Research on the Development of University Sports Industry Based on Fuzzy Comprehensive Evaluation Method

Dongbo Wang [1], Wenjuan Lu[2]
[1] *School of Physical Education, Hubei Normal University, Huangshi 435002, China*
[2] *School of Economic and Management, Hubei Normal University, Huangshi 435002, China*

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Abstract: To clarify the utility of colleges and universities to help the development of sports industry, and to evaluate the degree of utility in promoting the sports industry in colleges and universities, is an effective way to further promote the development of sports industry in colleges and universities. Combining expert consultation to construct university function evaluation index in sports industry development, analytic hierarchy process (AHP) is used to assign weights to each index, and fuzzy comprehensive evaluation method is used to evaluate the function of university in the development of sports industry. The main conclusions are as follows: This method can solve the problem of weight distribution, which can help to find out the leading factors in promoting the development of sports industry; Through the empirical analysis, it is helpful to solve the ambiguity and uncertainty of the evaluation process, and realize the objective evaluation of the university to promote the development of the sports industry.

1. INTRODUCTION

As a key department to promote social development, colleges and universities should give full play to their own advantages to promote the development of sports industry. Teaching staff in colleges and universities will have important driving force in the development of sports industry, training sports management, creative design and intermediary and other professionals. Scientific research is intangible asset which can promote the development of sports industry in colleges and universities, especially sports colleges and universities play an important role in high-end sports equipment development and brand innovation. Sports consumption to promote the development of sports industry is the fundamental and cornerstone is the need for enough people, colleges and universities have a huge student consumer groups, will undoubtedly have a profound impact on the development of sports industry. To a certain extent, colleges and universities to promote the development of sports industry, also related to the promotion of the national economy.

Chinese scholars have made in-depth study around the question of promoting the development of sports industry in colleges and universities. Colleges and universities have two important resources to promote the development of sports industry, sports population and sports stadiums (Chen, G. Y., 2015). Colleges and universities should be from the characteristics of sports industry and the characteristics of disciplines, based on good job disciplines, specialties, curriculum, teaching materials, teaching research and practice link, for China's sports industry training and create all kinds of business and management personnel (Zhong, T. L., 2012); In the transformation path of China's sports industry scientific and technological achievements, we must strengthen the integration of universities and research institutes path, colleges and universities should give full play to the leading role of science and technology (Chen, H., 2013); Colleges and universities should focus on the development of sports and cultural industries, supplemented by other sports industries, and the formation of social sports industry complementary advantages, common and harmonious development, building a highly competitive sports industry development model (Zheng, H. S., 2012); Colleges and universities should strengthen the cultivation of market-oriented business personnel and research efforts to promote the development of sports industry (Zhang, J. B., & Wang, R. L., 2012); The lack of talent in sports industry has become the bottleneck of the development of sports industry. Colleges and universities should take up the important task of cultivating sports talents and promote the innovation and development of sports economy and education (Feng, W. Z., 2008); Colleges and universities should make full use of a large number of excellent physical education teachers resources, so that teachers participate in the guide to the ranks of the scientific and technical people, to provide scientific guidance for mass sports consumption (Chen, Q. L., & Zhai, S. B., 2007).

In summary, the domestic scholars of the study focused on qualitative aspects, and the specific design of the functional indicators of the development of sports industry, the determination of the weight of each index and the empirical analysis of quantitative analysis of very little. Based on the combination of qualitative and quantitative research, this paper tries to construct the functional evaluation index system of the university in the development of sports industry, and uses the analytic hierarchy process to quantify the index weight. Based on the results of AHP to carry out effective analysis of the survey data, and strive for colleges and universities to promote the development of sports industry, the

effectiveness of the evaluation to provide a reference.

2. THE CONSTRUCTION OF FUNCTIONAL EVALUATION SYSTEM AND THE ESTABLISHMENT OF INDEX WEIGHT IN THE DEVELOPMENT OF SPORTS INDUSTRY

2.1 The Construction of the Evaluation Index System of the Function of Sports Industry in Colleges and Universities

Scientific social index system should be based on different research objectives and objectives of the object, the objective of the existence of a number of indicators to be classified and combined. Based on the utility function of the university in the development of sports industry, this paper takes five primaries and 20 secondary indicators as the experimental preselected index set based on the literature review, the expert visit and the field investigation. Using the Delphi method to investigate the relevant experts, after two rounds of expert advice, expert consensus rate of 90% or more (Table 1), and ultimately built a four-level indicator and 14 secondary indicators Evaluation Index System of University Function. The target layer (A layer) of the index system is the comprehensive evaluation of the function of the university in the sports industry. The main level (B layer) includes the contents of economic utility, the effect of sports culture communication, the teaching effectiveness of college teachers, the promotion of science and technology, Sub-quasi layer (C layer) is 14 specific utility evaluation indicators (Table 2).

Table 1. Expert Advice Form

Expert classification	Groups	
	1	2
University sports department leader	4(3)	3(3)
Sports industry experts	8(7)	6(5)
Sport management experts	2(2)	2(2)
Provincial Sports Bureau experts	3(2)	2(2)
Σ	17(15)	13(12)
%	90	92

Table 2. Function Index and Weight of Universities in the Development of Sports Industry

First grade index	Weight	Second grade index	Weight
U_1 Economic boost utility	0.062	U_{11} Number of student groups	0.164
		U_{12} Student awareness of consumption	0.539
		U_{13} Physical education facilities in colleges and universities	0.297
U_2 Sports culture communication utility	0.273	U_{21} Organized the campus sports culture festival	0.527
		U_{22} Undertake large sports events	0.296
		U_{23} Research on sports industry culture	0.113
		U_{24} Construction of high level sports team	0.064
U_3 Teacher leadership utility	0.554	U_{31} Sports industry personnel training	0.567
		U_{32} Sports industry discipline planning and professional design	0.105
		U_{33} Guide the national science and fitness	0.113
		U_{34} Participates in sports industry development	0.216
U_4 Technology driven utility	0.112	U_{41} University sports industry technology research and development	0.359
		U_{42} Academic transformation of sports industry in colleges and universities	0.517
		U_{43} College sports industry project promotion	0.124

2.2 Constructing Judgment Matrix by Analytic Hierarchy Process

Table 3. Judgment Matrix Scale and Its Meanings

Scales	Meanings
1	i compared with j , i and j are equally important
3	i compared with j , i and j are slightly important
5	i compared with j , i and j are significantly important
9	i compared with j , i and j are extremely important
2,4,6,8	for the above importance ranged from 1,3,5,7,9
1,1/2,…,1/9	contrary to the above description

American analytical scientist T.L. Satty proposed the analytic hierarchy process, which is a combination of qualitative analysis and quantitative analysis, the qualitative problem into quantitative practical decision-making method, through the analysis of a number of subordinate indicators on the same The impact of the superior indicators, so as to determine the weight of the evaluation index. According to the research needs, select the relevant field of experts 15 people (college sports industry research in the field of six people, of which four have a doctorate; sports management field of two people, one of whom has a doctorate; 4 administrative departments of the university, including three levels of leadership at the district level, level leadership 1; Sports General Administration 3) to investigate. According to the 1-9 scale method (Table 3), the factors were compared with each other, and the weight distribution of the judgment matrix was constructed according to the average of 15 experts. Construct the first-order index (B-layer) judgment matrix A; construct the secondary index (C layer) judgment matrix A1, A2, A3, A4. The details as follows:

$$A=\begin{bmatrix}1 & 1/4 & 1/6 & 1/3\\ 4 & 1 & 1/3 & 4\\ 6 & 3 & 1 & 5\\ 3 & 1/4 & 1/5 & 1\end{bmatrix} \quad A_1=\begin{bmatrix}1 & 1/3 & 1/2\\ 3 & 1 & 2\\ 2 & 1/2 & 1\end{bmatrix}$$

$$A_2=\begin{bmatrix}1 & 2 & 6 & 5\\ 1/2 & 1 & 4 & 3\\ 1/6 & 1/4 & 1 & 3\\ 1/5 & 1/3 & 1/3 & 1\end{bmatrix}$$

$$A_3=\begin{bmatrix}1 & 6 & 3 & 4\\ 1/6 & 1 & 1 & 1/2\\ 1/3 & 1 & 1 & 1/3\\ 1/4 & 2 & 3 & 1\end{bmatrix} \quad A_4=\begin{bmatrix}1 & 1/2 & 4\\ 2 & 1 & 3\\ 1/4 & 1/3 & 1\end{bmatrix}$$

2.3 Consistency Test of Judgment Matrix and Establishment of Function Index Weight

In view of the complexity of the functions of universities and colleges in the development of sports industry, people also have some subjectivity in understanding. In order to ensure the validity of the judgment matrix and reflect the relative importance of each index scientifically, it is necessary to test the consistency of the judgment matrix. Taking the consistency test of judgment matrix by using the formula "CR=CI/RI", where CR is called the random consistency ratio; and CI=(λmax-n)/n-1 is the judgment matrix consistency index value, λmax is the largest eigenvalue of the judgment matrix; RI is obtained by repeating the calculation of the eigenvalues of the random judgment matrix multiple times, The mean random consistency index (Table 4) was calculated for 1000 times from 1 to 15-dimensional matrices. When CR = CI / RI <0.01, it is considered that the judgment matrix has satisfactory consistency, otherwise it needs to adjust the judgment matrix to make it have satisfactory consistency.

λmax and W are calculated using the power law, and the method of law and square root. The maximum characteristic root of the judgment matrix A is calculated as λmax = 4.210, CIA = (λmax-n) /n-1=0.070, RIA = 0.89, and the criterion of consistency judgment is obtained: CR = CI / RI = 0.078 < 0.10, indicating that the consistency test passed, that is, the index weight distribution is reasonable.

Similarly, the maximum characteristic root λmax = 3.009 and CRA1 = 0.010 <0.10 of the judgment matrix A1 are obtained, and the matrix consistency test is passed; The maximum eigenvalue of the judgment matrix A2 is λmax = 4.248, CRA2 = 0.093 <0.10, and the matrix consistency test is passed; The maximum eigenvalue of the judgment matrix A3 is λmax = 4.170, CRA3 = 0.064 <0.10, and the matrix consistency check is passed; The maximum eigenvalue of the judgment matrix A4 is λmax = 3.108, CRA4 = 0.093 <0.10, and the matrix consistency check is passed. Therefore, A, A1, A2, A3, A4 weight distribution is reasonable.

The weight of the index factor can be obtained from the judgment matrix A-A4 and the maximum characteristic root calculated therefrom, as follows:

W=(0.062,0.273,0.554,0.112)

W_1=(0.164,0.539,0.297)

W_2=(0.527,0.296,0.113,0.064)

W_3=(0.567,0.105,0.113,0.216)

W_4=(0.359,0.517,0.124)

According to the judgment matrix A-A4 and their maximum eigenvalues, then we can obtain the weights of the indicator factor as follows:

W=(0.062,0.273,0.554,0.112)

W1=(0.164,0.539,0.297)

W2=(0.527,0.296,0.113,0.064)

W3=(0.567,0.105,0.113,0.216)

W4=(0.359,0.517,0.124)

Table 4. Average random consistency index

n	1	2	3	4
RI	0	0	0.58	0.94

3. AN EMPIRICAL STUDY ON FUZZY COMPREHENSIVE EVALUATION

Fuzzy comprehensive evaluation is based on the principle of fuzzy mathematics, the application of the principle of fuzzy relationship synthesis, some marginal unclear, easy to quantify the quantitative factors, from a number of factors to assess the status of the subordinate level of a comprehensive evaluation of the method. On the basis of the analytic hierarchy process, the results of the empirical investigation are evaluated by fuzzy comprehensive evaluation method. Concrete steps: through the calculation of the index weight; on-site empirical investigation; to build a single factor fuzzy evaluation matrix; fuzzy comprehensive evaluation.

3.1 Questionnaire Production and Investigation

In this paper, the evaluation of the utility of the function of colleges and universities in the development of sports industry is carried out mainly through questionnaire and expert discussion. According to the author's "Scale of Indicators System for the Development of Sports Industry in Colleges and Universities", the reliability and validity of the scale were proved by exploratory factor analysis and empirical analysis. The weights of the relevant indicators were determined by expert survey. Application of the Likert 5 scale for the application of measurement, the use of on-site send and receive questionnaire 140 copies (Including Hubei Province, some colleges and universities related to the leadership of 16 people; including 985,211 and ordinary colleges and universities; sports industry experts 29; 60 sports industry teachers; students on behalf of 35 people). Recovering questionnaires 137, 125 is valid, 89.3% efficiency. The main discussion invited experts from universities and government departments.

3.2 Construct A Set of Evaluation Factors

The evaluation factor set is a collection of the various factors of the evaluation object. Through the construction of sports industry in the construction of functional indicators system to determine the fuzzy comprehensive evaluation of the factors set.

$U = (U_1, U_2, U_3, U_4)$ = {Economic utility, sports culture communication effect, teacher leading utility, science and technology to promote the effectiveness}

$U_1 = (U_{11}, U_{12}, U_{13})$ = (The number of students 'consumer groups, the awareness of students' consumption, and the physical material facilities of colleges and universities);

$U_2 = (U_{21}, U_{22}, U_{23}, U_{24})$ = (Organize the campus sports culture festival, undertake large-scale sports events, sports industry culture research, high-level sports team construction);

$U_3 = (U_{31}, U_{32}, U_{33}, U_{34})$ = (Sports industry personnel training, sports industry discipline planning and professional design, to guide the people of science and fitness, to participate in sports industry development);

$U_4 = (U_{41}, U_{42}, U_{43})$ = (University sports industry technology research and development, university sports industry science and technology transformation, university sports industry project promotion).

3.3 Set the Rating Level Domain

The rating hierarchy is a collection of evaluation levels. The questionnaire of functional evaluation in the development of sports industry is divided into five measurement grades according to the characteristics of the utility factors, which are very important, important, important, and less important. Composition comment set V = (v1, v2, v3, v4, v5). In order to quantify the convenience of calculation, in turn assigned to 5,4,3,2,1. (Table 5)

Table 5. Quantitative Standard for Functional Evaluation of Higher Education in Sports Industry

Evaluation value	Comments	Grade
$x_i > 4.5$	Very important	E_1
$3.5 < x_i \leq 4.5$	More important	E_2
$2.5 < x_i \leq 3.5$	Important	E_3
$1.5 < x_i \leq 2.5$	General	E_4
$x_i \leq 1.5$	Not very important	E_5

3.4 The Determination of Single Factor Fuzzy Judgment Matrix

Based on the judgment criteria, this paper constructs a fuzzy evaluation matrix R for the set of evaluation factors U. According to the five-level semantic scale used in the measurement, the function evaluation index of the university in the development of the sports industry is quantified. Based on the construction method of the single factor evaluation matrix, the field survey data is constructed into matrix, and the single factor fuzzy judgment matrix R, R_1, R_2, R_3, R_4. The scores of each column in the matrix show that the evaluation of the utility of the university in the sports industry is from the evaluation index.

$$R=\begin{bmatrix}0.168 & 0.416 & 0.160 & 0.184 & 0.072\\ 0.448 & 0.192 & 0.232 & 0.112 & 0.016\\ 0.336 & 0.392 & 0.168 & 0.104 & 0.000\\ 0.152 & 0.304 & 0.456 & 0.024 & 0.064\end{bmatrix}$$

$$R_1=\begin{bmatrix}0.072 & 0.136 & 0.344 & 0.408 & 0.040\\ 0.296 & 0.272 & 0.160 & 0.272 & 0.000\\ 0.056 & 0.096 & 0.392 & 0.344 & 0.112\end{bmatrix}$$

$$R_2=\begin{bmatrix}0.208 & 0.456 & 0.128 & 0.168 & 0.040\\ 0.152 & 0.104 & 0.416 & 0.208 & 0.120\\ 0.040 & 0.120 & 0.336 & 0.424 & 0.080\\ 0.256 & 0.344 & 0.136 & 0.232 & 0.032\end{bmatrix}$$

$$R_3=\begin{bmatrix}0.312 & 0.256 & 0.232 & 0.104 & 0.016\\ 0.136 & 0.200 & 0.336 & 0.248 & 0.080\\ 0.232 & 0.400 & 0.128 & 0.104 & 0.136\\ 0.240 & 0.296 & 0.224 & 0.184 & 0.056\end{bmatrix}$$

$$R_4=\begin{bmatrix}0.144 & 0.312 & 0.248 & 0.168 & 0.128\\ 0.240 & 0.336 & 0.168 & 0.144 & 0.112\\ 0.000 & 0.168 & 0.432 & 0.264 & 0.056\end{bmatrix}$$

3.5 Fuzzy Comprehensive Evaluation of the Function of Sports Industry in Colleges and Universities

The weighted average M (o, ⊕) fuzzy synthesis operator is used to synthesize the index weight W and the fuzzy comprehensive evaluation matrix R of the index to obtain the effect evaluation vector B in the sports industry.

3.5.1 Evaluation Vector of Economic Utility

$$B_1=W_1 \bullet R_1=(0.164,0.539,0.297) \bullet \begin{bmatrix} 0.072 & 0.136 & 0.344 & 0.408 & 0.040 \\ 0.296 & 0.272 & 0.160 & 0.272 & 0.000 \\ 0.056 & 0.096 & 0.392 & 0.344 & 0.112 \end{bmatrix}$$

The normalized evaluation vector after normalization:(0.188,0.197,0.259,0.316,0.040)

3.5.2 Evaluation Vector of Sports Culture Communication Effectiveness

$$B_2=W_2 \bullet R_2=(0.527,0.296,0.113,0.064) \bullet \begin{bmatrix} 0.208 & 0.456 & 0.128 & 0.168 & 0.040 \\ 0.152 & 0.104 & 0.416 & 0.208 & 0.120 \\ 0.040 & 0.120 & 0.336 & 0.424 & 0.080 \\ 0.256 & 0.344 & 0.136 & 0.232 & 0.032 \end{bmatrix}$$

The normalized evaluation vector after normalization:(0.246,0.258,0.251,0.151,0.051)

3.5.3 The Evaluation Vector of Leadership in Colleges and Universities

$$B3=W3 \bullet R3=(0.567,0.105,0.113,0.216) \bullet \begin{bmatrix} 0.312 & 0.256 & 0.232 & 0.104 & 0.016 \\ 0.136 & 0.200 & 0.336 & 0.248 & 0.080 \\ 0.232 & 0.400 & 0.128 & 0.104 & 0.136 \\ 0.240 & 0.296 & 0.224 & 0.184 & 0.056 \end{bmatrix}$$

The normalized evaluation vector after normalization:(0.269,0.275,0.230,0.137,0.050)

3.5.4 Evaluation Vector of Science and Technology Promoting Utility

$$B4=W4 \bullet R4=(0.359,0.517,0.124) \bullet \begin{bmatrix} 0.144 & 0.312 & 0.248 & 0.168 & 0.128 \\ 0.240 & 0.336 & 0.168 & 0.144 & 0.112 \\ 0.000 & 0.168 & 0.432 & 0.264 & 0.056 \end{bmatrix}$$

The normalized evaluation vector after normalization:(0.176,0.307,0.229,0.167,0.111)

3.5.5 Comprehensive Evaluation Vector of Utility in Sports Industry in Colleges and Universities

$$B_5=W \bullet R=(0.062,0.273,0.554,0.112) \bullet \begin{bmatrix} 0.168 & 0.416 & 0.160 & 0.184 & 0.072 \\ 0.448 & 0.192 & 0.232 & 0.112 & 0.016 \\ 0.336 & 0.392 & 0.168 & 0.104 & 0.000 \\ 0.152 & 0.304 & 0.456 & 0.024 & 0.064 \end{bmatrix}$$

The normalized evaluation vector after normalization:(0.336,0.329,0.217,0.102,0.016)

3.5.6 Grade Evaluation

According to table 5 the quantitative evaluation of the effectiveness evaluation of the sports industry in Colleges and universities:

$V_1 = 5\times0.188 + 4\times0.197 + 3\times0.259 + 2\times0.316 + 1\times0.040 = 3.177$

$V_2 = 5\times0.246 + 4\times0.258 + 3\times0.251 + 2\times0.151 + 1\times0.051 = 3.368$

$V_3 = 5\times0.269 + 4\times0.275 + 3\times0.230 + 2\times0.137 + 1\times0.050 = 3.459$

$V_4 = 5\times0.176 + 4\times0.307 + 3\times0.229 + 2\times0.167 + 1\times0.111 = 3.240$

$V = 5\times0.336 + 4\times0.329 + 3\times0.217 + 2\times0.102 + 1\times0.016 = 3.867$

Based on the comprehensive evaluation score, the overall score of utility evaluation in Hubei province is 3.867 ($3.5 < xi \leqq 4.5$), which indicates that the evaluation of college utility in the development of sports industry is at the "more important" level, which belongs to evaluation score E2. 4 level indicators in the economic utility, the effectiveness of sports and cultural communication, college teachers to lead the effectiveness of science and technology to promote the effectiveness of comprehensive evaluation are in the "important" level, belonging to the evaluation score E3. Ranking as follows: Teacher-led Utility> Sports Culture Communication Utility> Technology to Promote Utility> Economic utility.

4. CONCLUSIONS

This paper constructs the function index system of the university in the development of the sports industry. The target layer of the index system is the evaluation of the utility function of the university in the sports industry. The main level includes the economic power utility, the effectiveness of sports and cultural communication, college teachers to lead the effectiveness of science and technology to promote the effectiveness of four aspects of content. The secondary level is 14 specific utility evaluation indicators. And The analytic hierarchy process (AHP) is used to analyze the utility indexes, which can solve the distribution of the weights of each utility index. Through the table 2 shows the weight vector of 14 secondary indicators, we can found the sports industry personnel training, the campus sports culture festival, participate in the sports industry development, the university sports industry science and technology transformation is the leading factor in promoting the development of sports industry in colleges and universities, and also the advantage of colleges and universities in promoting the development of sports industry.

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