

An Exploratory Study of Long-Term Performance Evaluation for Elite Basketball Players

Kun-Tzu Yu¹, Zhong-Xin Su^{2, +}, Rui-Chen Zhuang²

¹Department of Information Engineering and informatics, Tzu Chi College of Technology, 880, Sec.2, Chien-kuo Rd. Hualien, 970, Taiwan

²General Education Center, Taiwan Hospitality & Tourism College, 268 Chung-Hsing ST., Feng-Shan Village, Shou-Feng County, Hualien, Taiwan

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Abstract: Objective: The purpose of this study is to propose technical performance Indices (TPIs) for constructing a long-term technical performance evaluation method for elite basketball players. **Method:** Eight technical criteria, including points per game (PPG), field goals made (FGM), rebounds, assists, blocks, steals, turnovers, and fouls, were selected as TPIs. After the weights of players in each position under each criterion were determined, a technical performance evaluation method was formed using expert opinions and application of Analytical Hierarchy Process (AHP). **Results:** These are based on the defensive and offensive records of the 3rd TSBL (Taiwan Super Basketball League) players. (1) The consistency ratio (C.R.) derived from the AHP consistency test is $0.097 < 0.1$, indicating that the consistency of expert opinions was high and the proposed weight setting for each criterion was reliable. (2) In Pearson's correlation analysis, the correlation coefficient between the TPIs and winning rate of seven basketball teams reached 0.822 and the P-value was 0.023, showing a highly positive relationship between the two. (3) Assuming that players' performances in each team obey the normal distribution and remain independent of each other, ANOVA showed no significant difference in single TPIs among the seven basketball teams TPIs (Table 5). **Conclusion:** The AHP test results and correlations between TPIs and winning rate all indicated that the proposed technical performance indices were highly valid and reasonable. By applying this method, we hope to help managers of basketball teams identify their own weaknesses and strengths. Coaches and players can utilize it as a reference for future training and adjustment plans.

Keywords: Analytic Hierarchy Process (AHP), technical performance Indices (TPIs), Taiwan Super Basketball League (TSBL).

1. Introduction

1.1. Research Background and review of literature

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. Many previous studies such as Barfield Jean-Paul, Johnson Robert J., Russo Paul, and Cobler Dennis C. (2007), Cheng Chi-Jen (2006), Chang Li-Ching & Chen Shun-Yi (2005), and Gary (1996) have made in-depth analyses of techniques of basketball players in various age groups or games. These studies employed various statistical methods and produced many significant research findings. However, the long-term and highly-intensive elite sport of basketball has received much less affection. With the development of the National Basketball Association (NBA), the Euro Basketball League (EBL), and the more recent Chinese Basketball Association (CBA) and TSBL, the domestic basketball environment is growing and should be academically investigated. Based on this motivation, this study attempts to construct a systematic technical performance evaluation method for elite basketball players based on converting offensive and defensive records into technical performance Indices (TPIs). TPIs take into account the mean, variance, and relative deviation of each player's long-term performance in each technical criteria. As expressed by Wang Chun-Ming (2002), a good evaluation method

⁺ Corresponding author. Tel.: 886-3-8235089;
E-mail address: ykt.kevin@msa.hinet.net

needs to objectively consider the long-term technical levels of each player (mean) and the stability of the player's performance (standard deviation).

According to Hsu Ching-Tze (2004), Tsai Yi-Chuan (2004), Trninic S (2000), and John & Joseph (1999), a player's psychological state, basic skills, physical condition, and intelligence will be completely reflected in his offensive and defensive records in each game. So, we selected eight major technical items, including points per game (PPG), field goals made (FGM), rebounds, assists, blocks, steals, turnovers, and fouls, as the criteria for performance evaluation. In addition, player performance evaluation is a multi-criteria decision and involves different weighting criteria for players in different positions. How to objectively and effectively determine the weight for each criterion in order to extrapolate player performance evaluation, should be prudently considered. Analytic Hierarchy Process (AHP) proposed by Saaty (1986, 1990, 2000), is a method of systematic analysis suitable for this complicated kind of issue. This method collects expert opinions and makes pair-wise comparisons of evaluation items on a nominal scale to construct a comparison matrix and compute the eigenvalues and eigenvectors, which represent the ranking of elements in each hierarchy. Then, the max eigenvector can be used to carry out the consistency test and derive the relative weight of each criterion as a reference indicator. Many scholars have often applied AHP in other sporting fields, notably Wang Yih-Tzu (2004), who applied AHP to selecting baseball players for the national team. Wang Feng & Ba Yi-Min (2003) used it in the evaluation of high-level shooters. Wang Feng, Chang Ching-Po, Lee Yong, and Chao Ruey-Hua (2001) also adopted it in research for selection of high jump athletes. So, it is a totally appropriate method for this study to determine the weight of each TPI, allowing the construction of an overall performance method for players in each position.

Basketball has been very popular in Taiwan. Wang Jen-Sheng (2005) mentioned that although the TSBL has been in existence since 2003. It is not a professional league, despite its long-term gaming system and corporate management making it well qualified to be a professional league. Therefore, this study uses the offensive and defensive records of the 3rd TSBL players as an example to demonstrate the applicability of the proposed method. The results are discussed below.

1.2. Research Objectives

(1) To construct eight TPIs, including PPG, FGM, rebounds, assists, blocks, steals, turnovers, and fouls, to measure the performance of a player in each technical criteria.

(2) Through expert opinions and AHP, to define the weight of each criterion and further construct an integrated evaluation method.

(3) Based on the performances of the seven basketball teams, to investigate the Pearson's correlation coefficient between team performance and winning rate and to verify the validity and feasibility of the proposed method.

(4) To investigate whether there are significant differences in each single criterion among the seven basketball teams through ANOVA. Any single criterion with significant differences will be tested using Scheffe's multiple comparison.

1.3. Term Definition and Explanation

(1) TPIs: A total of eight items, namely PPG, FGM, rebounds, assists, blocks, steals, turnovers, and fouls, are included. The performance of each player in each technical criteria is quantified for evaluation. The mean and standard deviation of each index will be considered.

(2) Player performance index: After the weight of each item for each player position was determined, the arithmetic weighted mean of the eight TPIs as a player performance index were calculated, giving the overall performance level for each player.

(3) Team performance index: The player performance indices of the top 5 players, added to with the most playing time in each position (forward, center, and guard) are taken as the team performance index.

2. Method

2.1. Research Subjects

This study uses the records of each team in the 3rd TSBL during 2005-06 collected from a public and open-access sport website in Taiwan. Please refer to the TSBL website (http://tw.sports.yahoo.com/sbl/sbl_record_team.html). Considering the consistency of statistical analysis, only 5 players with the most playing time in each position were selected as subjects for further analysis.

2.2. Research Constraints

Some TSBL players were wounded or had limited playing time and inconsistency of the statistical results may have occurred. Therefore, these players are not included in the analysis.

2.3. Research Methods and Procedures

(1) Constructing an AHP pair-wise comparison matrix

The scale adopted in AHP is shown in Table 1. Commonly used in each domain by experienced scholars, this scale has become a reasonable basis for pair-wise comparison of relative importance.

Table 1. Scale of importance for pair-wise comparison

Level of preference	Numerical Rating
Equally preferred	1
Between equally preferred and moderately preferred	2
Moderately preferred	3
Between moderately preferred and strongly preferred	4
Strongly preferred	5
Between strongly preferred and very strongly preferred	6
Very strongly preferred	7
Between strongly preferred and extremely preferred	8
Extremely preferred	9

(2) Calculating the max eigenvalue and eigenvector

The purpose of calculating the max eigenvalue and eigenvector is to verify if the pair-wise comparison matrix complies with the consistency requirement. They can be calculated by the following formulas, respectively.

Firstly, eigenvector:

$$W_i = \left(\prod_{j=1}^m a_{ij} \right)^{1/m} / \sum_{i=1}^m \left(\prod_{j=1}^m a_{ij} \right)^{1/m}$$

where m is the number of evaluation items, a_{ij} denotes the result of pair-wise comparison between i and j. If the preference rating of i is 2 times the rating of j, a_{ij} and a_{ji} are 2 and 0.5, respectively.

Secondly, max eigenvalue λ_{max} :

First of all, the pair-wise comparison matrix is multiplied by the derived eigenvector W_i to obtain a new vector W'_i . The average ratio between the two can be calculated as follows:

$$\begin{bmatrix} \mathbf{1} & a_{12} & \dots & a_{1m} \\ a_{21} & \mathbf{1} & \dots & a_{2m} \\ \vdots & \vdots & \ddots & \vdots \\ a_{m1} & \dots & \dots & \mathbf{1} \end{bmatrix} * \begin{bmatrix} W_1 \\ W_2 \\ \vdots \\ W_m \end{bmatrix} = \begin{bmatrix} W'_1 \\ W'_2 \\ \vdots \\ W'_m \end{bmatrix}, \lambda_{max} = (\mathbf{1}/m) * (W'_1/W_1 + W'_2/W_2 + \dots + W'_m/W_m)$$

Thirdly, consistency test:

Inconsistency may exist in the judgment of the importance of each criterion. Therefore, to test the consistency of decision-makers' judgment, the pair-wise comparison matrix should be tested for consistency. If the consistency ratio C.R. ≥ 0.1 , the consistency has exceeded the tolerable range, then the decision makers

need to reconsider the correlation between the factors adopted. $C.R. = \frac{C.I.}{R.I.}$ and $C.I. = \frac{\lambda_{max} - m}{m - 1}$, where

R.I. is a random index. Table 2 shows the corresponding R.I. when the number of indices is m.

Fourthly, the weight of each index:

After the above-mentioned consistency test is completed, the weight of each index can be calculated. Sum all the values in each column and divide each value by the total to obtain a normalized pair-wise comparison table. Calculate the mean of values in each row in the normalized pair-wise comparison table to

obtain the weight of each index.

Table 2. Random Index Table

m	1	2	3	4	5	6	7	8
R.I.	0.00	0.00	0.58	0.90	1.12	1.24	1.32	1.41
m	9	10	11	12	13	14	15	
R.I.	1.45	1.49	1.51	1.48	1.56	1.57	1.59	

(3) Expert interview

Four well-known basketball experts in Taiwan, including Lee Yun-Kuang, Lin Chien-Ping, Chiu Chung-Chi, and Dong Fang Chia-Der were invited to provide information needed by this study. The interviews were not very formal. Non-standard, unstructured, and open-ended questions, relating to the evolution of domestic and international basketball, players' salaries, and management of domestic TSBL teams were discussed in the beginning. The focus progressively shifted to the core issues, including the objectives, procedures, and methods of this study, to further derive the data necessary for the pair-wise comparison matrix.

(4) TPIs

Larger-the-better type TPIs: For items such as PPG, FGM, rebounds, assists, blocks, and steals, which

are better if larger, the index U_i can be defined as follows: $U_i = \frac{\bar{X}_i}{S_i}$, $i \in \{P, G, R, A, B, S\}$, where (\bar{X}_i, S_i)

denote the mean and standard deviation of the player performance under the criterion i . It can be calculated from these larger-the-better type TPIs that if \bar{X}_i is larger, U_i will be larger, and the performance will be better. Smaller S_i indicates that when the player maintains stable performance throughout the entire season and can demonstrate better performance, so the index U_i is relatively larger. Thus, U_i can reflect the technical performance of each player.

Smaller-the-better type TPIs: For items, such as turnovers (T) and fouls (F), which are better if smaller, the index L_i can be defined as follows: $L_i = \frac{av_i}{\bar{X}_i}$, $i \in \{T, F\}$,

where \bar{X}_i denotes the average turnovers or fouls of each player in all games, and av_i is the average turnovers or fouls of all the players in the league, which also represents the average level among all players. Similarly, $L_i \geq 1$ indicates that the average number of turnovers or fouls of the player is lower than the overall level. L_i increases with the decrease of \bar{X}_i , indicating that a smaller number of turnovers or fouls leads to relatively better performance. If $0 < L_i < 1$, the player has more turnovers or fouls than the overall level and will present a less satisfactory performance. Therefore, the index L_i can reasonably reflect each player's smaller-the-better type TPIs in the league.

(5) Player performance index

With the above TPIs, the player performance index can be calculated. By classifying the players into forward, guard, and center, the weights determined through AHP used to calculate the arithmetic weighted mean as follows:

$$\frac{[U_P * w_P] + [U_G * w_G] + [U_R * w_R] + [U_A * w_A] + [U_B * w_B] + [U_S * w_S] + [L_T * w_T] + [L_F * w_F]}{W}$$

where $W = w_P + w_G + w_R + w_A + w_B + w_S + w_T + w_F$, and w_i is the weight of each index determined through AHP.

(6) Team performance index

As defined before, the team performance index is the sum of the performance indices of main-force players of a team. In this study, at most five players with the most playing time in each position were selected from each basketball team, and the sum of player performance indices represented the team performance index of each team.

3. Results

3.1. Applying AHP to calculate the weight of each TPI

(1) Constructing a pair-wise comparison matrix

Through the evaluation of four basketball experts, the relative importance of the TPIs of each position was determined. Based on the 9-point scale shown in Table 1, the average rating by the four experts is shown in Table 3.

Table 3. Pair-wise comparison matrix

		PPG	FGM	Rebounds	Assists	Blocks	Steals	Turnovers	Fouls
Center	PPG	1.00	1.00	0.25	3.00	2.00	6.00	4.00	6.00
	FGM	1.00	1.00	0.20	3.00	2.00	5.75	3.50	5.50
	Rebounds	4.00	5.00	1.00	8.00	7.50	9.00	5.25	7.50
	Assists	0.33	0.33	0.13	1.00	3.00	4.75	1.25	4.75
	Blocks	0.50	0.50	0.13	0.33	1.00	7.50	4.50	3.00
	Steals	0.17	0.17	0.11	0.21	0.13	1.00	0.20	0.33
	Turnovers	0.25	0.29	0.19	0.80	0.22	5.00	1.00	0.50
	Fouls	0.17	0.18	0.13	0.21	0.33	3.00	2.00	1.00
Forward	PPG	1.00	3.00	6.00	5.50	9.00	8.00	5.00	6.00
	FGM	0.33	1.00	6.50	5.50	7.50	8.00	4.50	7.00
	Rebounds	0.17	0.15	1.00	2.00	3.00	3.75	3.50	5.75
	Assists	0.18	0.18	0.50	1.00	6.50	6.00	2.75	6.50
	Blocks	0.11	0.13	0.33	0.15	1.00	1.00	0.20	0.25
	Steals	0.13	0.13	0.27	0.17	1.00	1.00	0.50	0.50
	Turnovers	0.20	0.22	0.29	0.36	5.00	2.00	1.00	1.00
	Fouls	0.17	0.14	0.17	0.15	4.00	2.00	1.00	1.00
Guard	PPG	1.00	0.50	4.00	5.50	8.00	7.25	3.00	6.75
	FGM	2.00	1.00	3.50	2.00	7.50	7.00	3.00	7.25
	Rebounds	0.25	0.29	1.00	1.00	5.00	8.25	2.00	6.25
	Assists	0.18	0.50	1.00	1.00	6.25	8.50	2.75	6.25
	Blocks	0.13	0.13	0.20	0.16	1.00	1.50	0.25	0.50
	Steals	0.14	0.14	0.12	0.12	0.67	1.00	1.00	0.50
	Turnovers	0.33	0.33	0.50	0.36	4.00	1.00	1.00	0.50
	Fouls	0.15	0.14	0.16	0.16	2.00	2.00	2.00	1.00

(2) Consistency test:

Derived from the results shown in Table 3, the max eigenvalue λ_{max} was 8.954, and the consistency ratio (C.R.) was 0.097, which satisfied the requirement of C.R.<0.1.

(3) The weight of each index

After the consistency test was passed, the weight of each index for each position could be calculated. Through normalization and row averaging, the weight of each index was obtained as shown in Table 4.

3.2. Player and team performance indices

Based on the original offensive and defensive records of each player, the mean and standard deviation of each item during the entire season were calculated. Using the indices shown in Table 4, each TPI of each player was computed, and the arithmetic weighted mean could be used to obtain the performance index of

each player. The sum of the performance indices of all the players was the team performance index. The ranking of the selected basketball teams from high to low was: Yulon, Taiwan Beer, Dacin, Videoland, Bank of Taiwan, Yeou Ming, and ETTV, as shown in Table 5.

Table 4. Normalized pair-wise comparison and weight of each index

		PPG	FGM	Rebounds	Assists	Blocks	Steals	Turnovers	Fouls	Weight (Wi)
Center	PPG	0.14	0.12	0.12	0.18	0.12	0.14	0.18	0.21	0.15
	FGM	0.14	0.12	0.09	0.18	0.12	0.14	0.16	0.19	0.14
	Rebounds	0.54	0.59	0.47	0.49	0.46	0.21	0.24	0.26	0.41
	Assists	0.05	0.04	0.06	0.06	0.19	0.11	0.06	0.17	0.10
	Blocks	0.07	0.06	0.06	0.02	0.06	0.18	0.20	0.11	0.10
	Steals	0.02	0.02	0.05	0.01	0.01	0.02	0.01	0.01	0.02
	Turnovers	0.03	0.03	0.09	0.05	0.01	0.12	0.05	0.02	0.05
	Fouls	0.02	0.02	0.06	0.01	0.02	0.07	0.09	0.04	0.04
Forward	PPG	0.44	0.61	0.40	0.37	0.24	0.25	0.27	0.21	0.35
	FGM	0.15	0.20	0.43	0.37	0.20	0.25	0.24	0.25	0.26
	Rebounds	0.08	0.03	0.07	0.14	0.08	0.12	0.19	0.21	0.11
	Assists	0.08	0.04	0.03	0.07	0.18	0.19	0.15	0.23	0.12
	Blocks	0.05	0.03	0.02	0.01	0.03	0.03	0.01	0.0	0.02
	Steals	0.06	0.03	0.02	0.01	0.03	0.03	0.03	0.02	0.03
	Turnovers	0.09	0.05	0.02	0.03	0.14	0.06	0.05	0.04	0.06
	Fouls	0.07	0.03	0.01	0.01	0.11	0.06	0.05	0.04	0.05
Guard	PPG	0.24	0.17	0.38	0.53	0.23	0.20	0.200	0.23	0.27
	FGM	0.48	0.33	0.33	0.19	0.22	0.19	0.200	0.25	0.28
	Rebounds	0.06	0.10	0.10	0.10	0.15	0.23	0.133	0.22	0.13
	Assists	0.04	0.17	0.10	0.10	0.18	0.23	0.183	0.22	0.15
	Blocks	0.03	0.04	0.02	0.02	0.03	0.04	0.017	0.02	0.03
	Steals	0.03	0.05	0.01	0.01	0.02	0.03	0.067	0.02	0.03
	Turnovers	0.08	0.11	0.05	0.04	0.12	0.03	0.067	0.02	0.06
	Fouls	0.04	0.05	0.02	0.02	0.06	0.06	0.133	0.03	0.05

Table 5. Performance indices of each basketball team

Single TPIs		PPG	FGM	Rebound	Assist	Block	Steal	Turnover	Foul	Player Performance index	Team performance index
Yulon	Center 1	2.60	1.52	3.56	1.76	1.31	1.00	0.73	1.03	2.45	8.95
	Forward 1	1.87	1.89	2.11	1.32	0.53	1.70	1.46	1.01	1.74	
	Forward 2	1.45	0.99	1.37	0.76	0.40	0.37	2.18	1.01	1.20	
	Guard 1	2.18	1.45	2.16	1.93	0.27	1.28	1.58	1.84	1.81	
	Guard 2	2.09	1.71	1.77	1.96	0.39	1.05	1.31	1.16	1.75	
Dacin	Center 1	2.73	2.42	2.81	1.55	1.20	1.08	0.71	0.94	2.25	8.25
	Forward 1	1.56	1.73	1.66	1.95	0.00	1.29	0.93	0.99	1.55	
	Forward 2	2.04	1.26	1.77	1.68	0.40	1.14	0.80	1.06	1.58	

	Guard 1	1.72	1.46	1.76	1.24	1.01	0.76	1.05	0.82	1.45	
	Guard 2	1.80	1.54	1.44	0.91	0.78	0.97	1.33	0.73	1.41	
Taiwan Beer	Center 1	1.67	1.34	2.08	0.87	0.88	1.21	1.72	0.87	1.60	8.38
	Forward 1	2.91	2.58	2.26	2.26	0.67	1.19	0.68	1.14	2.36	
	Forward 2	1.49	0.97	1.74	1.59	0.19	0.82	1.55	1.60	1.36	
	Guard 1	2.41	1.88	1.64	0.95	0.46	0.71	1.38	1.26	1.72	
	Guard 2	1.55	1.24	1.34	1.77	0.39	1.35	0.69	1.00	1.35	
Videoland	Center 1	1.38	1.87	1.39	0.79	0.72	0.37	1.60	1.29	1.32	7.98
	Forward 1	1.61	1.46	1.58	0.87	0.69	1.32	1.31	1.10	1.41	
	Forward 2	2.54	1.84	1.63	1.55	0.28	0.76	0.87	1.11	1.87	
	Guard 1	2.12	1.87	3.03	2.18	1.05	1.03	0.73	0.78	1.97	
	Guard 2	1.46	1.19	1.75	1.98	0.40	1.09	0.94	0.84	1.40	
ETTV	Center 1	1.33	1.88	1.62	0.83	0.49	0.90	1.11	0.93	1.36	7.34
	Forward 1	1.21	1.81	1.55	1.08	0.54	0.75	1.59	0.94	1.37	
	Forward 2	2.27	1.74	1.62	1.40	0.19	1.06	0.84	1.30	1.74	
	Guard 1	1.64	1.46	1.74	0.81	0.19	0.83	1.58	1.05	1.38	
	Guard 2	1.59	1.94	1.97	0.75	0.65	0.93	1.07	0.64	1.48	
Bank of Taiwan	Center 1	1.81	3.02	1.48	1.15	0.67	0.91	0.67	0.73	1.56	7.66
	Forward 1	1.58	1.70	1.73	0.96	0.40	0.87	0.82	0.83	1.43	
	Forward 2	1.27	1.12	2.02	1.11	0.53	0.93	1.17	1.61	1.28	
	Guard 1	2.01	1.45	2.15	2.43	0.56	1.41	0.94	0.91	1.76	
	Guard 2	1.80	1.79	1.63	1.93	0.00	1.58	0.69	0.89	1.63	
Yeou Ming	Center 1	1.64	1.51	2.31	0.84	0.88	0.84	0.79	0.82	1.65	7.60
	Forward 1	1.93	1.31	2.04	1.27	0.52	1.16	0.81	1.12	1.55	
	Forward 2	1.59	2.34	2.99	1.26	0.19	1.40	0.64	1.56	1.81	
	Guard 1	1.25	0.98	1.52	2.03	0.39	1.27	1.77	0.93	1.33	
	Guard 2	1.58	1.01	1.96	0.81	0.58	0.73	1.30	1.09	1.26	

3.3. Correlation analysis

As shown in Table 6, the result of Pearson's correlation analysis indicated that the correlation coefficient between team performance and winning rate in regular games reached 0.822 and P-value, indicating that the level of significance was 0.023. The result highlighted a highly positive relationship between the two and also proved the validity and reliability of the proposed indices.

Table 6. Analysis of correlation between team performance index and winning rate

Team	Yulon	Dacin	Taiwan Beer	Videoland	ETTV	Bank of Taiwan	Yeou Ming	Pearson's correlation coefficient	P-value
Team performance index	8.95	8.38	8.25	7.97	7.34	7.66	7.60	0.82*	0.023
Winning rate	0.80	0.63	0.67	0.43	0.37	0.50	0.10		

*p<.05

3.4. Comparison analysis

In Table 5, we find that the centers of Yulon and Dacin had better performances than another teams; the forwards of Taiwan Beer performed better than others; the guards of Yulon and Videoland had better

performances. The advantages and weaknesses of each team in different player position are obvious. In addition, assuming that players' performances in each team obey the normal distribution and are independent of each other, there is no significant difference in single TPIs among the seven basketball teams through one-way ANOVA. It could be inferred that the top five players of each team had close technical performances, and perhaps the bench strength of each team was the key to winning, as shown in Table 7. Table 5 provides much useful information, which is a worthwhile reference for all relevant and interested parties.

Table 7. ANOVA of TPIs

Item	Source of variance	SS	DF	MS	F	P-value
PPG	Between group	1.061	6	0.177	0.929	0.490
	Within group	5.333	28	0.190		
	Total	6.395	34			
FGM	Between group	0.559	6	0.093	0.390	0.879
	Within group	6.689	28	0.239		
	Total	7.247	34			
Rebound	Between group	1.060	6	0.177	0.642	0.696
	Within group	7.707	28	0.275		
	Total	8.768	34			
Assist	Between group	1.294	6	0.216	0.804	0.575
	Within group	7.504	28	0.268		
	Total	8.798	34			
Steal	Between group	0.287	6	0.048	0.447	0.841
	Within group	2.993	28	0.107		
	Total	3.279	34			
Block	Between group	0.250	6	0.042	0.426	0.855
	Within group	2.736	28	0.098		
	Total	2.986	34			
Turnover	Between group	1.135	6	0.189	1.240	0.316
	Within group	4.274	28	0.153		
	Total	5.409	34			
Foul	Between group	0.369	6	0.061	0.817	0.566
	Within group	2.107	28	0.075		
	Total	2.476	34			

*p<.05

4. Conclusions

Through a review of literature and expert opinions, eight major items including PPG, FGM, rebounds, assists, blocks, steals, turnovers, and fouls, were selected as criteria for player performance evaluation, and the complicated original data were also converted into meaningful TPIs. TPIs differed from the indices used in conventional quantitative studies and could objectively integrate the measures of each player in each

technical criteria, including mean and standard deviation. Using the data from 3rd TSBL, this study explains the application of the proposed evaluation method. It was discovered that the consistency ratio (C.R.) reached $0.097 < 0.1$, indicating that the expert opinions were highly consistent, and the determined weight of each index was reliable. Besides, in Pearson's correlation analysis, it was found that the correlation coefficient between the team performance index and winning rate in regular games reached 0.822. Such results not only highlight the positive relationship between the two but also prove the validity of the proposed method.

This study attempts to provide a new evaluation method for performance management of elite basketball players. We hope to help the managers of basketball teams understand their own weaknesses and strengths, help to adjust to future training plans for the coaches, review the offensive and defensive performances in the entire league, and to better evaluate aptitudes. This is only a preliminary step and the focus was placed on the construction of the method. In the future, we also expect to introduce Fuzzy AHP, determine the weight of each index more objectively, and perform more meaningful statistical analysis to offer a highly practical reference.

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