Performance Evaluation in Retail Sector

Ali Emre Ates, Mehtap Dursun, and Nazli Goker

***Abstract*—**Performance management consists of aligning individual objectives with organizational objectives. It is simply a matter of obtaining better organizational results by understanding and managing performance within an agreed framework of planned objectives, standards and requirements. The main elements of performance management are agreement, measurement, feedback, positive reinforcement and dialogue. Possible results of effective performance management can be stated as clarifying professional responsibilities and expectations, improving individual and collective productivity, developing employee capacities to their fullest extent through effective feedback and coaching, behavior management for align with the organization's core values, goals and strategy, provide a foundation for operational decisions on human capital, and improve communication between employees and managers. In this study, performance evaluation of a technology company that performs in the retail sector is conducted and the results are analyzed.

***Keywords*—**Data envelopment analysis, decision making, performance management, retail sector

I. INTRODUCTION

PERFORMANCE management can be defined as achieving better organizational results by understanding and managing performance within an agreed framework of planned objectives, standards and requirements. This process exists to establish a common understanding of what needs to be done for the management and development in the short and long terms.

The main elements of performance management are agreement, measurement, feedback, positive reinforcement and dialogue. Performance management focuses on planning and improving future performance rather than a retrospective performance assessment. It operates as a continuous and evolving process, in which performance improves over time; and provides the basis for regular and frequent dialogues between managers and individuals on performance and development needs. It mainly concerns individual performance but can also apply to teams.

In the literature, it is seen that many studies on performance evaluation have been carried out. In recent years, personnel evaluation ([1],[2]), project performance evaluation ([3], [4]), evaluation of logistics service providers ([5], [6]) supplier performance evaluation ([7], [8], [9]) are at the forefront. Data envelopment analysis ([10], [11], [12]) and decision making models were frequently used in performance studies ([13], [14], [15]).

In this study, performance evaluation of a technology company that performs in the retail sector is conducted. 12 stores in the same region and category are selected, and data envelopment analysis (DEA), which solves the decision-making problems that require considering multiple inputs and outputs to evaluate the efficiency scores of decision-making units, is employed for the evaluation. The rest of the study is organized as follows. In Section 2, Data Envelopment Method is briefly explained. The case study is illustrated in Section 3. Finally, conclusions are given in the last section.

II. DATA ENVELOPMENT ANALYSIS

The original data envelopment analysis (DEA) model, also named as the CCR model, proposed by Charnes et al. [16], computes the relative efficiency of a DMU by maximizing the ratio of its total weighted outputs to its total weighted inputs subject to the condition that the output to input ratio of every DMU be less than or equal to unity. The traditional DEA formulation can be represented as follows:

$$\max E_{j0} = \frac{\sum_{r=1}^{s} u_r y_{rj0}}{\sum_{i=1}^{m} v_i x_{ij0}}$$

subject to, (1)

$$\frac{\sum_{r=1}^{s} u_r y_{rj}}{\sum_{i=1}^{m} v_i x_{ij}} \leq 1, \quad \forall j,$$

$$u_r, v_i \geq \varepsilon, \quad \forall r, i$$

where E_{J0} is the efficiency score of the evaluated DMU, u_r is the weight assigned to output r, v_i is the weight assigned to input i, y_{rj} is the quantity of output r generated and x_{ij} is the amount of input i consumed by DMU j, respectively, and ε is a small positive scalar.

Formulation (1) has nonlinear and nonconvex properties, however, it can be transformed into a linear programming model via a transformation. The linear programming model for calculating the relative efficiency of a DMU is given in the following set of equations.

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$$\max E_{j0} = \sum_{r=1}^{s} u_r y_{rj0}$$

subject to, (2)

$$\sum_{i=1}^{m} v_i x_{ij0} = 1,$$

$$\sum_{i=1}^{m} v_i x_{ij} - \sum_{r=1}^{s} \mu_r y_{rj} \geq 0,$$

$$u_r, v_i \geq \varepsilon, \ \forall r, i$$

While conventional DEA – CCR Model has many positive aspects in terms of efficiency measurement, it also has some shortcomings. Many new approaches / models have been proposed in order to overcome these disadvantages.

One of the shortcomings of conventional DEA model is that it assigns unrealistic weights to the inputs and outputs to produce high efficiency score for the evaluated DMU and therefore the number of efficient DMUs can be quite high. Mimsum and minimax efficiency models [17] are two of the proposed models which are developed to overcome this problem. Minsum efficiency model aims to minimize the sum of the deviations from efficiency for each DMU and represented as follows:

$$\min M$$

subject to (3)

$$\sum_{i=1}^{m} v_i \, x_{ij_0} = 1,$$

$$\sum_{r=1}^{s} u_r \, y_{rj} - \sum_{i=1}^{m} v_i \, x_{ij} + d_j = 0, \qquad \forall j,$$

$$M \geq d_j, \qquad \forall j,$$

$$u_r, v_i, d_j \geq 0, \qquad \forall r, i, j,$$

where d_j is the deviation from efficiency for DMU$_j$, (i.e. $d_j = 1 - E_j$ when E_j is the efficiency score of DMU$_j$), and M is the maximum deviation from efficiency.

Likewise, minsum efficiency is to minimize the total deviation from efficiency [17]. The resulting model is as

$$\min \sum_{j=1}^{n} d_j$$

subject to (4)

$$\sum_{i=1}^{m} v_i \, x_{ij_0} = 1,$$

$$\sum_{r=1}^{s} u_r \, y_{rj} - \sum_{i=1}^{m} v_i \, x_{ij} + d_j = 0, \qquad \forall j,$$

$$u_r, v_i, d_j \geq 0, \qquad \forall r, i, j.$$

Throughout the literature, common-weight DEA-based models have been proposed in order to avoid the shortcomings of classical DEA models. These models provide a common evaluation for all DMUs and do not require subjective assessment to determine input and output weights. Hence, the discriminating power is improved that restricts the selection of input and output weights in favour of respective DMUs [18].

Sun et al. [19] employed the following linear programming model that results in super efficiency scores for DMUs.

$$\min \sum_{j=1}^{n} \left(\sum_{i=1}^{m} v_i x_{\max} - \sum_{i=1}^{m} v_i x_{ij} \right) + \sum_{j=1}^{n} \left(\sum_{r=1}^{s} u_r y_{rj} - \sum_{r=1}^{s} u_r y_{\min} \right)$$

subject to (5)

$$\sum_{i=1}^{m} v_i \, x_{ij} - \sum_{r=1}^{s} u_r \, y_{rj} \leq 0, \quad \forall j,$$

$$\sum_{i=1}^{m} v_i \, x_{max} = 1,$$

$$\sum_{r=1}^{s} u_r \, y_{min} = 1,$$

$$u_r, v_i \geq \varepsilon, \qquad \forall r, i.$$

where $x_{\max} = \max\{x_{ij} | j = 1, \ldots, n\}$, $i=1,2,\ldots,m$ and $y_{\min} = \min\{y_{rj} | j = 1, \ldots, n\}$, $r=1,2,\ldots,s$.

III. CASE STUDY

In this study, performance evaluation of a technology company that performs in the retail sector is conducted. 12 stores in the same region and category are selected. Employee numbers, sales amounts, customer evaluation scores, turnovers, working hours and similar data are collected and the performance of stores are evaluated employing the models given in Section 2.

The input and output data are given in Table 1 and the results of the DEA methodologies are provided in Table 2-5.

Table 1. Input and Output Data

Stores	Inputs			Outputs		
	Employee number	Area of the store (m^2)	Total premium	NPS	Conversion rate	Total turnover
1	60	3542	₺100697.33	52.13	0.12	₺1317523.58
2	32	1866	₺66934.26	51.38	0.06	₺9028861.46
3	41	3114	₺95236.95	51.01	0.07	₺10847285.92
4	43	2824	₺63058.25	51.92	0.15	₺12010550.56
5	29	2121	₺38450.87	49.27	0.10	₺7027468.57
6	27	2415	₺29992.94	58.26	0.09	₺5421230.97
7	34	2613	₺88856.25	60.52	0.14	₺7104473.45
8	31	2010	₺78222.24	49.60	0.24	₺7945112.71
9	31	2364	₺70617.73	60.08	0.13	₺7773632.54
10	18	1253	₺7618.37	48.14	0.10	₺4058008.19
11	37	3783	₺19876.83	51.63	0.16	₺7306513.52
12	24	2762	₺33944.39	50.49	0.10	₺5366156.74

Table 2. Results of CCR model

Stores	CCR	CCR - Rank
1	0.857420	10
2	1	1
3	0.937679	6
4	1	1
5	0.925862	7
6	0.858249	9
7	0.838657	12
8	1	1
9	0.975688	5
10	1	1
11	0.853643	11
12	0.915772	8

Table 3. Results of minimax model

Stores	Minimax	Minimax - Rank
1	0.818009	8
2	0.989728	2
3	0.852544	6
4	1	1
5	0.866138	4
6	0.760919	9
7	0.710443	11
8	0.889136	3
9	0.862459	5
10	0.832174	7
11	0.714518	10
12	0.687292	12

Table 4. Results of minsum model

Stores	Minsum	Minsum - Rank
1	0.792747	11
2	1	1
3	0.912876	7
4	1	1
5	0.925862	6
6	0.834998	9
7	0.81593	10
8	1	1
9	0.960615	5
10	1	1
11	0.792528	12
12	0.907926	8

Table 5. Results of Sun et al. [19] model

Stores	Sun et al. [19]	Sun et al. [19] Rank
1	2.148211	7
2	3.101503	1
3	2.076998	9
4	2.468384	4
5	2.342751	6
6	1.983896	10
7	2.101595	8
8	2.63212	3
9	2.42473	5
10	3.039033	2
11	1.377373	12
12	1.595253	11

According to the results of CCR model, stores 2, 4, 8, and 10 are efficient, but CCR, minimax, and minsum models do not provide full ranking of the stores. However, the model proposed by Sun et al. [19] gives full ranking of the stores and it identified store 2 as the most efficient store, which is followed by stores 10 and 8.

IV. CONCLUSIONS

In a globalizing world where competition and change are fast, customer needs are changing every day. The ability of companies to sustain their existence in this complex structure depends on their understanding of environmental changes and their adaptation to these changes. On the other hand, the level of knowledge and skills of employees is increasing and employees are expected not only to do their jobs but also to think and make decisions. Performance management system is considered as the most important management systems in order to achieve the goals of the companies.

In this study, performance evaluation of a technology company that performs in the retail sector is conducted. First classical CCR method is employed to determine the efficient stores. Employee number, area of the store and total premium are considered as inputs whereas NPS, conversion rate and total turnover are supposed as outputs of the model. CCR model dichotomized stores as efficient and inefficient but it did not provide full ranking of the stores. Common-weight DEA-based model introduced by Sun et al. [19] is utilized for ranking the stores and store 2 is determined as the most efficient store, which is followed by stores 10 and 8.

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