Research and Analysis of AHP on the Factors Affecting the Development of Dalian Sports Culture Industry

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Abstract: This study takes the development of Dalian's sports and cultural industry as the research object, and investigates the current situation of the development of Dalian's sports and cultural industry by designing a questionnaire. The survey results show that Dalian's sports and cultural industry is relatively satisfactory in five aspects, namely, the level of industrial marketization, the market development of industrial products, the potential of industrial development, the guarantee of industrial development and the resources of industrial development, but in terms of the brand construction of sports and cultural products There is a certain gap in specific indicators such as the total consumption of residents. Because most of the factors that affect the sports culture industry are often difficult to quantify the promotion of the sports culture industry, it is also difficult to carry out quantitative evaluation of such factors. Based on this, the following research uses the data of questionnaire and field survey, and AHP analytic hierarchy process combining subjective evaluation and objective evaluation to analyze the factors that promote the sports culture industry in Dalian. However, it is worth noting that among many factors, there is a large gap in the brand construction of sports and cultural products in Dalian. At present, there is a lack of well-known brands of cultural products in Dalian. At the same time, the overall consumption of sports and cultural products in Dalian is insufficient, as well as the lack of professional staff and inadequate access ability, which also directly restricts the further development of the sports industry in Dalian.

Keywords: Sports Culture Industry, Development, Influencing Factors, AHP Method

1. Introduction

Dalian is one of the first coastal open cities in China. It has a long history and cultural resources. It is also one of the cradles of sports culture in China. It is also a famous sports city in China [1]. Dalian is a famous sports city. It is known as "Football City", "Hometown of Track and Field" and "Hometown of Swimming". Dalian's sports culture has rich connotation and deep cultural accumulation. Dalian has cultivated a large number of sports talents for China's sports cause, made an indelible contribution to the rise of China's sports cause, and also laid a stable foundation for the construction of Dalian's sports culture [2].

Many factors affecting the development of sports industry, such as industry development resources, industry development guarantee ability, industry development innovation ability, industry magnetization degree, etc., in addition to individual factors such as industrial investment, most of the factors affecting the sports culture industry on the role of sports culture industry is often difficult to quantify, so also difficult to quantitative evaluation of such factors. Based on this, the following research group used the data of questionnaire and field investigation, and the AHP method combining subjective evaluation and objective evaluation to analyze the factors promoting the sports culture industry in Dalian.

2. Construction of the Index System of Factors Influencing the Development of Sports Culture Industry

On the basis of the existing research, the research group summarized many factors into five factors: industrial magnetization level, industrial product market development, industrial development potential, industrial development guarantee and industrial development resources. The evaluation index system is shown in Table 1.

Table 1. *Evaluation index system of key factors for the development of sports culture industry in Dalian city.*

Standard layer (primary indicator)	Index layer (secondary index)
Industrial magnetization level A1	Improvement degree of industrial market system B1
	Degree of diversification of market entities B2
	Total household consumption is B3
Industrial product market development A2	Optimization of the product structure of the B4
	Product marketing level B5
	Product brand building B6
	Resource development and allocation B7
	Sports culture industry chain is improved in B8
Industrial development potential A3	Modern enterprise system construction B9
	Industrial structure optimization degree B10
	Industrial innovation ability B11
Industrial development guarantee A4	Regulations and policy system construction B12
	Industrial financing channel construction B13
	Sports infrastructure B14
Industrial development resources A5	Industrial capital, B15
	Professional talent: B16

3. Selection of Research Methods

In this paper, the hierarchical analysis method is selected in the research method, which is a qualitative and quantitative, systematic and hierarchical analysis method, which is the formal expression, treatment and objective description of people's subjective judgment [3-7]. Choose AHP method, the reason is that the method is suitable for the analysis of small samples, poor information problems, and environmental factors are more subjective, qualitative indicators, according to this characteristic, the method of questionnaire survey from the subjective demand of the construction of sports culture industry, and scientifically use the advantages of quantitative analysis of the objective data. The design of questionnaire follows the index system used in hierarchical analysis; to reflect the consistency of survey index and result analysis.

4. Analysis of Data

Through the questionnaire survey, the criterion level and scheme level in AHP analysis are determined. Among them, the criteria level is the level of industrial marketization [8], the market development of industrial products [9], the industrial development potential [10], the industrial development guarantee [11, 13, 14] and the industrial development resources [12, 15]. The five criteria level indicators correspond to 16 indicator level factors.

According to the above index system, the questionnaire was designed, and distributed to some scholars of Liaoning Normal University, Dalian University, Liaoning School of Foreign Business and Economics and some operators of sports culture enterprises. A total of 120 questionnaires were distributed and 114 were collected, among which 109 were valid. This paper uses hierarchical analysis method to analyze the questionnaire results and uses AHP software. The calculation results of criterion layer weight vector are as follows:

Table 2. *Judgment matrix of first-level indicators.*

Target layer	Magnetization level	market development	development potential	Development guarantee	Develop resources
Magnetization level	1.0000	1.3161	0.9564	0.2694	0.3216
market development	0.7598	1.0000	1.1472	0.4767	0.5193
development potential	1.0456	0.8717	1.0000	0.7731	0.6804
Development guarantee	3.7116	2.0978	1.8147	1.0000	0.6623
Develop resources	3.1098	1.9961	1.4698	1.5098	1.0000

The results of weight vector of each index layer are as follows:

Table 3. *Industrial magnetization, the judgment matrix of each index.*

Industrial magnetization	Improvement degree of industrial market system B1	Degree of diversification of market entities B2	Total household consumption is B3
Improvement degree of industrial market system B1	1.0000	0.9854	2.5900
Degree of diversification of market entities B2	1.0148	1.0000	1.8908
Total household consumption is B3	0.3861	0.5289	1.0000

Table 4. *Judgment matrix of each indicator of industrial product market development.*

Product market development	Optimization of the product structure of the B4	Product marketing level B5	Product brand building B6	Resource development and allocation B7
Optimization of the product structure of the B4	1.0000	1.4968	0.8141	1.3048
Product marketing level B5	0.6681	1.0000	0.7499	1.4953
Product brand building B6	1.2284	1.3335	1.0000	1.0430
Resource development and allocation B7	0.7664	0.6687	0.9588	1.0000

Table 5. *Judgment Matrix of each indicator of industrial development potential.*

Industrial development potential	Industrial chain improvement B8	Modern enterprise system construction B9	Industrial structure optimization degree B10
Perfect the body industry chain B8	1.0000	0.5469	0.6560
Modern enterprise system construction B9	1.8286	1.0000	1.8974
Industrial structure optimization degree B10	1.5244	0.5270	1.0000

Table 6. *Judgment Matrix of each indicator of industrial development guarantee.*

Industrial development guarantee	Industrial innovation ability B11	Regulations and policy system construction B12	Industrial financing channel construction B13
Industrial innovation ability B11	1.0000	0.8439	0.6267
Regulations and policy system construction B12	1.1850	1.0000	1.2068
Industrial financing channel construction B13	1.5955	0.8286	1.0000

Table 7. *Judgment Matrix of each indicator of industrial development resources.*

Industrial development resources	Sports infrastructure B14	Industrial capital, B15	Professional talent: B16
Sports infrastructure B14	1.0000	0.5346	0.6015
Industrial capital, B15	1.8707	1.0000	0.9170
Professional talent: B16	1.6624	1.0905	1.0000

Hierarchical single ordering and consistency testing.

In this paper, taking the judgment matrix of the first-level index as an example, the specific steps of the weight calculation and the matrix consistency test are shown as follows:

(1) Normalized to each column of the judgment matrix:

$$\overline{A_{ij}} = \frac{A_{ij}}{\sum\limits_{k=1}^{n} a_{kj}}; i = 1, 2, \cdots, n$$

A_{ij} a_{kj} Where, it represents the original judgment matrix, the element in the k-row and j-column of the original judgment matrix, and the normalized judgment matrix. $\overline{A_{ij}}$ get:

$$\overline{A_{ij}} = \begin{bmatrix} 0.1039 & 0.1807 & 0.1497 & 0.0669 & 0.1010 \\ 0.0789 & 0.1373 & 0.1796 & 0.1183 & 0.1631 \\ 0.1086 & 0.1197 & 0.1565 & 0.1919 & 0.2137 \\ 0.3855 & 0.2881 & 0.2841 & 0.2482 & 0.2080 \\ 0.3230 & 0.2741 & 0.2301 & 0.3747 & 0.3141 \end{bmatrix}$$

(2) Mean the normalized judgment matrix of each column by rows:

$$W_i = \frac{1}{n}\sum\limits_{j=1}^{n} \overline{a_{ij}}; i = 1, 2, \cdots, n$$

$\overline{a_{ij}}$ Where, it represents the element in the column j in row i of the normalized judgment matrix, indicating the weight of the i th indicator. And n represents the number of indicators. W_i

The weight coefficient of the first-level index is obtained:

$$W = \begin{bmatrix} 0.1204 \\ 0.1355 \\ 0.1581 \\ 0.2828 \\ 0.3032 \end{bmatrix}$$

(3) Calculate the maximum eigenvalue of the judgment matrix. $\lambda_{\max}$

$$\lambda_{\max} = \frac{1}{n} \sum_{i=1}^{n} \frac{(\sum_{j=1}^{n} a_{ij} W_j)}{W_i} \quad i,j=1,2,...,n$$

$\lambda_{\max}$ a_{kj} Where, it represents the maximum eigenvalue, the element in the column j column of the i th row of the original judgment matrix, and the weight of the j th indicator and the weight of the i th indicator. And n represents the number of indicators. W_j W_i

If the largest feature root must be greater than 0, the corresponding feature vector is the positive vector, and any other feature root of A must be smaller than the largest feature root. $|\lambda|$ $\lambda_{\max}$

The maximum feature root of the resulting judgment matrix is =5.2386.

(4) The consistency index CI and the consistency ratio CR were calculated.

$$CI = \frac{\lambda_{\max} - n}{n-1}$$

$\lambda_{\max}$ Where, is the maximum eigenvalue, CI is the consistency indicator, and n is the number of indicators.

When n=2, the positive reciprocal matrix of order 2 is always consistent, so no consistency test is required. When n is greater than 2, the matrix consistency is represented by CR. CR=CI/RI. RI takes values, as shown in Table 8. When CR <0.1, the judgment matrix meets the consistency test.

The consistency test result of the first-level index judgment matrix is CI=0.0596; CR=0.0533 <0.1. Meet the requirements of the consistency test.

Similarly, the weight coefficient and the consistency test of each judgment matrix of the index layer can be calculated.

$\lambda_{\max}$ The calculation results of the first-level index and the index layer judgment matrix are summarized in Table 9-Table 14. Where W represents the within-group weight of each indicator, representing the maximum eigenvalue. CI represents the consistency index, and CR represents the consistency ratio.

Table 8. The mean random agreement indicators.

order	1	2	3	4	5	6	7	8	9
RI	0.00	0.00	0.58	0.9	1.12	1.24	1.32	1.41	1.45

Table 9. Weight coefficient and consistency test of the first-level index-target layer.

Target layer	Marketization level	market development	development potential	Development guarantee	Develop resources	weight
Marketization level	1.0000	1.3161	0.9564	0.2694	0.3216	0.1204
market development	0.7598	1.0000	1.1472	0.4767	0.5193	0.1355
development potential	1.0456	0.8717	1.0000	0.7731	0.6804	0.1581
Development guarantee	3.7116	2.0978	1.8147	1.0000	0.6623	0.2828
Develop resources	3.1098	1.9961	1.4698	1.5098	1.0000	0.3032
consistency check	$\lambda_{\max}$ = 5.2386, CI=0.0596, CR=0.0533 <0.1, and passed the consistency test					

Table 10. The weight coefficient and consistency test of the index layer-industrial marketization.

Industrial marketization	Improvement degree of industrial market system B1	Degree of diversification of market entities B2	Total household consumption is B3	weight
Improvement degree of industrial market system B1	1.0000	0.9854	2.5900	0.4270
Degree of diversification of market entities B2	1.0148	1.0000	1.8908	0.3885
Total household consumption is B3	0.3861	0.5289	1.0000	0.1845
consistency check	$\lambda_{\max}$ = 3.0536, CI=0.0268, CR=0.0462 <0.1, and passed the consistency test			

Table 11. Index layer-the weight coefficient and consistency test of product market development.

Product market development	Optimization of the product structure of the B4	Product marketing level B5	Product brand building B6	Resource development and allocation B7	weight
Optimization of the product structure of the B4	1.0000	1.4968	0.8141	1.3048	0.2766
Product marketing level B5	0.6681	1.0000	0.7499	1.4953	0.2316
Product brand building B6	1.2284	1.3335	1.0000	1.0430	0.2827
Resource development and allocation B7	0.7664	0.6687	0.9588	1.0000	0.2091
consistency check	$\lambda_{\max}$ = 4.0629, CI=0.0233, CR=0.0233 <0.1, and passed the consistency test				

Table 12. Weight coefficient and consistency test of index layer-industrial development potential.

Industrial development potential	Industrial chain improvement B8	Modern enterprise system construction B9	Industrial structure optimization degree B10	weight
Industrial chain improvement B8	1.0000	0.5469	0.6560	0.2260
Modern enterprise system construction B9	1.8286	1.0000	1.8974	0.4787
Industrial structure optimization degree B10	1.5244	0.5270	1.0000	0.2952
consistency check	$\lambda_{\max}$ = 3.0234, CI=0.0117, CR=0.0202 <0.1, and passed the consistency test			

Table 13. Weight coefficient and consistency test of index layer-industrial development guarantee.

Industrial development guarantee	Industrial innovation ability B11	Regulations and policy system construction B12	Industrial financing channel construction B13	weight
Industrial innovation ability B11	1.0000	0.8439	0.6267	0.2672
Regulations and policy system construction B12	1.1850	1.0000	1.2068	0.3712
Industrial financing channel construction B13	1.5955	0.8286	1.0000	0.3617
consistency check	λ_{max} = 3.0262, CI=0.0131, CR=0.0226 <0.1, and passed the consistency test			

Table 14. Weight coefficient and consistency test of index layer-industrial development resources.

Industrial development resources	Sports infrastructure B14	Industrial capital, B15	Professional talent: B16	weight
Sports infrastructure B14	1.0000	0.5346	0.6015	0.2210
Industrial capital, B15	1.8707	1.0000	0.9170	0.3859
Professional talent: B16	1.6624	1.0905	1.0000	0.3931
consistency check	λ_{max} = 3.0047, CI=0.0023, CR=0.0040 <0.1, and passed the consistency test			

With CR <0.1 from the above results, the above can pass the consistency test.

Hierarchical total ranking and consistency test, using the results of the single ranking of all indicators at the same level, can calculate the weight of the importance of all factors at the level of the previous level, which is the total ranking of the hierarchy. The comprehensive weight in the table is the total ranking corresponding to each index.

Table 15. Composite weights.

evel 1 indicators	weight	Secondary indicators	weight	Comprehensive weight	sort
Industrial marketization level A1	0.1204	Improvement degree of industrial market system B1	0.4270	0.0514	8
		Degree of diversification of market entities B2	0.3885	0.0468	9
		Total household consumption is B3	0.1845	0.0222	16
Industrial product market development A2	0.1355	Optimization of the product structure of the B4	0.2766	0.0375	12
		Product marketing level B5	0.2316	0.0314	14
		Product brand building B6	0.2827	0.0383	11
		Resource development and allocation B7	0.2091	0.0283	15
Industrial development potential A3	0.1581	Sports culture industry chain is improved in B8	0.2260	0.0357	13
		Modern enterprise system construction B9	0.4787	0.0757	5
		Industrial structure optimization degree B10	0.2952	0.0467	10
Industrial development guarantee A4	0.2828	Industrial innovation ability B11	0.2672	0.0755	6
		Regulations and policy system construction B12	0.3712	0.1050	3
		Industrial financing channel construction B13	0.3617	0.1023	4
Industrial development resources A5	0.3032	Sports infrastructure B14	0.2210	0.0670	7
		Industrial capital, B15	0.3859	0.1170	2
		Professional talent: B16	0.3931	0.1192	1

Finally, a consistency test of the hierarchical total ranking is required, as shown below.

$$\text{CI overall} = \sum_{i=1}^{5} W_i CI_i$$

=0.1204*0.0060+0.1355*0.0210+0.1581*0.0117+0.2828*0.0131+0.3032*0.0023=0.0098

$$\text{RI overall} = \sum_{i=1}^{5} W_i RI_i$$

=0.1204*0.58+0.1355*0.90+0.1581*0.58+0.2828*0.58+0.3032*0.58=0.6234

CR total =CI total / RI total = 0.0098/0.6234=0.0157 <0.1, fit to the consistency test.

W_i, CI_i, RI_i Specifically, the weight of the i th index in the first-level index and the average random consistency index of the first-level index.

5. Conclusion

First, according to the analysis results of the comprehensive weight, the Dalian sports culture industry, influence the weight of ranking for professional talents, industrial capital, regulations and policies, industrial financing channels, modern enterprise system construction, industrial innovation ability, sports infrastructure, industrial market system perfect degree, market main body diversification, industrial structure optimization degree, product brand construction, product structure optimization, sports culture industry chain, product marketing level, resource development and configuration,

residents' total consumption.

Second, from the perspective of the weight distribution of the first-level index, the weight of industrial development resources is the largest, accounting for 0.3032; the second is industrial development guarantee, the weight is 0.2828; the weight of industrial development potential index is 0.1581, the third is market development 0.1355; the first-level index with the smallest weight is the marketization level index, the weight is 0.1204.

Third, from the perspective of the weight distribution of the second-level indicators, professional talents and industrial capital rank the first and second in the industrial development resource indicators, and the two indicators are the necessary resource conditions to measure the development of the sports industry. Among the industrial development indicators, the weight of policy and regulation system construction is the largest, which reflects the demand of policies and regulations in Dalian sports culture industry. In the potential index of industrial development, the modern enterprise system construction occupies the largest weight. The industry is composed of micro individual enterprises. The development of individual enterprises will undoubtedly bring the development and growth of the industry.

Acknowledgements

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