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Men's basketball competition performance influence analysis based on analytic hierarchy process

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ABSTRACT

The paper applies analytic hierarchy process analyzing men's basketball competition performance each influence factor. By documents literature and comparative analysis, it defines men's basketball competition performance each influence factor, and defines corresponding comparison judgment matrix, and solves men's basketball competition performance each influence factor weight. It gets following conclusion: In men's basketball competition performance influence three first grade indicators, basketball player has largest impact, the secondary is basketball coach, and basketball referee has smallest impact. In 24 second grade indicators, basketball player body condition and technical condition have big influences on basketball competition performance, basketball player's other conditions also have big influences on competition, basketball player's selection and training should be major focus. Basketball coach has also very big influence on competition performance; especially for basketball coach guiding training ability and spot command ability should be taken seriously.

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KEYWORDS

Men's basketball;
Analytic hierarchy process;
Weight.

INTRODUCTION

A basketball competition is not only two parties' basketball players' technical, physical quality and psychological quality and other aspects confrontation, and is also two parties' basketball coaches battle of wits, meanwhile, basketball referees influence on competition also cannot be ignored. To one men's basketball team, due to different periods, its member combinations have different structures, sports teams are also in different historical development phase, meanwhile world basketball development and its levels let Chinese men's basketball team has different historical backgrounds,

which surely will let it constantly adjust its own development strategy in future training and constant adjust its own tactics in competitions so that can constantly improve its own basketball skills and competition performance under world men's basketball rapidly development background.

For Chinese men's basketball performance constantly decreasing in recent years and how to improve Chinese men's basketball performance problems, lots of scholars have made analyses and researches on them and put forward many precious thoughts. Among them, Long Jing (2008) applied document literature and questionnaire survey researching basketball competition

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penalty each influence factors, and made attribution analysis of each factor importance, which provided references for defining main factors to it^[1]; Xian Yun-Long (2005) applied mathematical statistics, documents literature and other methods analyzing Chinese university basketball coaches and athletes current status, researched each aspect existed problems from the aspect of their members compositions and technical level as well as others, and proposed corresponding counter measurements and suggestions for Chinese basketball development^[2]; Zhu Tian-Ming (2013) researched on important reasons that Chinese men's basketball fell behind world men's basketball powers, and analyzed Chinese men's basketball future development thoughts and directions, which had important practical significances and theoretical values for Chinese men's basketball future development strategies^[3]; Wen Ji-Huai (2007) applied system analysis method, questionnaire survey and other methods making comprehensive researches on Chinese men's basketball, analyzed Chinese men's basketball sustainable development each element, and made targeted suggestions on it, which provided theoretical references for Chinese men's basketball competitive performance development^[4]; Song Qin-Long etc. analyzed Chinese men's basketball competition performance in London Olympic Games, and researched on Chinese men's basketball competition each technology playing, and provided Chinese men's basketball development strategies in the hope of promoting Chinese men's basketball competitive levels development^[5].

The paper researches on men's basketball team performance and its development each influence factor, and applies analytic hierarchy process to analyze them. By ranking men's basketball team and its development each influence factor importance, in the hope of providing references for Chinese men's basketball future development.

MEN'S BASKETBALL COMPETITION HIERARCHICAL STRUCTURAL FEATURES

A wonderful basketball competition generally is composed of competition two parties' members, coaches and spot referees working^[1]. Correctly analyze the three aspects influence degree on competition

is the key to one team improving its own competitive performance and winning the competition. In recent years, world basketball competitive levels are constantly developing, Chinese men's basketball members compositions and national team development phase are constantly changing, Chinese men's basketball competition performance are also on the slide. Men's basketball competition performance each influence factor shows hierarchy, different hierarchies each element mutual effect, and same hierarchy different factors mutual effect are composed organic system decides men's basketball competition performance. Carry out analytic hierarchy process with men's basketball competition performance each factor, it can scientific and reasonable research each factor mutual connections, and make clear men's basketball competition hierarchical elements. To analyze men's basketball competition result each aspect influence factor, the paper carries out analytic hierarchy process structural modeling with basketball player, coach and spot referee three elements as bottommost three elements.

Basketball team member influences on competition performance

Athlete body condition, technical level, physical quality, basketball awareness and psychological quality as well as others, each condition has great influences on a team competition performance. Basketball is a kind of strong technical sports event; meanwhile its competition has also features as fast, high intense and strong confrontation so on. If a team wants to stand out in fiercely competition, and then the team athletes should have very high physical qualities and conditions, as athlete's height, weight, spring and strength so on. Athlete physical quality and condition is an athlete technical and a team tactics base, only with very high physical quality and condition as well as equal spring ability and endurance, athlete can confront with opponent team members in strong confrontation basketball competition.

Meanwhile, a team's athlete technical level, intelligence level and psychological level are also the important factors that affect a team competition performance. A team's athlete, if he hasn't superb skills in playing ball games, he will be difficult to give high level tactics into play, and even cannot dominate in competition. Athlete

intelligence level refers to basketball player's learning ability, innovative ability and others in training, and athlete psychological level refers to his resourcefulness, interference resisting abilities. Athlete not only should strengthen technical training at ordinary times, but also should strive for cultivating his own basketball awareness. To a excellent basketball player, rich competition experiences are also indispensable, basketball player only possesses rich competition experience and then can make better judgment on competition status, timely adjust tactics and control competition rhythms.

From above analysis, basketball each condition is a team tactics playing and others each aspect base, is the key to competition winning. For Chinese men's basketball present existing problems, the paper defines basketball player influences on competition from eight aspects that are basketball player body condition, technique, tactics, physical quality, psychological quality, intelligence level, body contacting ability and competition experience.

Basketball team coach influences on competition performance

There are many factors decide a basketball competition winning, except for players themselves each kind of conditions, it has also two parties' coaches spot command abilities so on. A basketball team's members themselves strong strength cannot on behalf of the team's strong strength. A team is a unified entity; it needs members' mutual cooperation, each tactic flexible applying. In competition, a relative weak strength team also tends to defeat stronger strength team, which generally is because coaches can apply proper tactics, fully play each member advantages and dominate in the competition. When two equal strength teams come across in the competition, coaches' effects in competition are particularly prominent.

An excellent team has very high requirements of coaches. Coach should have higher professional technology and organizing ability, meanwhile he should comprehensively and carefully learn his members and opponent members, good at analyzing own party and opponent member abilities and features, fully make use of his own advantages to make up his own disadvantages, attack opponent weakness, and plan corresponding competition tactics. With world basketball constantly

development, basketball tactics and techniques have taken quite great development, science and technology as well as basketball combinations are getting closer, high technology penetrating on basketball will also gradually deepen, coaches scientific researching levels height, information technology application in their training, which directly affects sports team overall strength improvement. Meanwhile, coach decides an athlete's technical level and tactics level, training methods with rationality and targeted will directly affect sports training effects.

By researching and analyzing, the paper researches on a team coach to its competition performance influences from eight aspects that are coach's scientific research ability, training guiding ability, spot command ability, computer network level, qualified professional quality, innovative ability, organizing and management ability as well as communicative coordinate ability.

Basketball competition referee influences on competition performance

Whether referee's judgment is reasonable and correct has great influences on a competition result. And in completion each factor mutual effect let referee judgment in competitor has certain leeway. Referees' penalty accuracy and scale differences in competition not only affect athletes' scores and performance, but also affect athletes' emotions and normal playing, as well as coaches' spot command and others. That a basketball referee professional level, whether problems handling is fair or not and handling with live events as well as others also occupy certain positions in a competition winning.

There are many factors affect basketball referee's penalty to one competition, as basketball referee's himself professional theoretical knowledge level, mobile path and mobile steps, view and penalty angle, as well as competition teams' technical levels so on. The paper summaries basketball referee's influences on competition performance from eight aspects that are basketball referee's mastering degree on basketball competition rules and referee law, basketball referee's basketball professional theoretical knowledge, basketball referee control and management abilities to competitions, basketball referee's thought emphasis, basketball referee's degree of impartiality and adhering to principles, bas-

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ketball referee's self emotional unstable influences, basketball referee's physical quality and basketball referee's confidence.

MEN'S BASKETBALL COMPETITION STRUCTURE'S ANALYTIC HIERARCHY PROCESS MODEL

Analytic hierarchy process application

When apply analytic hierarchy process solving practical problems, firstly it needs to refine practical decisions, ranking and other problems each influence factor from practical problems, meanwhile form into three layers according to each element mutual relations that are top layer, middle layer and decision layer, so that make problems orderly, hierarchical on a complicated problem's elements compositions. Among them, middle layer can have multiple layers, and the first layer elements numbers generally cannot beyond nine.

In order to define same layer each factor to its previous layer factor influence, analytic hierarchy process adopts Saaty (1-9 ratio scale table) forming into judgment matrix that makes comparison with same layer each factor importance. Handling data in this way can apply possessed data and experiences and also convert practical problems into mathematical problems. Same layer each factor paired comparison forms into comparison judgment matrix, values in comparison judgment matrix represents former factor to post factor importance, its scale table is as TABLE 1.

Use $a_i, a_j (i, j = 1, 2, \dots, n)$ representing each factor,

from which n is factor number that used for comparing. a_{ij} represents factor and factor a_j comparative importance, its values can refer to TABLE 1. Then it can compose $A - U$ judgment matrix P by a_{ij} .

$$P = \begin{bmatrix} a_{11} & a_{12} & \dots & a_{1n} \\ a_{21} & a_{22} & \dots & a_{2n} \\ \vdots & \vdots & \ddots & \vdots \\ a_{n1} & a_{n2} & \dots & a_{nn} \end{bmatrix}$$

There are four methods to calculate weight, as geometric method, eigenvector method, arithmetic method and least square method. The paper applies eigenvector calculating weight vector W . That is firstly solving judgment matrix P maximum eigenvalue λ and its eigenvector w . Carry out normalization on eigenvector w , and it can get corresponding weight vector W .

In order to ensure solved analytic hierarchy process model feasibility, it needs to do consistency test on established analytic hierarchy process model. When solved consistency proportion CR value is less than 0.10, and then it can think that established model consistency is very well that established judgment matrix can be used for analytic hierarchy process modeling, otherwise, it needs to revise judgment matrix. Consistency proportion CR computing method is as formula (1) show.

$$CR = \frac{CI}{RI} \tag{1}$$

TABLE 1 : Saaty (1-9 ratio scale table)

Scale score	Definition
1	Indicates two factors have equal importance by comparing
3	Indicates the former is slightly more important than the later by comparing two factors
5	Indicates the former is obviously more important than the later by comparing two factors
7	Indicates the former is intensely more important than the later by comparing two factors
9	Indicates the former is extremely more important than the later by comparing two factors
2,4,6,8	Former factor relative to post factor importance is between believe in judgment middle value
Above values reciprocal	Represents two factors comparing, post factor importance relative to former factor

TABLE 2 : 1-9 order judgment matrix RI value

n	1	2	3	4	5	6	7	8	9
RI	0	0	0.58	0.90	1.12	1.24	1.32	1.41	1.45

Among them, *CI* is judgment matrix consistency indicator, its computing method is as formula (2) show.

$$CI = \frac{\lambda - n}{n - 1} \quad (2)$$

Among them, *RI* is 1-9 order judgment matrix average random consistency indicator, its values is as TABLE 2 show.

Basketball competition hierarchical structure element indicator explanation

This paper has already made system analysis of

men’s basketball competition performance influence factors, by above analysis, it is clear that make comparison rank modeling to men’s basketball competition performance each influence factor, the model can be divided into three layers that are target layer, criterion layer and scheme layer. Among them, target layer is men’s basketball competition, criterion layer has three first grade indicators that are respectively basketball player, basketball coach and basket ball referee. Scheme layer is physical quality, psychological quality, intelligence level, spot command ability and basketball

TABLE 3 : Men’s basketball analytic hierarchy process model

Target layer		Men’s basketball competition		
First grade indicator	C1 basketball player	C2 basketball coach	C3 basket ball referee	
		C21 scientific research ability	C31 mastering degree on basketball competition rules and referee law	
		C22 training guiding ability	C32 basketball professional theoretical knowledge	
	C11 body condition	C23 spot command ability	C33 control and management abilities to competitions	
	C12 Technique	C24 computer network level,	C34 thought emphasis C35 degree of impartiality and adhering to principles	
	C13 Tactics	C25 qualified professional quality	C36 self emotional unstable influences	
Second grade indicator	C14 physical quality	C26 innovative ability C27 organizing and management ability	C37 physical quality	
	C15 psychological quality	C28 communicative coordinate ability	C38 confidence	
	C16 intelligence level C17 body contacting ability			
	C18 experience			

TABLE 4 : Number of people percentage that thinks each factor larger affects judging result

Factor	C31	C32	C33	C34	C35	C36	C37	C38
Occupied number of people	98%	46%	95%	38%	74%	23%	61%	74%

TABLE 5 : Basketball referee each factor comparative judgment matrix

Indicator	C31	C32	C33	C34	C35	C36	C37	C38
C31	1	6	2	6	3	7	5	4
C32	1/6	1	1/6	3	1/4	3	1/3	1/4
C33	1/2	6	1	6	3	7	4	4
C34	1/6	1/3	1/6	1	1/4	2	1/3	1/4
C35	1/3	4	1/3	4	1	5	2	1
C36	1/7	1/3	1/7	1/2	1/5	1	1/4	1/5
C37	1/5	3	1/4	3	1/2	4	1	1/2
C38	1/4	4	1/4	4	1	5	2	1

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TABLE 6 : Basketball competition result influences three indicators comparative judgment matrix

Indicator	C1	C2	C3
C1	1	3	7
C2	1/3	1	5
C3	1/7	1/5	1

TABLE 7 : Basketball competition result influences each indicator weight

Indicator	C1	C2	C3
Weight	0.6491	0.2790	0.0719

referee's degree of impartiality and adhering to principles so on. Its analysis model is as TABLE 3 show.

MEN'S BASKETBALL COMPETITION ANALYTIC HIERARCHY PROCESS MODEL SOLUTION

Each layer factors comparative judgment matrix establishment and solution

This paper carries out comparative judgment matrix establishment for selected each layer's each indicator by consulting documents. If proceed with comparative judgment matrix establishing on basketball referee's judging effects each indicator, the paper consults information, statistics gets that 98% people think that referee mastering degree on basketball competition rules and referee law have very big influence on its judging, 46% people think that referee mastering degree on

basketball professional theoretical knowledge is very important for its judging. The paper listed basketball referee's judging result influences each second grade indicator, it is thought each second grade indicator important percentage on number of statistical people is as TABLE 4 show.

Take TABLE 4 as reference; construct basketball referee judge structure influences eight indicators paired comparative matrix, its matrix value is as TABLE 5 show.

According to TABLE 5 basketball referee judging result influences each indicator comparative judgment matrix, respectively solve matrix eigenvalue and eigenvector, and solve maximum eigenvector $\lambda = 8.4833$. Corresponding eigenvector value is:

$$w = [0.7002, 0.1036, 0.5714, 0.0722, 0.2660, 0.0533, 0.1715, 0.2535]^T$$

Normalize solved eigenvectors; obtained vector W is solved comparative judgment matrix each indicator weight value, solved weight vector is:

$$W = [0.3195, 0.0473, 0.2607, 0.0329, 0.1214, 0.0243, 0.0782, 0.1157]^T$$

By formula(2), it can solve TABLE 5 showed judgment matrix consistency indicator $CI = \frac{8.4833 - 8}{8 - 1} = 0.0690$,

by TABLE 2, it can consult when $n = 8$, judgment matrix average random consistency indicator $RI = 1.41$, and then it can solve comparative judgment matrix consistency proportion

$$CR = \frac{CI}{RI} = 0.0523 < 0.10 \text{ by formula (1) that comparative}$$

TABLE 8 : Basketball player each indicator comparative judgment matrix

Indicator	C11	C12	C13	C14	C15	C16	C17	C18
C11	1	2	4	4	5	6	6	7
C12	1/2	1	3	3	5	5	6	6
C13	1/4	1/3	1	1	3	4	4	4
C14	1/4	1/3	1	1	2	4	3	4
C15	1/5	1/5	1/3	1/2	1	2	3	2
C16	1/6	1/5	1/4	1/4	1/2	1	1	2
C17	1/6	1/6	1/4	1/3	1/3	1	1	2
C18	1/6	1/6	1/4	1/4	1/2	1/2	1/2	1

TABLE 9 : Basketball player influences each indicator weight

Factor	C11	C12	C13	C14	C15	C16	C17	C18
Weight	0.3364	0.2493	0.1251	0.1126	0.0649	0.0408	0.0396	0.0312

judgment matrix consistency meets requirements.

Similarly, it can solve basketball player, basketball coach and basketball referee three first grade indicators to basketball competition result influences comparative judgment matrix as TABLE 6.

By above formula, it can solve comparative judgment matrix feature root as $\lambda = 3.0649$, consistency proportion $CR = 0.0560$, which conforms to comparative judgment matrix consistency requirements. Solved each indicator weight by comparative judgment matrix is as TABLE 7show.

By documents analysis and researches, it can solve basketball player's competition performance each indicator influence factor, comparative judgment matrix is as TABLE 8 show.

By above formula, it can solve comparative judgment matrix feature root as $\lambda = 8.3584$, consistency proportion $CR = 0.0363$, which conforms to comparative judgment matrix consistency requirements. Solved weights by comparative judgment matrix are as TABLE 9 show.

By documents analysis and researches, it can solve

basketball coach's competition performance each indicator influence factor, comparative judgment matrix is as TABLE 10 show.

By above formula, it can solve comparative judgment matrix feature root as $\lambda = 8.4736$, consistency proportion $CR = 0.0513$, which conforms to comparative judgment matrix consistency requirements. Solved weights by comparative judgment matrix are as TABLE 11 show.

Men's basketball competition structure each indicator concern grades classification

According to TABLE 7, TABLE 9and TABLE 11 basketball competition performance influences 24 second grade indicators to their last layer's first grade indicators weights and each first grade indicator weight, solve their total weights. Their weights are as TABLE 12 show.

According to solved competition performance influences 24 indicators total weights, it can make grades classification on the 24 indicators influence degrees. Here, we take weight 0.05and 0.01 as boundary lines,

TABLE 10 : Basketball coach each indicator comparative judgment matrix

Indicator	C21	C22	C23	C24	C25	C26	C27	C28
C21	1	1/6	1/7	2	1/4	1/2	1/5	1/4
C22	6	1	1/2	6	5	4	3	3
C23	7	2	1	7	6	5	4	3
C24	1/2	1/6	1/7	1	1/4	1/2	1/4	1/4
C25	4	1/5	1/6	4	1	4	1	1
C26	2	1/4	1/5	2	1/4	1	1/4	1/4
C27	5	1/3	1/4	4	1	4	1	1
C28	4	1/3	1/3	4	1	4	1	1

TABLE 11 : Basketball player influence each indicator weight

Indicator	C21	C22	C23	C24	C25	C26	C27	C28
Weight	0.0326	0.2345	0.3382	0.0280	0.1002	0.0444	0.1113	0.1108

TABLE 12 : Each indicator total weight value

Factor	C11	C12	C13	C14	C15	C16	C17	C18
Total weight	0.2184	0.1618	0.0812	0.0731	0.0421	0.0265	0.0257	0.0203
Factor	C21	C22	C23	C24	C25	C26	C27	C28
Total weight	0.0091	0.0654	0.0944	0.0078	0.0280	0.0124	0.0311	0.0309
Factor	C31	C32	C33	C34	C35	C36	C37	C38
Total weight	0.0230	0.0034	0.0187	0.0024	0.0087	0.0017	0.0056	0.0083

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when one indicator total weight is less than 0.01, it can regard its concern grade as low level, when one indicator total weight is more than 0.05, it can regard its concern grade as high level, when one indicator weight is between 0.01 and 0.05, it can regard its concern grade as medium level, each indicator concern degree is as TABLE 13 show.

Men's basketball competition structure each indicator analysis

By above, it is clear that in basketball competition result influence three first grade indicators, the maximum influence on competition performance is basketball player, its weight is 0.6491. In analyzed competition performance influences 24 second grade indicators, weight above 0.1 factors only have basketball player body condition and technique. Meanwhile listed as high concern degree six indicators, there are four indicators are indicators relative to basketball player, basketball player's other four indicators are also listed as medium concern. Therefore, it is clear that basketball player each condition has largest influences on com-

petition result, to really keep a foothold in competition increasingly intense competition field, basketball player selection and training are most important factors.

Basketball coach influences on competition is weaker than basketball player, his competition impact weight is 0.2790. His relative eight second grade indicators, listed as high concern and low concern indicators respectively have two ones, listed as medium concern indicators have four ones. Among them, basketball coach spot command ability weight is 0.0944, which ranks the third in the 24 second grade indicators, which shows basketball coach ability is also very important for competition result; to improve a basketball team competition performance, the basketball coach selection should be prudent.

Basketball referee impact on competition result is quite small, its weight value is only 0.0719. His relative eight second grade indicators, only two indicators are listed as medium concern; other six indicators are listed as low concern. But on a whole, basketball referee still plays certain roles in competition result; his effects cannot be ignored.

TABLE 13 : Each indicator concern degree's grade classification

Concern degree	Definition
Highly concern	Basketball player body condition, technique, tactics and physical quality Basketball coach's training guiding ability and spot command ability
Medium concern	Basketball player psychological quality, intelligence level, body contacting ability and competition experience Basketball coach's qualified professional quality, innovative ability, organizing and management ability as well as communicative coordinate ability Basketball referee's mastering degree on basketball competition rules and referee latent rules and basketball referee control and management abilities to competitions
Low concern	Basketball coach's scientific research ability and computer network level Basketball referee's basketball professional theoretical knowledge mastering degree, competition thought emphasis, degree of impartiality, self emotional unstable degree influences, self physical quality and confidence to competition judgment

CONCLUSIONS

The paper according to documents, analyzes and researches on basketball competition influence each aspect factor, defines competition result influences three first grade indicators and 24 second grade indicators,

defines basketball competition result influences each factor hierarchical structure; it defines basketball competition result influences each hierarchical factor comparative judgment matrix, establishes analytic hierarchy process model, and according to established comparative judgment matrix, it solves each hierarchical factor to competition performance influence weight, tests

solved weight value by consistency test model, and gets that it may pass consistency test conclusion; applies analytic hierarchy process analyzing basketball competition influence each factor, and gets the conclusion that basketball player each condition has maximum influences on basketball competition performance, from which basketball player body condition and technique have big influences on basketball competition performance, basketball player's other conditions also have big influence weights on competition, basketball player's selection and training should be major focus; Basketball coach has also very big influence on competition performance; especially for basketball coach guiding training ability and spot command ability which have very big influences on competition performance should be taken seriously.

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