

COMBINING AHP AND VIKOR METHODOLOGIES FOR RANKING BASKETBALL TEAMS

Seyhan Sipahi*
School of Business
Istanbul University
Istanbul, TURKEY
E-mail: sipahi@istanbul.edu.tr

Bilge Donuk
School of Physical Education and Sports
Istanbul University
Istanbul, TURKEY
E-mail: bdonuk@istanbul.edu.tr

ABSTRACT

In the area of sport management, there is a great need for trusted methodologies for the performance evaluation of sport teams. The purpose of this study is to propose a hybrid multi-criteria model for evaluating performance and obtaining overall ranking of basketball teams. The model successfully combines the Analytic Hierarchy Process (AHP) and the VIKOR (Vise Kriterijumska Optimizacija I Kompromisno Resenje) method, which is a novel multi-criteria methodology for the optimization of complex systems. In the study, sixteen teams that perform in the first division of the Turkish National Basketball League were ranked in accordance with ten technical evaluation criteria. The ranking obtained was compared with the actual ranking at the end of the season. The study demonstrated that the VIKOR methodology combined with AHP is an efficient decision tool and it can successfully be applied by basketball managers and practitioners to evaluate team performance.

Keywords: AHP, VIKOR Method, basketball, ranking

1. Introduction

Today's rapid advancement of modern sports science provides several innovative methodologies that play vital important role on the measurement and prediction of the team effectiveness or performance. Successful sport managers usually implement trusted scientific methodologies that the team success usually depends on the use of these methods. For instance, the implementation of performance evaluation methodologies in basketball can help coaches and managers to predict overall performance of the team, to determine strengths and weaknesses of players who perform in various positions, and to measure continuing progress of the team.

The purpose of this study is to propose a novel multi-criteria model for evaluating the overall performance and obtaining the ranking of basketball teams. Different from the prior similar studies, the proposed model successfully combines the Analytic Hierarchy Process (AHP) and the VIKOR (Vise Kriterijumska Optimizacija I Kompromisno Resenje) method, which is a novel multi-criteria methodology for the optimization of complex systems. In the study, sixteen teams that perform in the first division of the Turkish National Basketball League were ranked in accordance with the 2008-2009 season

* Corresponding author

data and ten technical evaluation criteria. The ranking obtained was compared with the actual ranking at the end of the season. The study demonstrated that the VIKOR methodology combined with AHP is an efficient decision tool and it can successfully be applied by basketball managers and practitioners to evaluate team performance.

2. Performance Evaluation in Basketball

Player technical performance management involves the keeping of systematic records and analysis of past performances to enhance a player's performance through "evaluation" and "feedback" and to discover his potential in pursuit of better management of the basketball team (Yu, Su, and Zhuang, 2008). With the development of the National Basketball Association (NBA) and the Euro Basketball League (EBL), performance evaluation is getting importance and academically investigating.

As the statistics in basketball have been becoming available, several related studies have appeared in the sport literature which made use of quantitative or statistical techniques. These studies have usually aimed to predict the success and to evaluate performance of teams or players. In their study, Trninic and Dizdar (2000) inspected prior studies related to performance evaluation in basketball. In their study, they also employed a system for the actual performance evaluation of basketball players. Stern, Israeli, and Bar-Eli (2006) predicted the ranking of 11 Israeli basketball teams by employing AHP method. Four experts participated in the evaluation process and six criteria were introduced to evaluate and rank the teams. Consistency tests led to sensitivity analyses conducted with five criteria and three experts. The results were validated against the actual ranking at the end of the season. Although there was good correlation between each expert's ranking and the actual results, the best correlation was between the predicted average rank (over all the experts) and the actual results. In another study, Isik and Gencer (2007) evaluated the technical performances of teams, at home and away fields, placed in 2006-2007 Turkish Beko Basketball League during regular season. In order to evaluate home field and away field performances, 240 played games were analyzed. In the study, data that consist of points, rebounds, steals, assists, blocks, shooting attempt, shooting made, free throw attempt, free throw made, and turnovers were processed into SPSS package. By adopting the efficiency rating formula that is used to evaluate the players' efficiency, home field and away field efficiency ratings of the teams were obtained.

In 2009, Cooper, Ruiz, and Sirvent presented an application of Data Envelopment analysis (DEA) to the assessment of basketball players in the Spanish Basketball League. Besides the traditional use of DEA, they used a procedure that guarantees a full profile of non-zero weights. Their study demonstrated that these values can be used to identify relative strengths and weaknesses in individual players. Rimler et al. (2009) used Bayesian analysis with Markov Chain Monte Carlo (MCMC) estimation to generate estimates of technical efficiency for each game played by an Atlantic 10 Conference men's basketball team during the 2005-2006 season. The findings of their study indicated that technical efficiency does not vary significantly, either across or within teams. Moreover, technical efficiency does not correlate strongly with productivity. In addition, parameter estimates suggested that a single turnover or offensive rebound could mean the difference between winning and losing. Finally Winston (2009), in his book entitled "Mathletics", demonstrated how simple arithmetic, probability theory, and statistics can be combined with a large dose of common sense to better evaluate players and game strategy in America's major sports such as baseball, football and basketball.

In 1970's, Thomas L. Saaty developed AHP technique, which constructs decision making problem in various hierarchies as a goal, criteria, sub-criteria and decision alternatives (Saaty, 1990, 2001a, 2001b, Saaty and Vargas, 2001). AHP method helps decision makers to deal with complex decision problems, set priorities and to make the best decision especially when subjectivity exists. It is very suitable to solve problems where the evaluation criteria can be organized in a hierarchical way into sub-criteria. Due to its mathematical simplicity and flexibility, AHP has been a favorite decision tool for research in many fields.

In their study, Sipahi and Timor presented a comprehensive literature review of AHP and ANP methodologies and compiled a wide list of areas where these methodologies had been used (2010).

The VIKOR method is a novel multi-criteria methodology and was first introduced by Opricovic and Tzeng (Opricovic, 1998; Opricovic & Tzeng, 2004). It can be defined as a multi-criteria optimization of complex systems. The method determines the rank of decision alternatives under conflicting criteria. Assuming that each alternative is evaluated according to each criterion function, the compromise ranking could be performed by comparing the measure of closeness to the ideal alternative. The compromise solutions could be the basis for negotiations, involving the preference of decision makers by criteria weights (Opricovic and Tzeng, 2004).

In this study, the ranking of sixteen teams that perform in the first division of the Turkish National Basketball League was obtained considering ten evaluation criteria. Criteria were determined by literature search and by consulting of basketball experts. The criteria used in the model are as follows:

Two-Point Field Goal Percentage (C1.1): The percentage of two- point field goal attempts that were successful during the season.

Three-Point Goal Percentage (C1.2): The percentage of three- point field goal attempts that were successful during the season.

Free Throw Percentage (C1.3): The percentage of free throws that were successful during the season.

Average of Assists (C1.4): The average number of assists obtained during the season.

Average of Blocks (C2): The average number of blocks obtained during the season.

Average of Steals (C3): The average number of steals obtained during the season.

Average of Turnovers (C4): The average number of turnovers obtained during the season.

Average of Offensive Rebounds (C5): The average number of offensive rebounds during the season.

Average of Defensive Rebounds (C6.1): The average number of defensive rebounds during the season.

Average of Points per Game (C6.2): The average number of points obtained during the season.

5. Findings And Discussion

In this study, AHP method was used to prioritize evaluation criteria in accordance with the expert judgments. First, the hierarchical structure of the evaluation criteria was constructed (Figure 1).

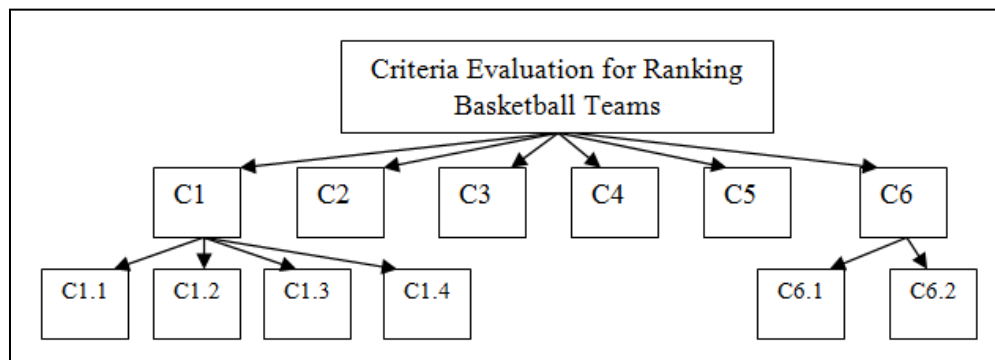


Fig. 1 The Hierarchical Structure of the Evaluation Criteria

After constructing the hierarchy, an AHP questionnaire was designed. In the AHP survey questionnaire, pairwise comparisons were performed on the basis of nine scale of AHP. Questionnaires were filled by an expert focus group formed by 12 basketball authorities constituted from basketball coaches and elite

basketball players. Aggregate pairwise comparison matrix was obtained by taking geometric means of expert judgments.

Table 1. Weights of Evaluation Criteria

Criteria	Relative Weights	Overall Weights
C1. Goal and Point Related Criteria	0.4277	
<i>C1.1. Two-Point Field Goal Percentage</i>	0.3134	0.1341
<i>C1.2. Three-Point Goal Percentage</i>	0.4659	0.1993
<i>C1.3. Free Throw Percentage</i>	0.1437	0.0615
<i>C1.4. Average of Points per Game</i>	0.0770	0.0329
C2. Average of Assists	0.2391	0.2391
C3. Average of Blocks	0.0673	0.0673
C4. Average of Steals	0.1065	0.1065
C5. Average of Turnovers	0.0442	0.0442
C6. Rebounds	0.1152	
<i>C6.1 Average of Offensive Rebounds</i>	0.4075	0.0469
<i>C6.2 Average of Defensive Rebounds</i>	0.5925	0.0683
	TOTAL	1.0000

In the Table 1, the last column presents the overall relative weights of the criteria and sub-criteria. It can be noticed from the table that the highly weighted criteria are “average of assists” (23.91%), “three-point goal percentage” (19.93%), and “two-point goal percentage” (13.41%) respectively. After determining the relative weights of the evaluation criteria, sixteen teams that perform in the first division of the Turkish National Basketball League were ranked by VIKOR method in accordance with the 2008-2009 season data and criteria weights. The data for each criterion were obtained from the Turkish Basketball Federation official website (www.tbf.org.tr) and were presented in the Table 2.

Table 2. Data for Teams under Each Criterion

Teams	Criteria									
	C1.1	C1.2	C1.3	C1.4	C2	C3	C4	C5	C6.1	C6.2
Aliaga Petkim	50.40	23.90	60.40	11.70	2.00	8.00	13.70	11.70	21.00	77.40
Antalya	47.40	38.20	69.10	15.30	2.80	6.90	13.00	10.40	23.60	81.30
Banvit	54.10	36.20	77.60	14.80	1.40	6.10	12.80	9.40	22.70	84.50
Besiktas	54.20	36.80	67.80	18.60	2.20	7.00	12.90	10.80	23.40	83.50
Darusafaka	50.60	33.30	67.30	13.60	1.70	6.80	13.20	9.50	21.80	73.30
Efes Pilsen	56.20	38.80	66.60	18.60	2.70	10.30	11.50	11.00	21.70	85.70
Erdemir	50.00	34.60	72.00	13.70	2.20	5.80	13.30	9.90	22.50	72.60
Fenerbahce	57.40	40.60	67.10	18.00	3.00	7.60	13.50	9.30	23.60	83.40
Galatasaray	51.70	35.80	63.60	15.60	1.90	8.80	13.20	10.10	23.70	78.50
Kepez Belediye	50.70	35.90	69.90	14.60	2.50	6.70	16.30	10.90	22.10	76.30
Mersin	52.90	37.80	65.30	14.80	2.60	9.80	13.20	11.50	21.10	83.90
Oyak Reno	51.00	32.00	67.60	14.70	3.30	6.90	13.80	9.60	22.30	75.60
Pinar Karşıyaka	49.30	33.00	68.20	15.30	3.60	7.20	14.90	11.60	23.50	77.50
Turk Telekom	54.60	42.60	76.60	17.60	2.30	6.40	12.00	8.40	22.60	83.00
Selcuk U	50.90	32.00	68.00	15.20	2.80	8.50	15.50	9.70	23.20	76.80
Ted Kolej	46.30	31.00	61.70	12.90	4.30	8.30	12.70	9.20	19.80	68.60

The values S, R and Q were computed for each team and they were presented in the Table 3.

Table 3. The Ranking List of Teams Respectively by S, R, and Q

	S_j	R_j	Q_j	Rank (S_j)	Rank (R_j)	Rank (Q_j)	C_1	C_2	Actual Ranking
Aliaga Petkim	0.717	0.239	0.854	16	14	16	NO	NO	14
Antalya	0.413	0.124	0.295	6	4	5	NO	NO	6
Banvit	0.589	0.199	0.768	8	16	14	YES	NO	12
Besiktas	0.514	0.148	0.427	5	11	9	NO	NO	5
Darusafaka	0.648	0.214	0.835	15	15	15	NO	YES	8
Efes Pilsen	0.296	0.107	0.108	1	6	2	YES	NO	1
Erdemir	0.550	0.173	0.620	14	12	12	NO	NO	11
Fenerbahce	0.260	0.102	0.058	2	2	1	NO	NO	2
Galatasaray	0.575	0.198	0.627	9	13	13	YES	NO	4
Kepez Belediye	0.547	0.173	0.514	13	9	11	YES	NO	13
Mersin	0.394	0.124	0.285	4	8	4	NO	NO	7
Oyak Reno	0.458	0.132	0.317	10	3	6	NO	NO	10
Pinar Karşıyaka	0.345	0.113	0.225	7	1	3	NO	NO	9
Turk Telekom	0.505	0.140	0.395	12	5	8	NO	NO	3
Selcuk U	0.514	0.165	0.430	11	7	10	YES	NO	15
Ted Kolej	0.465	0.134	0.322	3	10	7	YES	NO	16

Inspecting the Table 5, it can be seen that teams “Banvit”, “Efes Pilsen”, “Galatasaray”, “Kepez Belediye”, “Selcuk U.” and “Ted Kolej” have acceptable advantage as they satisfy “*condition C1*” that indicated in the previous section. Moreover, only “Darusafaka” have acceptable stability as they satisfy “*condition C2*”. The VIKOR ranking results (rank Q_j) indicate that “Fenerbahce” is the best ranked team with good advantage. It was also the second ranked team of the season.

When the VIKOR ranking is compared with the actual ranking at the end of the season (Table 3), a correlation between two rankings could be observed. However, none of the teams are in the same ranking position. Even though there is a similarity between VIKOR results and actual ranking, the position of some teams such as “Galatasaray”, “Pinar Karsiyaka” and “Turk Telekom” and “Ted Kolej” are significantly different between two rankings. For instance, “Galatasaray” was in the 4th place at the end of the season but, it is on the 13th place in the VIKOR ranking. Although the team had a good three point field goal percentage and good average point per game, it is the 8th ranked team for the average of assists that is the highest weighted criterion (Table 1 & 2). The model shows that the team could be ranked better by strengthening its average number of assists.

6. Conclusion

In many areas of sport, there is an increasing need for quantitative methodologies that systematically analyze data in the form of ranks and evaluate the performance of teams. Quantitative analysis allows to easily spot the strengths and weaknesses of the team and to show the opportunities and threats that team could be exposed. Performance evaluation and ranking methodologies contribute to increase the performance and the success of the teams. Especially in National Basketball Association (NBA) and the Euro Basketball League (EBL), performance evaluation is getting more importance and academically investigating. This study proposes a novel hybrid methodology to obtain the overall ranking of basketball teams. The criteria weights were determined by the use of AHP model in accordance with the judgments of basketball authorities. The VIKOR methodology was used to rank teams. Coaches and team managers should take into account the success of the team for each performance criterion, thereby to be meticulous on the selection and placement of players to appropriate positions. If players could be more successful in

their positions and increase their performance, the overall performance of the team would also be affected positively. Consequently, the results of the proposed model can be used to anticipate future performance, to indicate strengths and weaknesses of the team, to monitor progress, and to help the coaches and club managers to make better decisions. Even though the model was applied to basketball, it is flexible and applicable to many team sports.

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