x}_{m2}\ldots & \hat{x}_{mn} \end{bmatrix} i = 0,1,2,\ldots,m \qquad ve \qquad j = 1,2,\ldots,n \qquad (5)$$

1 www.techopedia.com and www.cskbilisim.com. Date of access: June 16, 2022.

Table 1.
Literature Review of Studies Made with Multicriteria Decision-Making Methods in the IT Sector

Year	Author Surname	Objective of the Study	Method of the Study	Result
1996	Thore and others	By examining the data of the companies operating in the US IT sector between 1981 and 1990, it is aimed to have information about the efficiency of the companies.	VZA	It has been concluded that the efficiency processes of long-term companies such as Apple and Compaq are also stable.
1997	Wang and others	It is aimed to examine whether there is a relationship between using information technology on the profitability of enterprises operating in the IT sector.	VZA	It has been concluded that there is a relationship between the profitability of the examined enterprises and the utilization of information technologies.
2000	Shafer and Byrd	It is aimed to examine whether the investments made by the enterprises in the IT sector help to improve and whether these enterprises use their resources effectively.	VZA	It was determined that the enterprises included in the analysis did not make any improvement on the investments they made and that these enterprises did not use their resources effectively.
2006	Chen and others	It is aimed to examine the effect of the investments made by the enterprises in the IT sector on the financial performance of the enterprises.	VZA	New models have been developed regarding the impact of investments in information technologies on the financial performance of enterprises operating in the information sector.
2010	Tektüfekçi	It is aimed to measure the financial efficiency of the companies in the technology sector in the ISE by examining the data for the years 2007–2009.	VZA	It has been determined that the companies included in the analysis have a low efficiency value in general.
2010	Dumanoğlu and Ergül	It is aimed to have information about the financial status of the companies by examining the data of 11 technology companies in the ISE for the years 2006–2009.	TOPSIS	The results obtained with the 4-year data were compared with each other and interpreted.
2010	Kelemenis and Askouris	It is aimed to examine the IT staff selection process to be commissioned for an enterprise operating in the IT sector.	BLURRY TOPSIS	The criteria to be used in the selection of the IT staff to be commissioned were determined and the IT staff recruitment was completed.
2011	Chen and others	It is aimed to evaluate the changes in the efficiency of the enterprises over time by examining the data of the companies traded in the IT sector in the Chinese stock market for the years 2005–2007.	VZA	It was concluded that most of the enterprises were ineffective.
2012	Perçin and Karakaya	It is aimed to evaluate the financial performance of companies operating in information technology.	BLURRYAHP ve TOPSIS	The financial performance ratings of the companies included in the research were calculated.
2012	Türkmen and Çağıl	It is aimed to convert the financial performance of IT sector companies into a single score.	TOPSIS	The performances of the companies that are the subject of the analysis are listed with the calculated scores.
2012	Bulgurcu	It is aimed to examine the data of the 13 enterprises traded in the BIST IT sector for the years 2009–2011 and the financial performance of these enterprises.	TOPSIS	The financial performances of the enterprises are listed on the basis of 10 financial ratios.
2012	Behzadian and others	It is aimed to compare the performances of the candidates who applied for a job in a company in the IT sector.	AHP and TOPSIS	Recruitment processes were completed by comparing the performances of the candidates who applied for the job.

2012	Chaghooshi and others	It is aimed to determine the evaluation criteria of the optimal industrial robot system studies in the IT sector.	TOPSIS and BLURRYVIKOR	The criteria were determined using the fuzzy Shannon entropy method.
2013	Stiakakis and Sifaleras	It is aimed to examine whether the best European enterprises operating in the telecommunication technologies sector, which are in the European Union industrial research and development investment table, are effective in terms of their financial performance.	VZA and AHP	The findings obtained as a result of the analysis show that many enterprises are not in an efficient situation in terms of their financial performance.
2013	Hu and Shieh	It is aimed to evaluate the financial performance of Taiwan technology enterprises traded in China.	VZA	The most productive units in the enterprise were determined by sensitivity analysis.
2013	Gupta, Kavidayal, and Mishra	It is aimed to measure the efficiency of the enterprises operating in the Indian IT sector.	VZA	Companies that are present and active in the Indian IT sector have been identified.
2013	Sueyoshi and Goto	It is aimed to examine whether there is a relationship between R&D expenditures and corporate values of enterprises in the IT sector of Japan and between other sectors.	VZA	It has been concluded that the R&D expenditures of the enterprises included in the analysis increase the institutional value, and in addition, the R&D expenditures made by the enterprises in the IT sector are more important than other sectors.
2013	Zhao and Yang	It is aimed to establish a measurement model of information technology service management in the IT sector.	ELECTRE	The service management model was created by measuring the real data of the enterprises and applying the ELECTRE model.
2013	Oliveira and Alves	It is aimed to contribute to the planning process of technology transfer policies in the IT sector.	ELECTRE	A multiple model has been developed to evaluate the technology transfer process in uncertain and complex situations.
2013	Yıldırım and Onay	It is aimed to list the services provided by companies operating on cloud technology.	BLURRY AHP and MOORA	Evaluation criteria were determined with fuzzy AHP, and ranking was made with MOORA.
2014	Tayyar and others	It is aimed to examine the financial performances of the companies operating in the IT sector in the BIST between the years 2005 and 2011.	GIA and AHP	It has been determined that the high profitability ratios in the evaluation of the financial performances of the enterprises affect the financial performance of the enterprises.
2014	Tayyar and others	It is aimed to measure the financial performance of the enterprises operating in the BIST informatics and technology sector by using the data of the years 2005–2011.	GIA and AHP	The performance values of the companies that are the subject of the analysis are listed.
2014	Büyükarıkan and Büyükarıkan	It is aimed to evaluate the financial performance of the companies operating in the BIST IT sector.	Altman Z-score and Springate financial failure models.	The businesses included in the analysis are ranked according to their financial performance levels.
2015	Cebeci and Özbilgin	It is aimed to examine the corporate governance principles and financial performances of companies traded in the IT sector on the BIST between 2009 and 2013.	Financial and non-financial data in the financial statements were used.	It has been determined that the enterprises included in the analysis do not have difficulty in paying their short-term debts, but their net working capital is not sufficient.
2015	Attila and Kabataş	It has been determined that the enterprises included in the analysis do not have difficulty in paying their short-term debts, but their net working capital is not sufficient.	VZA	After giving information about the IT sector, the financial performance of the enterprises was analyzed.

2015	Özdağoğlu	It is aimed to evaluate the financial performances of 12 companies in the BIST informatics sector with the data of 2014.	VZA	The financial performances of 12 companies included in the analysis were analyzed.
2015	Yücel and Ahmetoğulları	It is aimed to examine to what extent the R&D expenditures of enterprises operating in BIST technology, software, and informatics sectors affect the change in net profit and profit per share.	Financial and non-financial data in the financial statements were used.	The status of the R&D expenditures of the enterprises included in the analysis on the net profit shares has been determined.
2015	Cebeci and Özbilgin	It is aimed to evaluate the corporate governance and financial performance of enterprises in the BIST IT sector.	Financial and non-financial data in the financial statements were used.	The examined enterprises were evaluated in terms of their corporate governance and ranked in terms of their financial performance.
2016	Akyüz and Bilgiç	It is aimed to determine the factors that affect the asset profitability of enterprises operating in the IT sector.	Financial and non-financial data in the financial statements were used.	The relationship between return on assets ratio, leverage ratio, current ratio, acid-test ratio, and cash ratio was examined within the scope of the proposed hypotheses.
2017	Yeniay	It is aimed to measure and evaluate the efficiency based on the financial performance of the companies operating in the IT sector in the BIST between 2013 and 2015.	VZA, Window Analysis, and Malmquist TFV	It has been determined to what extent the companies traded in the IT sector are financially efficient.
2017	Biçen and Sezgin	It is aimed to examine whether there is a relationship between the financial ratios of the companies operating in the BIST informatics sector and their business values.	Panel data method	The relationship between the financial ratios of the examined businesses and the business value has been revealed.
2017	Orçun and Eren	It is aimed to evaluate the financial performance of the selected enterprises for the years 2010–2015.	TOPSIS	No statistically significant relationship could be found between the rankings of financial performance of the companies included in the analysis for the years 2010–2015 and the rankings of returns calculated over annual closing prices.
2018	Gök Kısa and Perçin	It is aimed to evaluate the financial performance of companies in the IT sector, which are among the largest companies in the Global 2000 list, announced by Forbes magazine.	ENTROPI and VIKOR	The businesses included in the analysis are ranked according to their financial performance levels.
2018	Ayçin and Aşan	It is aimed to evaluate the financial performance of companies operating in the BIST IT sector.	ENTROPI and TOPSIS	The companies that are the subject of the analysis are ranked in terms of their financial performance.
2019	Doğan and Calp	It is aimed to evaluate six companies providing services in the IT sector in terms of performance.	GIA	The enterprises included in the analysis are arranged in order of success in terms of their performance.
2020	Yerdegelen Kaygın	It is aimed to analyze the financial performances of 15 companies traded in the BIST IT sector for the years 2015–2018.	MULTIMOORA	Among the companies examined, it was concluded that the financial performances of LINK, KFEIN, LINK, and LINK companies are in the best condition; the financial performances of KAREL, NETAŞ, ARENA, and KAREL companies were in the worst condition.
2021	Salman and Peker	It is aimed to evaluate the financial performances of 12 R&D centers belonging to seven different companies that are traded in the Turkish Defense Industry.	ENTROPI and ARAS	According to the data of 12 R&D centers examined, the criterion with the highest weight was R&D revenues, while the criterion with the lowest weight was R&D expenditures.

2021	Arslan and others	It is aimed to assist in the selection of the most suitable technopark for businesses that plan to operate in the IT sector in the provinces of Istanbul or Izmit.	ENTROPI and ARAS	The data of informatics companies operating within seven technoparks in Istanbul and Izmit provinces were examined and ITU technopark was determined in the first place and Yıldız technopark was determined in the second place.
2021	Uygurtürk and Yıldız	It is aimed to evaluate the efficiency levels and financial performances of enterprises operating in the BIST IT sector.	VZA and GIA	It was concluded that 85% of the companies in the top seven in the financial performance ranking were effective in 2014, 2015, and 2018. According to 2016 and 2017, it has been concluded that 100% of the companies in the top seven are effective.

The weighted by the entropy method, S_i ; *i*. being the optimum value of the decision option,

$$S_i = \sum_{j=1}^{n} \hat{x}_{ij}, \quad i = 0,\ldots,m :, \quad j = 1,\ldots,n \tag{6}$$

is caltulated. It is evaluated as the best for the highest value and the worst for the smallest value. Finally, the degree of utility is calculated by proportioning the S_i values of the alternatives to the S_0 values.

$$K_i = \frac{s_i}{s_0}, \; i = 0,1,\ldots,m \tag{7}$$

The utility function values of the alternatives can be calculated with the ratios that take values in the range of [0,1], and the values are evaluated by ordering them from largest to smallest.

Examination of Companies Operating in Borsa Istanbul Information Sector in Terms of Financial Performance

Within the scope of the study, 18 companies operating in the Borsa (stock market) İstanbul IT sector are examined in terms of their financial performance between the years 2021 and 2018, and the data are obtained from the Public Disclosure Platform data distribution system. The criteria selected for financial performance evaluation are mainly evaluated by the ENTROPI method, and the performances of the companies are evaluated by the ARAS method. The enterprises and criteria included in the application are shown in Table 2.

In the ENTROPI method, after the decision matrix is normalized, the ENTROPI values of the criteria are determined and the criteria weights are calculated. After the criterion weights are calculated with the ENTROPI method, the financial performances of the enterprises are evaluated and ranked with the ARAS method. The initial matrix, which is created by considering the performance values of the decision options according to the criteria, is rearranged according to the utility aspects of the criteria. After normalization to the utility decision matrix, the importance weights of the criteria are included in the ARAS method, and the weighted decision matrix is presented in Table 3.

After the weighting process, the optimality function value and the values expressing the degree of utility for each decision alternative are determined, respectively, and the performance ranking according to the ARAS method is given in Table 4 on a yearly basis.

Table 2.
Business and Criteria Information

The Company Name	The Code	The Company Name	The Code
ALCATEL	F1	**KAFEİN**	F10
ARD GRUP	F2	**KAREL**	F11
ARENA	F3	**KRON**	F12
ARMADA	F4	**LİNK**	F13
DATAGATE	F5	**LOGO**	F14
DESPEC	F6	**NETAŞ**	F15
ESCORT	F7	**PAPİLON**	F16
FONET	F8	**PALİSTİKKART**	F17
İNDEKS	F9	**SMARTİKS**	F18
Criteria name-codes			
Total current assets			**K1**
Revenue (net sales)			**K2**
Net profit			**K3**
Total equity			**K4**
Operating profit			**K5**
Total assets			**K6**
Equity ratio			**K7**
Sales profitability			**K8**
Equity capital turnover			**K9**

Table 3.
Decision Matrices Related to ARAS Method, Calculated by the ENTROPI Method of Criterion Weights

	K1	K2	K3	K4	K5	K6	K7	K8	K9
The weighted normalized decision matrix									
The year 2021									
Wj	0.10569	0.10284	0.10696	0.11510	0.10994	0.10871	0.08727	0.0624	0.0991
Opt.	1.55E-11	7.86E-12	3.04E-10	1.05E-10	1.45E-10	1.56E-11	9.89E-03	1.14E-04	1.53E-03
F1	6.11E-03	4.01E-03	3.05E-03	1.43E-02	2.56E-03	5.98E-03	3.91E-04	3.63E-06	1.37E-03
F2	8.97E-04	8.52E-04	9.46E-04	5.85E-03	5.92E-03	1.54E-03	2.96E-04	5.30E-06	7.09E-04
F3	1.78E-02	1.86E-02	2.32E-02	1.47E-02	8.20E-03	1.69E-02	2.90E-03	5.96E-06	6.17E-03
F4	1.49E-02	1.40E-02	8.03E-03	1.12E-02	3.99E-03	1.33E-02	1.32E-03	2.73E-06	6.12E-03
F5	2.84E-03	5.80E-03	2.20E-03	4.32E-03	2.71E-03	2.57E-03	9.32E-04	1.81E-06	6.54E-03
F6	1.89E-03	2.37E-03	1.63E-03	2.52E-03	2.27E-03	1.70E-03	1.19E-03	3.29E-06	4.59E-03
F7	3.82E-05	5.84E-07	7.61E-03	3.50E-03	4.00E-03	8.39E-04	3.99E-03	6.23E-02	8.13E-07
F8	2.75E-04	2.62E-04	6.99E-04	2.38E-03	1.37E-03	8.13E-04	5.39E-04	1.28E-05	5.36E-04
F9	3.28E-02	4.01E-02	2.56E-02	1.97E-02	2.25E-02	2.96E-02	2.38E-03	3.05E-06	9.91E-03
F10	7.09E-04	8.12E-04	4.57E-03	3.24E-03	1.70E-03	1.28E-03	2.58E-03	2.69E-05	1.22E-03
F11	7.46E-03	5.02E-03	2.91E-03	1.03E-02	1.29E-02	8.29E-03	5.19E-04	2.77E-06	2.38E-03
F12	4.78E-04	2.59E-04	3.29E-04	1.45E-03	1.74E-03	6.74E-04	4.17E-04	6.08E-06	8.71E-04
F13	3.18E-04	6.83E-05	1.44E-04	1.24E-03	3.54E-04	3.45E-04	2.14E-04	1.01E-05	2.69E-04
F14	3.82E-03	2.35E-03	2.44E-05	1.50E-02	8.38E-03	7.70E-03	2.98E-06	4.97E-08	7.61E-04
F15	1.41E-02	7.04E-03	2.27E-02	6.38E-04	2.99E-02	1.56E-02	6.52E-02	1.54E-05	5.37E-02
F16	5.41E-04	9.01E-05	4.76E-04	2.06E-03	1.68E-04	5.31E-04	4.24E-04	2.53E-05	2.13E-04
F17	5.85E-04	1.05E-03	1.46E-03	1.51E-03	1.07E-03	6.22E-04	1.77E-03	6.66E-06	3.38E-03
F18	1.29E-04	1.11E-04	1.46E-03	1.24E-03	1.84E-04	3.97E-04	2.16E-03	6.27E-05	4.37E-04
The year 2020									
Wj	1.13E-01	1.08E-01	1.16E-01	1.23E-01	1.16E-01	1.16E-01	1.24E-01	6.81E-02	1.17E-01
Opt.	2.87E-11	1.05E-11	6.95E-10	1.84E-10	3.37E-10	2.85E-11	3.19E-01	7.62E-04	7.59E-03
F1	9.29E-03	4.73E-03	2.14E-02	1.08E-02	3.73E-03	8.99E-03	1.80E-02	1.09E-04	4.75E-03
F2	8.04E-04	5.18E-04	1.13E-03	4.39E-03	6.50E-03	1.44E-03	2.35E-03	5.25E-05	1.28E-03
F3	1.38E-02	2.11E-02	7.93E-03	1.48E-02	1.63E-02	1.23E-02	4.90E-03	9.06E-06	1.56E-02
F4	1.46E-02	1.28E-02	6.48E-03	8.95E-03	5.00E-03	1.28E-02	6.61E-03	1.22E-05	1.56E-02
F5	4.26E-03	7.03E-03	7.75E-04	4.73E-03	5.37E-03	3.79E-03	1.49E-03	2.66E-06	1.62E-02
F6	2.32E-03	2.72E-03	1.89E-03	2.48E-03	3.23E-03	2.05E-03	6.95E-03	1.67E-05	1.20E-02
F7	9.13E-05	1.48E-06	4.11E-03	2.35E-03	2.95E-03	7.12E-04	1.60E-02	6.68E-02	6.87E-06
F8	2.36E-04	2.69E-04	1.01E-03	2.40E-03	2.78E-03	8.06E-04	3.86E-03	9.10E-05	1.22E-03
F9	3.35E-02	4.24E-02	1.48E-02	1.69E-02	3.36E-02	3.01E-02	8.03E-03	8.43E-06	2.74E-02
F10	8.57E-04	7.11E-04	8.30E-04	5.79E-03	1.53E-03	2.42E-03	1.31E-03	2.81E-05	1.34E-03
F11	1.07E-02	4.21E-03	1.35E-02	1.28E-02	1.83E-02	1.12E-02	9.67E-03	7.73E-05	3.60E-03
F12	5.15E-04	2.21E-04	6.16E-04	1.51E-03	1.41E-03	7.54E-04	3.74E-03	6.73E-05	1.60E-03

Table 4.
Optimal Values and ARAS Performance Ranking

	2021	2020	2019	2018
1	8	7	8	3
2	11	11	14	16
3	3	2	3	6
4	5	6	6	5
5	9	9	9	9
6	10	10	10	10
7	4	3	4	7
8	14	15	15	15
9	2	**1**	**1**	**1**
10	12	14	11	12
11	6	5	5	4
12	15	16	16	17
13	18	18	18	18
14	7	8	7	8
15	**1**	4	2	2
16	17	17	17	13
17	13	12	12	14
18	16	13	13	11

According to the results reported in the table, the performance ranks of the companies are examined according to the ARAS method in the period covering the years 2018–2021. According to the findings of the analysis, it is seen that while the company with the highest performance in 2020–2018 was INDEX with the F9 code, NETAŞ company ranked first with the F15 code in 2021, and INDEX company fell into the second place during the pandemic period.

Conclusion

The change and development processes that have been experienced very rapidly from the past to the present have been affecting the economies of the countries in macroterms since the 1980s while also affecting the enterprises in microterms. Developments in the world economy and advances in technology have brought escalation in the competitive environment on a global basis. Businesses that wanted to keep up with the escalation in the competitive environment had to open up, make innovations, and keep up with the developments in technology (Akın, 2005, p. 3).

In today's economy, businesses should use their resources effectively and efficiently in order to continue their activities in risk environments faced within the scope of innovations that come with developments in technology and informatics. In addition, businesses aim to increase their financial performance levels after the activities (Gök Kısa & Perçin, 2018, p. 2). Along with the pandemic, the increasing work and entertainment sector in the virtual environment, as well as the technological advances, have increased the importance of the enterprises operating in the IT sector, and the IT sector enterprises have come to the forefront due to the contributions they have made to the economies of the countries during the pandemic process. In this context, the development of IT sector and the performance levels of the enterprises have also gained value.

Within the scope of enterprises operating in the IT sector, this sector has become important because it covers all the elements that collect information on computers, software and services, and process and disseminate this information, and investments in this sector have also started to increase. With the increase in investments in the IT sector, measuring the performance of enterprises in this sector has become a critical event (Lee et al., 2008, p. 98). Today, performance measurements of businesses play an important role not only for managers and investors but also for all other businesses in the same sector (Ertuğrul & Karakaşoğlu, 2009, p. 702). Many financial and non-financial decision-making criteria are used when evaluating the performances of businesses (Yalçın Seç et al., 2009, p. 11700).

In order to keep up with the rapidly developing world conditions and to gain a competitive advantage against their competitors in the market they are in, businesses should increase their performance steadily. Since the measurement of the performance of the enterprises has a structure that requires considering more than one factor together, it allows the use of multicriteria decision-making techniques (Gök Kısa & Perçin, 2018, p. 10).

Examining the performance of businesses helps the business management to see the deficiencies of the business, to determine the factors that negatively affect the performance of the business, and to reach the future plans of the business in a timely and efficient manner. Businesses that have performance appraisals measure and evaluate their assets and resources, thereby improving their assets and resources (Bayyurt, 2007, p. 578).

In the ARAS method, which was developed by Zavadskas and Turksis as one of the multicriteria decision-making methods in 2010, unlike other multicriteria decision-making methods, the utility function values of the alternatives of the enterprise are compared with the utility function value of the optimal alternative added to the decision problem by the person researching the subject.

In this study, the data of 18 companies in the BIST IT sector for the years 2018–2021 were obtained from the financial reports of the companies published at www.kap.org.tr, and the financial performances of these companies in the IT sector were evaluated. ARAS method, which is one of the multicriteria decision-making techniques, was used while performing the performance appraisal analysis. The criteria selected for financial

performance evaluation were weighted with the ENTROPI method, and the performances of the companies were evaluated with the ARAS method.

As a result of the analysis, the company that ranked first in the performance ranking in 2018–2019–2020 was INDEKS, while the company that ranked first in 2021 was NETAŞ. In addition, LINK took the last place in the financial performance ranking between 2018 and 2021. Firms that behave consistently are between 2018 and 2021—DATAGATE, which is consistently ranked ninth, and DESPEC, which is consistently ranked tenth.

The changes in the financial performance rankings of 18 companies in the BIST IT sector for the years 2018–2021 are as follows:

- ALCATEL: While it was ranked third in 2018, it dropped to the eighth place in 2019. Although it recovered a little in 2020 and rose to the seventh place, it is again in the eighth place in 2021.
- ARD GROUP: While it was 16th in 2018, it rose to 14th in 2019 and 11th in 2020. It is still in the 11th place in 2021.
- ARENA: While it was sixth in 2018, it rose to third place in 2019 and second place in 2020. In 2021, it fell to the third place again.
- ARMADA: While it was in the fifth place in 2018, it fell to the sixth place in 2019 and remained in this rank in 2020, but rose to the fifth rank again in 2021.
- DATAGATE: consistently ranked ninth between 2018 and 2021.
- DESPEC: consistently ranked tenth between 2018 and 2021.
- ESCORT: While it was ranked seventh in 2018, it rose to the fourth place in 2019 and third place in 2020 but dropped to the fourth place again in 2020.
- FONET: While it was consistently ranked 15th in 2018–2019–2020, it rose to 14th in 2021.
- INDEX: While it was at the top of the list in 2018–2019–2020, it was the second in 2021.

dropped in line.

- Caffeine: While it was in the 12th place in 2018, it rose to the 11th rank in 2019 but fell to the 14th rank in 2020. In 2021, it rose to the 12th place again.
- KAREL: It ranked fourth in 2018 and fifth in 2019 and 2020. In 2021, it fell to the sixth place.
- KRON: While it was ranked 17th in 2018, it rose to the 16th place in 2019 and maintained this position in 2020, placing it in the 15th place in 2021.
- LINK: It is the company at the end of the list for the years 2018–2021.
- LOGO: While it was in the eighth place in 2018, it rose to the seventh rank in 2019 but regressed to the eighth rank in 2020 and rose to the seventh rank again in 2021.
- NETAŞ: While it was in the second place in 2018 and 2019, it fell to the fourth place in 2020 but reached the top in 2021.
- PAPILON: While it was 13th in 2018, it dropped to 17th in 2019 and continued to be 17th in 2020 and 2021.
- PALISTIKKART: While it was 14th in 2018, it rose to 12th in 2019 and 12th in 2020 but fell to 13th in 2021.
- SMARTIKS: While it was 11th in 2018, it dropped to 13th in 2019 and continued to be 13th in 2020. In 2021, it fell to the 16th place.

As a result of the analysis, financial performance level rankings of the enterprises were made. For enterprises with low financial performance levels and medium level, it is recommended that they reexamine their financing and sales policies, evaluate the financial status of all their competitors in the IT sector, and, as a result of this evaluation, develop solution-oriented strategies and set targets to increase their financial performance in their future plans.

Peer-review: Externally peer-reviewed.

Declaration of Interests: The author declare that they have no competing interest.

Funding: This study received no funding.

Hakem Değerlendirmesi: Dış bağımsız.

Çıkar Çatışması: Yazar çıkar çatışması bildirmemiştir.

Finansal Destek: Yazar bu çalışma için finansal destek almadığını beyan etmiştir.

References

Akın, H. B. (2005). *Yeni ekonomi (strateji, rekabet ve küreselleşme), güncellenmiş* (*2*. Baskı), Çizgi Kitabevi.

Akyüz, F., & Bilgiç, S. (2016). Borsa İstanbul (BIST)'da İşlem gören bilişim firmalarının aktif kârlılıkları ile kaldıraç oranı, cari oran, nakit oranı ve asit-test oranının istatistiksel analiz yöntemiyle karşılaştırılması. *Uşak Üniversitesi Sosyal Bilimler Dergisi*, *9*(28/4), 88–102.

Arslan, H. M., Durak, İ., & Özdemİr, Y. (2021). Entropi-Aras Hibrit Yöntemi Ile Bilişim Işletmeleri için En Uygun Teknopark Bölgesinin Belirlenmesi. *Uluslararası Yönetim İktisat ve İşletme Dergisi*, *17*(3), 734–753. [CrossRef]

ATTİLA, İ., & Kabataş, Y. (2015). Türkiye'de bilişim sektöründe faaliyet gösteren İşletmelerin finansal performanslarının değerlendirilmesi: Veri zarflama analizi uygulaması. *Vergi Sorunları Dergisi*, *327*, 166–175.

Ayçin, E., & Aşan, H. (2018). BIST'te işlem gören bilişim sektöründeki firmaların finansal performanslarının entropi ve Topsis Yöntemleri ile değerlendirilmesi. *İzmir Uluslararası İktisadi İdari Bilimler Kongresi IZCEAS*, *18*, 1-20.

Bayyurt, N. (2007). İşletmelerde performans değerlendirmenin önemi ve performans göstergeleri arasındaki ilişkiler. *Sosyal siyaset Konferansları dergisi*, 53, 577-590.

Behzadian, M., Otaghsara, S. K., & Yazdani, M. (2012). Ignatius J, A state-of the-art survey of TOPSIS applications. *Expert Systems with Applications*, *39*(17), 13051–13069.

Biçen, Ö. F., & Sezgin, H. (2017). Finansal oranların firma değeri üzerindeki etkileri: Borsa İstanbul bilişim sektörüne yönelik bir panel veri analizi. *Yönetim ve Ekonomi Araştırmaları Dergisi*, *15*(3).

Bulgurcu, B. K. (2012). Application of TOPSIS technique for financial performance evaluation of technology firms in İstanbul stock exchange market. *Procedia – Social and Behavioral Sciences*, *62*, 1033–1040. [CrossRef]

Büyükarikan, U., & Büyükarikan, B. (2014). Bilişim sektöründe faaliyet gösteren firmaların finansal başarısızlık tahmin modelleriyle incelenmesi. *Akademik Bakış Dergisi*, *45*, 160–172.

Cebeci, G., & Özbilgin, İ. (2015). Borsa İstanbul bilişim endeksinde yer alan şirketlerin kurumsal yönetim ve finansal performans açısından değerlendirilmesi. *Gazi Üniversitesi Sosyal Bilimler Dergisi*, *2*(4), 47–64.

Cebeci, G., & Özbilgin, İ. G. (2015). Borsa İstanbul bilişim endeksinde yer alan şirketlerin kurumsal yönetim ve finansal performans açısından değerlendirilmesi. *Gazi Üniversitesi Sosyal Bilimler Dergisi*, *2*(4), 47–64.

Chaghooshi, A. J., et al. (2012). Integration of fuzzy Shannon's entropy with fuzzy TOPSIS for industrial robotic system section. *Journal of Industrial Engineering and Management*, *5*(1), 102–114.

Chen, X., Wang, X., Wu, D. D., & Zhang, Z. (2011). Analysing firm performance in Chinese IT industry: DEA Malmquist productivity measure. *International Journal of Information Technology and Management*, *10*(1), 3–23. [CrossRef]

Chen, Y., Lıang, L., Yang, F., & Zhu, J. (2006). Evaluation of information technology investment: A data envelopment analysis approach. *Computers and Operations Research*, *33*(5), 1368–1379. [CrossRef]

Dadelo, S., Turskis, Z., Zavadskas, E. K., & Dadeliene, R. (2012). Multiple criteria assessment of elite security personal on the basis of ARAS and expert methods. *Economic Computation and Economic Cybernetics Studies and Research*, *46*(4), 6588.

Deng, H., Yeh, C. H., & Willis, R. J. (2000). Inter-company comparison using modified TOPSIS with objective weights. *Computers and Operations Research*, *27*, 963–973.

Doğan, A., & Calp, M. H. (2019). Borsa İstanbul'da işlem gören bilişim sektörü şirketlerinin performans ölçümü. *Karadeniz 2. Uluslararası Sosyal Bilimler Kongresi*, *Rize*, 401-413.

Dumanoğlu, S., & Ergül, N. (2010). İMKB'de işlem gören teknoloji şirketlerinin mali performans ölçümü. *Muhasebe ve Finansman Dergisi*, *48*, 101–111.

Ertuğrul, İ., & Karakaşoğlu, N. (2009). Performance evaluation of Turkish cement firms with fuzzy analytic hierarchy process and TOPSIS methods. *Expert Systems with Applications*, *36*(1), 702–715. [CrossRef]

Fatihudin,D., Jusni, J., & Mochklas, M. (2018). How measuring financial performance. *International Journal of Civil Engineering and Technology*, *9*(6), 553557.

Ganga, M., Kalaiselvan, P., & Suriya, R. (2015). Evaluation of financial performance. *International Journal of Scientific and Research Publications*, *5*(4), 1–7.

Gök Kisa, A. C., & Perçin, S. (2018). Bütünleşik entropi ağırlık-VIKOR Yöntemi ile bilişim teknolojisi sektöründe performans ölçümü. *Ekonomik ve Sosyal Araştırmalar Dergisi*, *14*(1), 1–13.

Gupta, O., Kavidayal, P. C., & Mishra, R. C. (2013). Evaluating significance of marketing in Indian IT companies using DEA. *Global Journal of Management and Business*, *13*(5).

HU, R., & Shieh, C. J. (2013). High-tech industries' overseas investment performance evaluation application of data envelopment analysis. *South African Journal of Economic and Management Sciences*, *16*(5), 67–73. [CrossRef]

Kelemenis, A., & Askounis, D. (2010). A new TOPSISBased multicriteria Approach Personnel Selection. *Expert Systems with Applications*, *37*(7), 4999–5008. [CrossRef]

Lee, A. H. I., Chen, W., & Chang, C. (2008). A fuzzy AHP and BSC approach for evaluating performance of IT department in the manufacturing industry in Taiwan. *Expert Systems with Applications*, *34*(1), 96–107. [CrossRef]

Oliveira, S. R. M., & Alves, J. L. (2013). Multi model to assess the technology transfer process performance in highly complex spectrum under uncertainty and unpredictability. *International Journal of Business and Social Science*, *4*(16), 81–95.

Orçun, Ç. S. E., & Eren, B. S. (2017). TOPSIS Yöntemi ile Finansal Performans Değerlendirmesi: XUTEK Üzerinde Bir Uygulama. *Muhasebe ve Finansman Dergisi*, (75), 139–154. [CrossRef]

Özdağoğlu, A. (2015). Bilişim sektöründeki şirketlerin etkinliklerinin veri zarflama analizi ile değerlendirilmesi. *Yönetim ve Ekonomi*, *22*(2), 331–340.

Perçin, Selçuk-Karakaya, Aykut (2012). Bulanık karar verme yöntemleriyle Türkiye'de bilişim teknolojisi firmalarının finansal performanslarının değerlendirilmesi. *Marmara University Journal of the Faculty of Economic & Administrative Sciences*, *33*(2), 241–266.

Salman, S.,& Peker, İ. (2021). Savunma Sanayi Ar-Ge Merkezlerinin Performanslarının Entropive Aras Yöntemleri İle Değerlendirilmesi. *Uluslararası Ekonomi ve Yenilik Dergisi*, *7*(1), 51 –73. [CrossRef]

Seçme, N. Y., Bayrakdaroğlu, A., & Kahraman, C. (2009). Fuzzy performance evaluation in Turkish banking sector using analytic hierarchy process and TOPSIS. *Expert Systems with Applications*, *36*(9), 11699–11709. [CrossRef]

Shafer, S. M., & Byrd, T. A. (2000). A framework for measuring the efficiency of organizational investments in information technology using data envelopment analysis. *Omega*, *28*(2), 125–141. [CrossRef]

Spronk, J., Steuer, R. E., & Zopounidis, C. (2005). Multicriteria decision aid/analysis in finance. In *Multiple Criteria Decision Analysis: State of the Art Surveys*. *International Series in Operations Research and Management Science* (vol. *78*). Springer.

Stiakakis, E., & Sifaleras, A. (2013). Combining the priority rankings of DEA and AHP methodologies: A case study on an ICT Industry. *International Journal of Data Analysis Techniques and Strategies*, *5*(1), 1. [CrossRef]

Sueyoshi, T., & Goto, M. (2013). A use of DEA-DA to measure importance of R&D expenditure in Japanese information technology industry. *Decision Support Systems*, *54*(2), 941–952. [CrossRef]

TAYYAR, N., AKCANLI, F., GENÇ, E., & EREM, I. (2014). BIST'e kayıtlı bilişim ve teknoloji alanında faaliyet gösteren işletmelerin finansal performanslarının Analitik Hiyerarşi Prosesi (AHP) ve gri ilişkisel analiz (GİA) yöntemiyle değerlendirilmesi. *Muhasebe ve Finansman Dergisi*, *61*, 19–40.

Tayyar, N., Akcanlı, F., Genç, E., & Erem, I. (2014). BİST'e Kayıtlı Bilişim ve Teknoloji Alanında Faaliyet Gösteren İşletmelerin Finansal Performanslarının Analitik Hiyerarşi Prosesi (AHP) ve Gri İlişkisel Analiz (GİA) Yöntemiyle Değerlendirilmesi". *Muhasebe ve Finansman Dergisi*, 19–40.

Tektüfekçi, F. (2010). İMKB'ye kayıtlı halka açık teknoloji şirketlerinde finansal etkinliğin Veri Zarflama Analizi (VZA) ile değerlendirilmesi. *Organizasyon ve Yönetim Bilimleri Dergisi*, *2*(2), 69–77.

Thore, S., Phillips, F., Ruefli, T. W., & Yue, P. (1996). DEA and management of the product cycle: The U.S. Computer industry. *Computers and Operations Research*, *23*(4), 341–356. [CrossRef]

Türkmen, Sibel Yılmaz-Çağıl, Gülcan (2012). İMKB'ye Kote Bilişim Sektörü Şirketlerinin Finansal Performanslarının TOPSIS Yöntemi ile Değerlendirilmesi. *Maliye Finans Yazıları*. *26*(95), 59–78.

Uygurtürk, H., & Yıldız, İ. (2021). İşletmelerin etkinlikleri ile finansal performanslari arasındaki ilişki: Bilişim sektörü üzerine bir araştırma. *Verimlilik Dergisi*, *1*(1), 3–15. [CrossRef]

Wang, C. H., Gopal, R. D., & Zionts, S. (1997). Use of Data Envelopment Analysis in assessing Information Technology impact on firm performance. *Annals of Operations Research*, *73*, 191–213. [CrossRef]

What is the IT sector??. Retrieved from www.cskbilisim.com. Date of access: 16.06.2022.

What is the IT sector??. Retrieved from www.techopedia.com. Date of access: 16.06.2022.

Wilson, R. L., & Sharda, R. (1994). Bankruptcy prediction using neural networks. *Decision Support Systems*, *11*(5), 545–557. [CrossRef]

Yeniay, B. (2017). *Borsa İstanbul'da işlem gören bilişim sektörü şirketlerinin finansal performanslarına dayalı dinamik etkinlik analizi* [Yüksek Lisans Tezi]. Muğla Üniversitesi.

Yerdelen Kaygın, C. (2020). BİST bilişim sektöründe işlem gören şirketlerin finansal performanslarının multimoora yöntemleri ile ölçümü. *Muhasebe Bilim Dünyası Dergisi*, *22*(3), 529–546. [CrossRef]

Yildirim, B. F.,& Önay, O. (2013). BULUT teknolojisi firmalarının Bulanık AHP – Moora yöntemi kullanılarak sıralanması. *Yönetim Dergisi*, *24*(75), 59–81.

Yücel, R., & Ahmetoğullari, K. (2015). Ar-Ge harcamalarının firmaların net kâr değişimi ve hisse başına kârlılığına inovatif etkisi: BİST teknoloji yazılım ve bilişim sektöründe bir uygulama. *AİBÜ Sosyal Bilimler Enstitüsü Dergisi*, *15*(4), 87104.

Zhao, G. S. Y. (2013). IT Service Incident Management Model Decision Based on ELECTRE III, 6th International Conference on Information Management. *Innovation Management and Industrial Engineering*, *468*, 514-517.