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Application of analytic hierarchy model in performance evaluation for athletics coaches

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ABSTRACT

Base on current problems and conditions in coaches' performance evaluation system, with literature consultation, brainstorm and Delphi method, etc; construct the two-level and three-level index evaluation system, which includes the performance measurement and motivation measurement. Build an analytic hierarchy model to solve the weights of various indexes in such system. Evaluated by specialists, make the hierarchy performance on labor performance and labor process. Realize the accurate quantitative process on varied indexes in fuzzy mathematic method, which effectively makes up the shortages in straight-line evaluation system and reduces the human factors. Make the evaluation more correct, available, comprehensive and objective with many methods, so as to realize the comprehensive evaluation for short-term and long-term performance. © 2013 Trade Science Inc. - INDIA

KEYWORDS

Analytic hierarchy model;
Coach; Performance
evaluation.

INTRODUCTION

In competitive sports, as a widespread sport and big game for Olympic Games, track and field directly affects global sport performance, which is of great significance. The performance of athletes and competition depend on coaches' abilities. With the continuous development of track and field, the requirements for coaches and performance evaluation are improved. Performance evaluation is no longer a simple clerical work, but the core content of human source management system, which can be the delivery system and of great tactic significance. With scientific and reasonable performance evaluation system, the conceptions of tactic idea, development object and training center can be

directly delivered to coach, which can make them to improve levels continuously, make better plan and get better performance.

Analyze base on current problems and conditions in performance system, the medal and prize performance are important. But it has bad effects, that can't truly reflect the abilities of coaches especially those have rare competition chances, whose performance can't be truly reflected. However the purpose is to improve the basic motion skills and special motion skills, so the urgent problem is to build effective performance evaluation system.

By analyzing current performance systems and developing direction of track and field, this study builds an analytic hierarchy model, constructs the performance evaluation system, which effectively makes up the tra-

ditional shortages, reduces the human factors. Include more comprehensive indexes into such system to realize the true evaluation. It benefits for correction and objection of performance evaluation, which has great influence in fine development of track and field and scientific training group construction.

RESEARCH OBJECT AND RESEARCH METHOD

The research objects are track and field coaches and managers in their units in national track and field training class in 2010 and 2011.

Investigate in literature consultation. Know about current career labor features and performance evaluation methods seriously. Construct the theoretic system by looking up relative papers.

Make reference on 32 indexes, select in Delphi method, which can be classified into 3 procedures. At first, modify and supplement by specialists with high-level professional titles and posts. Then relative specialists selected to modify again. Delete the indexes with selection ratio less than 50% and 28 indexes are solved. At last, specialist group conduct questionnaire, and delete the indexes with selection ration less than 65%. Modify and classify according to real situation and get 22 indexes.

Conduct effective evaluation in analytic hierarchy method. Calculate weight coefficient of each index and construct the comparison system. Make scientific judgment on importance and important degree of various indexes. Then analyze the weight situation.

BASIC PRINCIPLE

Analytic hierarchy model can conduct integrated

Conduct brainstorm analysis on various indexes in performance evaluation. Invite 48 management specialists, coaches and athletes to conduct lectures, shown as TABLE 1. Make sure 32 indexes finally, after effective discussion and papers processing.

TABLE 1 : Member construction

people	number	professional title and post	Ratio (%)
sport management specialist	11	professor	10 (20.8)
		vice professor	1 (2.1)
track and field training management staff	12	pair office rank	1(2.1)
		middle-ranking and below	11 (22.9)
coach	14	high-level	9 (18.8)
		others	5 (10.4)
athlete	11	master sportsman	5 (10.4)
		others	6 (12.5)

analysis on quantity and quality, and simplify the problem. It gradually processes in quantity and model, disposes its key factors. Besides, deposes each key factor to make them more specified and quantitative. The small factors formed can be called as index. Conduct the evaluation on each key factor in the same layer. Calculate the weight coefficient and form a complicate object tree according to their relations.

Generally, classify the analytic hierarchy model into multi-layer object tree structure figure, shown as Figure 1. It usually has 3 layers, which are top layer, middle layer and bottom layer. The top layer is object layer, which is the final purpose. The middle layer is constraint layer, existing as research key factor. The bottom layer is operating hierarchy, which is the corresponding countermeasures and methods, which are indexes after processing.

Hierarchy according to different factors and indexes in each layer, then construct judgment matrix according

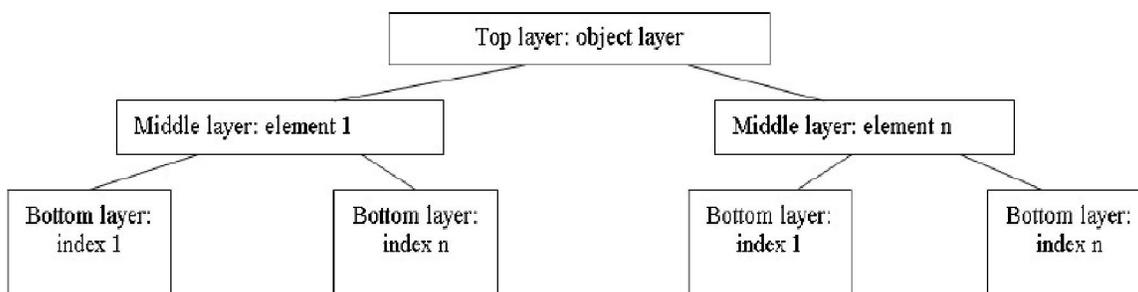


Figure 1 : Objective tree structure for analytic hierarchy model

FULL PAPER

to research purpose and requirement. Calculate the weight coefficients according the analysis results. The

method usually is SATTY weight analysis method, whose scale TABLE is shown as TABLE 2:

TABLE 2 : SATTY weight scale table

degree	indication	weight scale a_{ij}
same importance	2 indexes have same importance	1
middle value between same importance and appreciably importance	the important degree of 2 indexes is between same importance and appreciably importance	2
appreciably importance	according to experience, an index is appreciably important than another index	3
middle value between more important and appreciably importance	the important degree of 2 indexes is between more importance and appreciably importance	4
more important	according to experience, an index is more important than another index	5
middle value between more important and indeed importance	the important degree of 2 indexes is between more importance and indeed importance	6
indeed importance	the fact indicates an index is more important than another index	7
middle value between absolute importance and indeed importance	the important degree of 2 indexes is between absolute importance and indeed importance	8
absolute importance	the fact and experience indicate an index is obviously more important than another index	9

Two-two scale should be conducted in analyzing elements and indexes in different layers. Construct corresponding judgment matrix, shown as TABLE 3:

TABLE 3 : Judgment matrix

Ak	B1	B2	...	Bn
B1	B11	B12	...	B1n
B2	B21	B22	...	B2n
...
...
Bn	Bn1	Bn2	...	Bnn

After scaling, it should be noted: all the values are integer. i is row number and j is column number, i, j=1,2,3,4,5...yn. Conduct classification summarization

on various indexes data $\sum_{j=1}^n a_{ij}$. Then calculate the weight coefficient for each index in formula $W_i = \frac{1}{n} \sum_{j=1}^n (a_{ij} / \sum_{j=1}^n a_{ij})$.

If the importance ratio between i and j is a_{ij} , such value between j and I is $a_{ji} = \frac{1}{a_{ij}}$. According to evaluation advice, conduct evaluation and score on each index and element. Weight coefficient is the eigenvalue and eigenvector of a model, which depends on relative importance degree. It can be calculated in formula $\bar{W}_i = \sqrt[m]{a_{i1}a_{i2}...a_{im}}$. Sometimes the weight coefficient

is similar weight. Conduct normalized process in for-

mula $W_i = \frac{\bar{W}_i}{\sum_{i=1}^m \bar{W}_i}$. The final data is weight coefficient.

After calculating the weight coefficient, according to the single-hierarchy weights to the last layer, conduct the weight addition on indexes in the last layer. Then calculate the total hierarchy weight in the objective layer. Summary and analyze the varied papers, and process effectively. Scale conforming to “round off”. Then conduct consistency check, delete the results with too big or too small difference. Continue such test until with no problem.

While calculating the maximum eigenvalue and eigenvector of judgment matrix, the importance weights should be considered. Besides, single hierarchy analysis is essential. Some error can exist. But the significances of maximum eigenvalue and eigenvector in formula $BW = \lambda \max w$ should be noticed: the maximum eigenvalue of B is $\lambda \max$, whose normal eigenvector is, W_i is a quantity of W, which can be used for weight calculation in single hierarchy and evaluation, with high precision.

The consistency check formula is $CI = \frac{\lambda_{\max} - m}{m - 1}$, C is 0 means the consistency is fine. If $\lambda \max - m$ increases obviously, CI will increase obviously, so that the consistency decreases. Generally, $\lambda_{\max} = \frac{1}{n} \sum_{i=1}^m \lambda_i / m$ $\bar{y} \lambda_i = \frac{m}{\sum_{j=1}^m a_{ij} w_j / w_i}$,

the indexes in such formulas can reflect the real situation, which can promise the accuracy. Besides, sometimes, the comprehensive evaluation can be conducted in mean random consistency index RI, shown as TABLE 4. If the order is bigger than 2, conduct ratio processing on CI and RI, and the formula is $CR = \frac{CI}{RI}$. The method is used for random consistency check.

TABLE 4 : index R of mean random consistency

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

With reference to result analysis, if CR less than 0.1, the consistency is very good. If it bigger than 0.1, the consistency is bad and should be regulated. The smaller CR is, the better consistency is. Then conduct comprehensive index evaluation according to each index. Multiple can be used. Conduct weight calculation on each index, and make addition to get corresponding

coefficients. The formula is $GI = \sum_{j=1}^m C_j P_j$. Write ith index as P_i . Set the total number of evaluation indexes as m. Set group weight coefficient as C_i . Make sure the degree according to the results.

THE MODEL CONSTRUCTION

At first, construct the basic indexes for evaluation system. Conduct evaluation on research object in tactic management theory and balance scoring card. Then conduct effective judgment. According to career labor characteristics and relative research performances, the final indexes are shown as TABLE 5.

This study classifies the evaluation system into two one-level indexes, which are output and behavior. Output refers to the final result, also the final demonstration, including three 2-level indexes that athlete's per-

TABLE 5 : weight analysis in evaluation system

object layer	one-level index	two-level index	three-level index	weight coefficient
performance evaluation system for coaches	output (0.7294)	athlete's performance (0.5469)	rank (0.3275)	(0.1394)
		coach's performance (0.0681)	improving magnitude (0.6154)	(0.2683)
			coach's prize (0.3208)	(0.0186)
			coach's research performance (0.2471)	(0.0127)
		athlete selection (0.3605)	coach's reeducation situation (0.3792)	(0.0235)
			selection number (0.1647)	(0.0304)
			selection quality (0.8749)	(0.2276)
			comprehensive training plan (0.1693)	(0.0281)
			organizing and conduct training class (0.2146)	(0.0347)
			summarization and training class(0.1085)	(0.0192)
	complicating situation of training task(0.1984)		(0.0371)	
	work behavior (0.2703)	competition and training (0.6198)	information collection before competition (0.0371)	(0.0090)
			make competition plan (0.0486)	(0.0103)
			field command (0.0975)	(0.0162)
		management behavior (0.2863)	summarization after competition(0.1128)	(0.0174)
			athlete's attendance (0.1139)	(0.0087)
			read training log (0.2637)	(0.0239)
			athlete's violation (0.1429)	(0.0136)
			attendance for conference (0.1382)	(0.0124)
			athlete's satisfactory (0.7390)	(0.0158)
common relation (0.0795)			coach's satisfactory (0.1184)	(0.0036)
	manager's satisfactory (0.1057)	(0.0025)		

FULL PAPER

formance, coach's performance and athlete selection. The athlete's performance can be classified into three 2-level indexes that rank, performance improving magnitude. The final purpose is to make team to get good performance and how to improve the athlete's personal skill. The coach's performance can be classified into three three-level indexes, which are coach's prize, coach's research performance and coach's reeducation. The prize includes the prize of unit and prize out of unit, which relates to coach's performance closely. The ability of coach can be improved by publishing relative scholar paper and scientific research. Reeducation situation can improve the evaluation criteria. The athlete selection can be classified into two three-level indexes, which are number and quality. One of the coach's tasks is to select high-level and high potential athletes. As a competitive term, the difficulty is how to select fine athlete, which will directly relates to the ability of coach. It can be an effective index.

Behavior can be reflected from many perspectives, which can be classified into three two-level indexes, competition and training, management behavior and common relation. Training can be classified into four three-level indexes, which are comprehensive training plan, organizing and conduct training class, summarization and training class, summarization and training class and complicating situation of training task. Those are the basic contents for coaches. By making certain training plan, wholly planning the athlete's professional career, organizing and exercising personal ability positively, the coach's training level can be reflected, which is also an effective way to rapidly improve the athlete's ability. As a basic periodical unit, training class is the key section. Make corresponding reform by looking for various problems in the training, which can clear the direction. It demonstrates the science regulation of coach. Make different training plans and training periods for different athletes. Competition can be classified into four three-level indexes, which are information collection, making competition plan, field commanding and summarization after competition. It is an effective way. Helping athlete adapt to competition environment positively and effectively is of great significance, which is also the important indication of performance evaluation. Field performance is of little significance, which can be set as emergency. Its bad situation will also affect the performance.

The summarization can provide effective proofs for next plan. Management behavior can be classified into four three-level indexes, which are attendance, reading training log, athlete's violation and attending for conference. Those can correctly reflect the coach's management performance. Common relationship is classified into three three-level indexes, which are athletes is satisfactory, coach's satisfactory and manager's satisfactory. It directly relates to the training result and is of great significance in demonstrating the coach's management ability and good relationship.

This study indicates, rank, performance improving magnitude and athlete's selection are important. The other factors, such as prize, coach's research performance, coach's reeducation situation, athlete selection number, comprehensive training plan, organizing and conducting training class, summarization and training class, completing situation of training task, information collection before competition, making competition plan, summarization after competition, athlete's attendance, reading training log, athlete's violation, attendance situation for conference, athlete's satisfactory, coach's satisfactory and manager's satisfactory, have little effect.

CONCLUSION

Analytic layer model is important for performance evaluation system, which can wholly understand and evaluate the coach's ability. The model, combining the coach's career labor features, constructs a new evaluation index, realizing the effective balance between short-term performance and long-term development, indicating the balance between performance and motivation. It effectively makes up the traditional shortages, and avoids the shortages in linear model. Analytic hierarchy model can evaluate more comprehensively, objectively and correctly. It benefits for fine communication between coacher and athlete, coach and manager, improving the confidence and contributes to modern scientific group construction.

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