

Fuzzy Comprehensive Evaluation of Research on China's Sports Industry Development in Leisure Era

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Abstract: In the leisure era, the sports industry has attracted more and more people's attention, and fitness centers became the main places of citizens' relaxation and entertainment in the city, which not only played roles in relaxation but also let sports fitness to gain well development. The paper utilizes fuzzy comprehensive evaluation to evaluate China's sports industrial development. The values obtain from comprehensive evaluation show that China's sports industrial contribution is good and shows an excellent development trend.

Keywords: Fuzzy evaluation, Leisure era, Physical health, Sports industry.

1. INTRODUCTION

Sports industry is China's important affiliated enterprise, and also an indispensable industry contributing to the state economy. China's sports industry's current situation is not going well, so in this paper we carried out status conditions analysis targeting at China's sports industry and conducted strategic researches on future development [1]. China's sports industry surely has many drawbacks, for example low starting points, imbalanced development and so on [2]. But the overall trend is increasing by year; economically developed cities have higher requirements on sports industry [3].

By Table 1, it is clear that rapidly economically developed cities also have very developed sports industry, which indicates that the sports industry can be regarded as the important pillar of economy, and also an important state industry [4]. Table 2 shows Hubei province sports industry's forms of ownership, which is dominated both by state-owned holding and private holding, and meanwhile Hubei province introduces proactive industries from Hong Kong, Macao and Taiwan, which not only introduces advanced enterprises, but also brings in rational management system and lets Hubei province sports industry to enter into a brand new developmental height [5].

Table 3 summarizes Hubei province's sports and relative industries investigation data.

Sports manufacturing industry occupies considerably large proportions in Hubei province sports industry, and it can be called as pillar industry. The sports manufacturing industry introduced gross value of production, covering sports sales, sports construction industry, and sports service industry. However, from Table 3, it is shown that Hubei province sports service industry development is not very impressive. However, if the sports industry gets rid of sports

manufacturing industry, as shown in Fig. (1), it is established that sports sales and sports service industry will be increasing year by year, whereas the future of sports construction industry is surely uncertain so that it may have some connections with its attributes.

2. FUZZY EVALUATION MODEL ESTABLISHMENTS

2.1. Fuzzy Comprehensive Evaluation Model

Fuzzy comprehensive evaluation model is suitable for fuzzy calculation of multiple factors that are uncertain. The paper utilizes fuzzy comprehensive evaluation with the following steps:

(1) At first, the paper establishes a factor set U :
 $U = (U_1 \ U_2 \ \dots \ U_k)$

(2) Secondly, it establishes a judgment set V s (evaluation set).

(3) By establishing a fuzzy mapping from judgment matrix U to judgment matrix V , it gets a fuzzy relation as the following matrix shows:

$$R = \begin{bmatrix} r_{11} & r_{12} & \dots & r_{1n} \\ r_{21} & r_{22} & \dots & r_{2n} \\ \vdots & \vdots & & \vdots \\ r_{m1} & r_{m2} & \dots & r_{mn} \end{bmatrix}$$

(4) By establishing a weight set, $A = (a_1, a_2, \dots, a_n)$, the condition that should be met is :

$$\sum_{i=1}^n a_i = 1 \quad a_i \geq 0$$

(5) In fuzzy relation R , every line reflects the line influencing factors to judgment-object extent, and

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Table 1. China's sports industry status analysis.

Province	Guangdong	Jiangsu	Beijing	Liaoning	Zhejiang
Ratio	24%	15%	30%	13%	15%

Table 2. Hubei province sports industry's forms of ownership.

Forms of Ownership	Amount of Holdings	Percentage
State-owned holding	268	14
Collective-owned holding	195	6
Hong Kong, Macao and Taiwan-owned holding	32	2
Other holdings	658	31
Foreign enterprise holdings	21	1
Private holding	1987	49

Table 3. Sports industries' all kinds of output indicators.

Industry	Year 2006	Year 2007	Year 2008
Sports manufacturing industry	5516789	7544667	8653526
Sports sales industry	13347	174227	241567
Sports construction industry	35347	62678	53579
Sports service industry	94674	105384	128749

meanwhile, R in every column reflects the column influencing factors to judgment-object extent.

$$\sum_{i=1}^n r_{ij} \quad j = 1, 2, 3, \dots, m$$

Secondly, carry out following calculation:

$$B = A \cdot R$$

$$= (a_1, a_2, a_3, \dots, a_n) \cdot \begin{bmatrix} r_{11} & r_{12} & \dots & r_{1n} \\ r_{21} & r_{22} & \dots & r_{2n} \\ \vdots & \vdots & & \vdots \\ r_{m1} & r_{m2} & \dots & r_{mn} \end{bmatrix}$$

$$= (b_1, b_2, b_3, \dots, b_n)$$

In V , evaluation of fuzzy set B describes the combination. Based on the above described facts, a simple modified model that is obtained by fuzzy comprehensive evaluation is shown as Fig. (1):

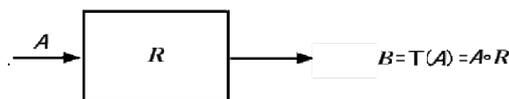


Fig. (1). Modified model.

According to Fig. (1), the modified fuzzy comprehensive evaluation model is established which corresponds to every factor of the grade evaluation transformation function, so that evaluation factors u_1, u_2, u_3, u_4, u_5 membership functions can be expressed as the following formulas (1), (2), (3)..., (5) respectively:

$$u_{v1}(u_i) = \begin{cases} 0.5(1 + \frac{u_i - k_1}{u_i - k_2}), & u_i \geq k_1 \\ 0.5(1 - \frac{k_1 - u_i}{k_1 - k_2}), & k_2 \leq u_i < k_1 \\ 0, & u_i < k_2 \end{cases} \quad (1)$$

$$u_{v2}(u_i) = \begin{cases} 0.5(1 - \frac{u_i - k_1}{u_i - k_2}), & u_i \geq k_1 \\ 0.5(1 + \frac{k_1 - u_i}{k_1 - k_2}), & k_2 \leq u_i < k_1 \\ 0.5(1 - \frac{u_i - k_3}{k_2 - k_3}), & k_3 \leq u_i < k_2 \\ 0.5(1 - \frac{k_3 - u_i}{k_2 - u_i}), & u_i < k_3 \end{cases} \quad (2)$$

Table 4. China’s sports undertaking evaluation indicator system.

Sports construction industry U_1	Sports personnel cultivation U_2	Sports organizations cultivation U_3	Sports undertaking revitalization U_4
Sports facilities introduction u_{11}	Professional coaches cultivation u_{21}	Sports events u_{31}	International sports undertaking introduction u_{41}
Sports facilities maintenance u_{12}	Universities faculty cultivation u_{22}	Sports activities u_{32}	Sports public undertaking development u_{42}
Stadium construction u_{13}	Sports foreign teachers introduction u_{23}	Sports lecturing u_{33}	Revitalization of sports traditional undertaking u_{43}
Daily sports facilities construction u_{14}	Training strength u_{24}	Sports overseas tour u_{34}	
Sports equipment maintenance and changing u_{15}			

Table 5. Four kinds of factors statistics ranking based on importance degree.

Classification	Rank1	Rank 2	Rank 3	Rank 4
Sports construction industry U_1	33	7	4	0
Sports personnel cultivation U_2	0	0	15	28
Sports organizations cultivation U_3	0	9	23	12
Sports undertaking revitalization U_4	3	3	19	21

$$u_{vi}(u_i) = \begin{cases} 0, & u_i \geq k_2 \\ 0.5(1 - \frac{k_1 - u_i}{k_2 - k_3}), & k_3 \leq u_i < k_2 \\ 0.5(1 + \frac{k_3 - u_i}{k_2 - u_i}), & u_i < k_3 \end{cases} \quad (3)$$

$$U_2 = \{u_{21}, u_{22}, u_{23}, u_{24}, u_{25}\}$$

$$U_3 = \{u_{31}, u_{32}, u_{33}\}$$

$$U_4 = \{u_{41}, u_{42}, u_{43}, u_{44}\}$$

By collecting and analyzing data, statistics of four kinds of factors ranked based on importance, has been obtained, see Table 5.

2.2. Combine with Fuzzy Evaluation Models to Evaluate China’s Sports Undertaking System

By the above model principles, a factor set U has been established, from which $U = (U_1 \ U_2 \ U_3 \ U_4)$ is obtained. Among them, sports construction industry is U_1 , sports personnel cultivation is U_2 , sports organizations cultivation is U_3 , and sports undertaking revitalization is U_4 , see Table 4. The paper establishes a small factor set out of four important factors sets.

Table 4 listed factors helped get an evaluation set.

$$U_1 = \{u_{11}, u_{12}, u_{13}, u_{14}\}$$

In Table 5, a four-column rank of a matrix has been established in which: sports construction industry is U_1 , sports personnel cultivation is U_2 , sports organizations cultivation is U_3 , sports undertaking revitalization is U_4 .

$$U_2 = \{33, 7, 4, 0\}$$

$$U_2 = \{7, 18, 18, 0\}$$

$$U_3 = \{0, 9, 23, 12\}$$

$$U_4 = \{3, 0, 19, 21\}$$

Weighted vector is obtained from rank 1 to rank 2

$$\beta = \{\beta_1, \beta_2, \beta_3, \beta_4\} = \{0.4, 0.3, 0.2, 0.1\}$$

Table 6. Remarks membership.

Evaluation Way	Set Scores Interval			
	0-60	60-80	80-90	90-100
Excellent	0	0	0.05	0.95
Good	0	0.05	0.9	0.05
Normal	0.05	0.9	0.05	0
Bad	0.95	0.05	0	0

Table 7. China's sports undertaking's evaluation obtained values for all indicators.

Each Layer Indicator	Evaluation Value	Each Layer Indicator	Evaluation Value
Sports facilities introduction u_{11}	Excellent	Sports events u_{31}	Excellent
Sports facilities maintenance u_{12}	Excellent	Sports activities u_{32}	Good
Stadium construction u_{13}	Normal	Sports lecturing u_{33}	Good
Daily sports facilities construction u_{14}	Normal	Sports overseas tour u_{34}	Normal
Sports equipment maintenance and changing u_{15}	Normal	International sports undertaking introduction u_{41}	Good
Professional coaches cultivation u_{21}	Excellent	Sports public undertaking development u_{42}	Excellent
Universities faculty cultivation u_{22}	Excellent	Revitalization of sports traditional undertaking u_{43}	Normal
Sports foreign teachers introduction u_{23}	Excellent		
Training strength u_{24}	Good		

$$U_i^* = U_i \cdot \beta^T$$

$$U_1^* = 14, U_2^* = 9.4, U_3^* = 4, U_4^* = 5.6$$

The paper takes normalization processing

$$U_1^* = 0.35, U_2^* = 0.3, U_3^* = 0.2, U_4^* = 0.15$$

It gets

$$\bar{A} = (0.35 \ 0.3 \ 0.2 \ 0.15)$$

The paper establishes remarks membership, as shown in Table 6.

China's sport undertaking's evaluation results obtained in sports construction industry, sports personnel cultivation, sports organizations cultivation, and sports undertaking revitalization, are given in Table 7.

By the above model, a single-layer indicator factor fuzzy weight set is:

$$U_1^* = \{U_{11}, U_{12}, U_{13}, U_{14}, U_{15}\} = \{0.26, 0.25, 0.24, 0.12, 0.17\}$$

$$U_2^* = \{U_{21}, U_{22}, U_{23}, U_{24}\} = \{0.53, 0.11, 0.24, 0.15\}$$

$$U_3^* = \{U_{31}, U_{32}, U_{33}, U_{34}\} = \{0.38, 0.31, 0.11, 0.24\}$$

$$U_4^* = \{U_{41}, U_{42}, U_{43}\} = \{0.3, 0.4, 0.3\}$$

By analyzing Table 5 and Table 3, an evaluation set for each column has been established in which: sports construction industry is U_1 , sports personnel cultivation is U_2 , sports organizations cultivation is U_3 , and sports undertaking revitalization is U_4 :

$$\text{Sports construction industry } U_1 = \begin{pmatrix} 0 & 0 & 0.05 & 0.95 \\ 0 & 0 & 0.05 & 0.95 \\ 0 & 0.05 & 0.95 & 0.05 \\ 0 & 0.05 & 0.95 & 0.05 \\ 0 & 0.05 & 0.95 & 0.05 \end{pmatrix}$$

$$\text{Sports personnel cultivation } U_2 = \begin{pmatrix} 0 & 0 & 0.05 & 0.95 \\ 0 & 0 & 0.05 & 0.95 \\ 0 & 0 & 0.05 & 0.95 \\ 0 & 0.05 & 0.9 & 0.05 \end{pmatrix}$$

Sports organizations cultivation

$$U_3 = \begin{pmatrix} 0 & 0 & 0.05 & 0.95 \\ 0 & 0.05 & 0.9 & 0.05 \\ 0 & 0.05 & 0.9 & 0.05 \\ 0.05 & 0.9 & 0.05 & 0 \end{pmatrix}$$

Sports undertaking revitalization

$$U_4 = \begin{pmatrix} 0 & 0 & 0.05 & 0.95 \\ 0 & 0.05 & 0.9 & 0.05 \\ 0 & 0.05 & 0.9 & 0.05 \end{pmatrix}$$

The above evaluation sets are calculated according to following formula:

$$B_i = A_i \cdot R_i$$

The normalization processing is carried out using the obtained B_i , and thus a fuzzy evaluation matrix is obtained:

$$\bar{B} = \begin{pmatrix} B_1 \\ B_2 \\ B_3 \\ B_4 \end{pmatrix} = \begin{pmatrix} 0.07 & 0.27 & 0.23 & 0.43 \\ 0 & 0.1 & 0.7 & 0.5 \\ 0.08 & 0.16 & 0.28 & 0.28 \\ 0.14 & 0.2 & 0.3 & 0.36 \end{pmatrix}$$

Thus, comprehensive evaluation value is as follows:

$$Z = U^* \cdot B = (0.40 \quad 0.05 \quad 0.34 \quad 0.18)$$

CONCLUSION

Sports industry is an industry indispensable for China's economy. This paper conducted status analysis of China's

sports industry, and carried out strategic researches on its future development. The paper utilized fuzzy mathematics to analyze recognition of human resources by the outer world, due to suffering from numerous factors, which are fuzzy. The fuzzy mathematics has been used to analyze China government's promotions of sports industry development.

CONFLICT OF INTEREST

The author confirms that this article content has no conflict of interest.

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