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Research of Basketball Offensive Technical Ability Based on AHP Analysis

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Abstract: A basketball offensive capability is reflected in the player's athletic ability. For this offensive and defensive competitive sport that needs to score in limited time and multi-player coordination, the capability embodied in the offense is an abstract and comprehensive capability. In order to carry out a feasible assessment on athletes' offensive capabilities, layering index analysis on the offensive effects reflected by the offensive technological capabilities in basketball game can well achieve the comprehensive evaluation on the athletic ability of offensive technique, synergy capability of offensive tactics and confrontational style. This study extracts the assessment indicators that reflect basketball offensive capability according to basketball characteristic, uses AHP analysis method to conduct layering research, gives the quantitative indicators methods and offensive capability assessment approach. The elaborated research contents and methods in this text provide a theoretical basis for improvement and assessment of basketball offensive capabilities.

Key words: AHP Analysis methods, indicators quantification, judgment matrix, weights

INTRODUCTION

Basketball is a team sport with athletics and has numerous fans' attention in an international level. Basketball will appear in two basic warfare states, that is offense mode and defense mode, in the confrontation process. Offence is intended to score and defense is to prevent the opponent team from scoring. In the limited time and space around the possession right of the ball, athletes of the two teams take the appropriate offensive and defensive posture (Yang, 2013). Basketball players use their technical methods, physical fitness and mutual cooperation, expand Omni bearing contest in time, space, skills, intelligence and psychology (Wang and Shuye, 2013). Systematic and scientific training plays a vital role to improve athletic ability of basketball players. The systematic and scientific training methods come from the qualitative analysis and quantitative research of the basketball players and the specific athlete (Liu, 2011). The training is achieved by feedback, only a reliable evaluation for basketball players' skill level can provide feasible guidance for the basketball players' skill upgrading based on the actual situation (Gu, 2013).

In this study, on the basis of previous studies, it analyzed the characteristics of basketball, extracts the indicators reflecting the basketball offensive skills by analyzing, builds AHP index system and gives the application principles and steps of AHP analysis method

in the basketball offensive capability evaluation in order to provide a theoretical basis for the development of our country's basketball.

ANALYSIS AND QUANTITATIVE METHODS OF BASKETBALL OFFENSIVE INDEX

A basketball offensive capability is reflected in the player's athletic ability. For this offensive and defensive competitive sport that needs to score in limited time and multi-player coordination, the capability embodied in the offense is an abstract and comprehensive capability (Fan, 2013). In order to carry out a feasible assessment on athletes' offensive capabilities, layering index analysis on the offensive effects reflected by the offensive technological capabilities in basketball game can well achieve the comprehensive evaluation on the athletic ability of offensive technique, synergy capability of offensive tactics and confrontational style (Wang, 2008). Here is the elaborate explanation for the integrated system of basketball offensive skills consisted of these three indicators and its layered indicators (Tan, 2013).

Basketball offensive index system: This article will divide the basketball's offensive techniques into three aspects to evaluate, namely offensive technique application ability, offensive tactical synergy capability and offensive confrontation style and analyze the offense effect through these three aspects (Wen, 2007).

The athletic ability of offensive skills is reflected in the offensive moving, passing, dribbling, break, cut, shooting and offensive rebounding. If N means the athletic ability of offensive techniques, n_1 means the offensive moving ability, n_2 means the passing ability, n_3 means the dribbling ability, n_4 means the breakthrough capacity, n_5 means the cut capacity, n_6 means the shooting ability, n_7 means the offensive rebounding capacity, then the Eq. 1 can represent the relationship between the above several parameters:

$$N = n_1 + n_2 + \dots + n_7 + \varepsilon_n \quad (1)$$

In Eq. 1 ε_n represents the sum of other technical indicators in addition to the offensive technique and athletic ability reflected by $n_i (i = 1, 2, \dots, 7)$, if $n_i (i = 1, 2, \dots, 7)$ can reflect N as far as possible then $\varepsilon_n \rightarrow 0$.

The offensive tactics synergy capability is embodied in the coordinated cut, the coordinated cover, the coordinated break point, the coordinated post and the fast break. If M represents the synergy coordinated capacity of offensive tactics, m_1 means the coordinated cut capacity, m_2 means the coordinated cover ability, m_3 means the coordinated break point capabilities, m_4 means the coordinated post ability, m_5 means the fast-break capability, then the Eq. 2 can represent the relationship between the above several parameters (Zhang and Feng, 2013):

$$M = m_1 + m_2 + \dots + m_5 + \varepsilon_m \quad (2)$$

In Eq. 2 ε_m represents the sum of other technical indicators in addition to the tactics synergy ability of offense play reflected by $m_i (i = 1, 2, \dots, 5)$, if $m_i (i = 1, 2, \dots, 5)$ can reflect M as far as possible then $\varepsilon_m \rightarrow 0$.

The offense and attack style is reflected in the courageous extent, perseverance extent and calm degree of the basketball game players. If a team can behave irrationally out of its normal offensive capability, these three levels can be reflected. If P represents the confrontation and offense style, p_1 means the players' thinking level, p_2 means the players' volitional quality, p_3 means the players' spirituality, then the Eq. 3 can represent the relationship between the above several parameter:

$$P = p_1 + p_2 + p_3 + \varepsilon_p \quad (3)$$

In Eq. 3, ε_p represents the rest sum of other quality indicators in addition to the offense and attack

reflected by $p_i (i = 1, 2, \dots, 3)$. If $p_i (i = 1, 2, \dots, 3)$ can reflect P as far as possible then $\varepsilon_p \rightarrow 0$.

If we use Q to represent the team's offensive effect and the relationship between Q and N, M, P satisfies the Eq. 4:

$$Q = N + M + P \quad (4)$$

Index quantification methods: The evaluation level of the index is divided into very good, about good, average, about poor and very poor five levels and respectively conduct assignment of these five grade; suppose the very good score segment is (100-90), the about good score segment is (89-80), the average score segment is (79-70), the about poor score segment is (69-60), the very poor score segment is (59-0), use the upper limit of each score segment to constitute level matrix, the value corresponding to very good is 100, the value corresponding to about good is 89, the value corresponding to average is 79, the value corresponding to about poor is 69, the value corresponding to very poor is 59. Then the level matrix is (100 89 79 69 59).

Set the judge group, if we want to assess a player n_1 's ability, their subordinated four indicators: Accurate observation and judgment, variable speed sudden and in time, rational use of mobile technology and stable center of body weight need grading and classification, as shown in Table 1.

If the weight of accurate observation and judgment is α_1 , the weight of the suddenly timely speed is α_2 , the weight of the reasonable mobile technology use is α_3 , the weight of the stable body center of gravity is α_4 , then we have the relationship between the weight matrix $A = (\alpha_1 \alpha_2 \alpha_3 \alpha_4)$, the single factor evaluation matrix R , rank matrix and the total score G as shown in the Eq. 4:

$$G = A \circ R \cdot (100 \ 89 \ 79 \ 69 \ 59)^T \quad (5)$$

If $AR = (\beta_1 \beta_2 \beta_3 \beta_4)$, then $A \circ R$ satisfies the Eq. 5:

$$A \cdot R = \frac{1}{\sum_{i=1}^5 \beta_i} AR \quad (6)$$

Table 1: Evaluation result table of player n_1 's ability by the judge group

	Very good	About good	Average	About poor	Very poor
Indicators level	X11	X12	X13	X14	X15
Accurate observation and judgment	X21	X22	X23	X24	X25
Variable speed sudden and in time	X31	X32	X33	X34	X35
Rational use of mobile technology	X41	X42	X43	X44	X45
Stable center of body weight					

X_{ij} represents the vote's ratio of the evaluation level

RESEARCH METHODS

Index system of basketball offense based on ahp analysis:

In this study, it uses AHP analysis method to analyze basketball offensive technical capability (Liu, 2013). The basic idea is to divide the problems to be resolved into hierarchical series and then according to the nature of the problem and the expected target, the problem is decomposed into different constituent elements. This

article divides the offensive indicator system of basketball into four layers, the first layer is the target layer and the indicator reflecting basketball offensive capability is the offensive effect Q, the second layer is composed of three indicators N, M, P and so on, according to the hierarchy analytic theory the index system of the basketball offensive ability is shown in Fig. 1.

The index interpretation of the fourth layer in Fig. 1 is shown in Table 2.

Table 2: Notes and meanings of fourth layer indexes

Index number	Index Interpretation	Index number	Index Interpretation
1	Observation and judgment is accurate	24	reasonable snatching position
2	variable speed suddenly in time	25	Cut into the timing correctly
3	Rational use of mobile technology	26	Passing the ball timely
4	stable body center of weight	27	Tacit coordination between the players
5	pass ball to key offensive players	28	Suitable cover timing
6	Passing to the cooperative region	29	Reasonable cover and timely response
7	cut timely and reasonable after passing	30	Technology convergence is coherent and reasonable after screening
8	catching the ball with offensive threat	31	Correct break opportunity and reasonable line
9	Reasonable skills of passing and catching the ball	32	Timely relay and ingenious passing
10	Reasonable dribbling opportunity with clear purpose	33	Coherent technology convergence and tacit cooperation
11	Reasonable technology use on the move	34	Coordinator has attack threat
12	Coherence technology convergence on the move	35	Coordinator's observation and judgment is correct with timely passing
13	Reasonable breaking opportunity and correct line	36	Rationale strain technology and tacit cooperation
14	Coherence technology convergence and appropriate application	37	Fast break with a strong sense
15	Coordinated body and stable body center of gravity	38	The first pass is quick and accurate
16	Cut into the time reasonably with correct route	39	Cohesion with rapid start
17	Rapid start ahead of the competition	40	Conveyance combination and reasonable technique application
18	Coherent technical convergence after the cutting in	41	Diligent in thinking and happy training
19	Fake action with strong anti-interference ability	42	Hard-working and have team spirit
20	Reasonable and correct shooting timing and mauner	43	Resolute and courageous to confrontation
21	Shooting technique with Cohesion and Coherence	44	be focused on and self-confident
22	Accurately determining the bouncing direction of the ball	45	Calm and sober
23	Grab rebounds with rapid start	46	Be Feisty and have courage to win

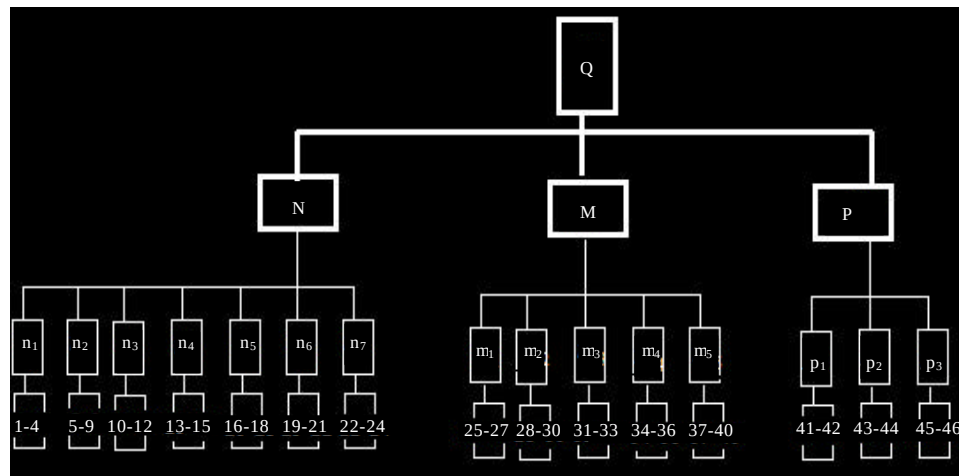


Fig. 1: Ability index system of basketball offensive technique

Determination method of the weight of each index:

Step 1: construct pair-wise comparison judgment matrix; the single scheduling problem of the factors of each level relative to the factor of the above level can be simplified as comparison and judgment of a series of pair-wise factors. This study introduces Saaty (1-9 ratio scale table) and then write it into matrix form, the Saaty (1-9 ratio scale table) is shown in Table 3 and the judgment matrix form is shown in Table 4

Step 2: will translate the initialized judgment matrix into a comprehensive judgment matrix

First, for the initialized judgment matrix according to the calculation method of the geometric mean to calculate the pair-wise contrast ratio of the various indexes, convert it to the final matrix and then, according to the calculation method in the Eq. 6 the comprehensive judgment matrix can be calculated:

$$\begin{cases} A(S) = [a(S)_{ij}]_{n \times n} \\ a_{ij} = k^* \sqrt[k]{\prod_{s=1}^k a(S)_{ij}}, S=1, 2, \dots, k; i, j=1, 2, \dots, n \end{cases} \quad (7)$$

Step 3: Calculate the eigenvector corresponding to the largest Eigen value of the comprehensive judgment matrix and then normalize the vector, that is the weight corresponding to each index

First, regularize each column of the judgment matrix. Regularization means conducting normalization process on it and then adds each row by row of the normalized judgment matrixes and adds the plus to composite the column vector, then normalize the column vectors after adding row by row and the vector is the eigenvectors corresponding to the largest eigenvalue and finally gets the largest Eigen value.

Step 4: The consistency tests of comprehensive judgment matrix

Consistency index CI is calculated as Eq. 7.

$$CI = \frac{\lambda_{max} - n}{n - 1} \quad (8)$$

When the comprehensive judgment matrix has the complete consistency, CI = 0; the greater Ci is, the worse the consistency is; in order to determine the satisfaction membership for CI, this study introduces the average random consistency index RI of the 1-9 order matrixes, as shown in Table 5.

Table 3: Saaty (1-9 ratio scale table)

Scale scores	Interpretation
1	The Same
3	Slightly important
5	Obviously important
7	Highly important
9	Extremely important
2, 4, 6, 8	When ranged between the adjacent scores

Table 4: Form of the judgment matrix

A_k	B_1	B_2	...	B_n
B_1	b_{11}	b_{12}	...	b_{1n}
B_2	b_{21}	b_{22}	...	b_{2n}
$\vdots$	$\vdots$	$\vdots$	$\vdots$	$\vdots$
B_n	b_{n1}	b_{n2}	...	b_{nn}

Table 5: Average random consistency index of 1-9 order matrixes

1	2	3	4	5	6	7	8	9
0.00	0.00	0.58	0.90	1.12	1.24	1.32	1.41	1.45

When the order of the comprehensive judgment matrix is greater than 2, the ratio of the judgment matrix consistency index CI and the average random consistency index RI of same order is the random consistency ratio CR of the judgment matrix; when $CR < 0.10$ the judgment matrix has satisfactory consistency, otherwise the judgment matrix needs adjustment.

CONCLUSION

In this study, it conducts a detailed analysis on basketball offensive technical ability and draws a multi-level evaluation index system for its ability evaluation; this study analyzes the rationality of the indicators and their quantification methods and gives the steps and principles to evaluate of the AHP analysis method and studies the application of this method in basketball offensive technical ability evaluation in detail; this study is about the evaluation method of basketball offensive technical capability, not involving the evaluation of the actual data; the actual data collection requires an objective scoring by expert groups; if in the situation to verify the calculation methods we can completely assume a series of data and then calculate follow the research methods of the text, therefore it is outside the text.

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