

Research on Influencing Factors of the Development of Cultural and Creative Industries Based on Grey Factor Analysis

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Abstract. In order to study the influencing factors of cultural and creative industries (CCIs), the Grey Factor Analysis and 30 different indexes are used to empirically analyze the correlation between the influencing factors and the added value of CCIs in Shanghai. At the same time, main environmental factors affecting the development of CCIs are explored. The result shows that technology research and development, policy and government financial support, human resources, social culture, cultural consumption environment, cultural industry basis and development status are important impacting factors on the development of CCIs in Shanghai. Based on the above research results, this paper puts forward some countermeasures and suggestions on the construction of a comprehensive environment to promote the sustainable and healthy development of CCIs.

Keywords: Influencing Factors; Grey Factor Analysis; Cultural and Creative Industries; Environmental factors.

1. Introduction

With the interactive and integrated development of the cultural industry and creative industry, a new industry format named CCI is formed by the elements comprising culture, creativity, technology, capital and manufacturing. The development of CCI has shown strong industrial functions in breaking through resource and environmental constraints, building industrial innovation capabilities, promoting industrial restructuring and upgrading and boosting overall economic growth (Fausto, 2018). In 2017, China's added value of culture and related industries was 3472.2 billion-yuan, an increase of 12.8% over the previous year, accounting for 4.2% of the GDP, an increase of 0.06 percentage points over the previous year. Shanghai started to develop its CCIs comparatively earlier than other cities in China. As of February 2019, 137 municipal cultural creative industrial parks have been established. In 2017, the added value of

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Shanghai's CCIs reached 334.014 billion-yuan, accounting for 12.1% of the city's GDP, contributing more than 23% to Shanghai's economic growth. It can be seen that CCI is getting more and more importance in many countries and regions in the world to alleviate resource and environmental pressures, enhance regional comprehensive competitive advantages, promote industrial restructuring and upgrading, and form new economic growth points. However, difficulties and uncertainties still exist in the development of China's CCIs. Therefore, it is necessary to conduct an in-depth analysis of the environmental factors, cracking on the obstacles to the development of CCIs, and construct a benign and comprehensive environment to promote the sustainable and healthy development of CCIs, so as to explore the development path and-model of this industry.

Previous studies mainly focused on particular influencing factors affecting CCIs from an empirical perspective, or focusing on individual factors affecting the development of creative industry. However, studies comprehensively analyzing the environmental factors affecting CCIs in the context of social and economic development are still rare. This paper aims to fill this gap.

The rest of this paper is arranged as follows. Section 2 reviews the related literature. Section 3 introduces indicators and research methodology. Section 4 describes data and empirical results. Section 5 gives conclusion and suggestions.

2. Literature Review

There is no consensus towards the definition of CCIs. The earliest attempt to define the term "cultural and creative industries" is made by the Department of Culture, Media and Sport of UK in 1998, which identified 13 sectors as constituting creative industries in the UK [3]. After that, two influential definitions were given by European Commission [6], who defines CCIs as industries using culture as an input, and UNCTAD [27], who stresses more on the creative aspect and describes CCIs as a set of creative economic activities. Inspired by the CCI concept, governments began to attach great importance to create better cultural and creative environment, so as to benefit urban development and economic growth. Overall, CCIs are increasingly important in the economic development of various countries [14].

Scholars have conducted in-depth analysis of the factors affecting the development of CCIs from different perspectives [1, 18]. It is believed that five essential conditions are required for the development of CCIs, known as the "four Ts" plus one, namely, technology, talent, tolerance, territorial assets and experimentation of constantly introducing new ideas, products and processes [9, 19, 26]. Florida [10] maintains that the most important development resource in the emerging economy of the 21st century is creative talent. He further points out the driving force of social progress lies in the rise of human creative activities, and believes that the region can continue to develop creative industry when it has the three conditions of talent, technology and tolerance. Xu [33] from Hong Kong maintains that talent, society, cultural resources and infrastructure are key elements for a region to develop CCIs. Chen and Ge [2] believe that institutions, environment, talents and culture are important factors influencing the location choice of CCIs, among which culture is the foundation, institution is the guarantee, talent is the key and the environment is the support. Zhang et al. in [35]

analyze factors affecting Beijing's CCIs and find that government policies and cultural environment are very important to Beijing's CCIs development. Wen and Hu in [32] deem that technologic-al factors, tolerance and talents are the main factors affecting the development of China's provincial CCIs, while the influence of infrastructure and government policy is relatively small.

Another strand of literature analyzes the influencing factors of CCIs from the perspective of industrial agglomeration. Rumpel et al. (2010) maintains that urban areas usually attract CCI enterprises, forming specialized clusters. MIT (2011) regards CCI clusters as one of the variables that influence the location decisions of CCI enterprises. Wang [28] points out that "agglomeration" is a general development modeling of CCIs at the initial stage, and it is a multidimensional dynamic evolution process, which can be divided into a starting stage of factor agglomeration, a take off stage of fusion penetration, and a mature stage of radiation linkages. Wang [28] believes that CCIs have an obvious trend of regional agglomeration, which is an important mode of creative industry agglomeration. The supplier market, labor market and accompanying knowledge spill over process formed in the process of agglomeration will enhance the competitiveness of CCIs. Wang [29] finds that there are regional differences in the effects of industrial structure, human capital and industrial policies on the concentration of urban cultural industries in different regions. Wang et al. [31] identified main factors affecting the development of Macao's cultural industry using grey relational method, which include demand capacity for cultural industry, government support, talents and related industries. Meng et al. [21] conducted similar study from the perspective of supply and demand in the cultural market.

In summary, most of the research focuses on individual factors of creative industry or analyzing particular factors of CCIs from an empirical perspective, seldom do these literatures put the CCIs in the context of social and economic development to comprehensively analyze the environmental factors affecting the development of CCIs, and try to construct a good and comprehensive environment conducive to the development of these industries. In this paper, grey relational analysis and grey factor analysis are used to select relevant indicators that are closely related to the development of CCIs. By systematic classification, the impact degree of environmental factors on CCIs is measured, and the environmental factors that affect CCIs are identified. After that, counter measures for developing CCIs are proposed.

Shanghai is a region with a relatively high level of development of CCIs in China. In 2015, Shanghai's comprehensive index of cultural industry development exceeded Beijing for the first time, ranking first in the country. Differ from other international metropolises which started the CCIs in the post-industrial era, such as London, New York and Tokyo, Shanghai is developing CCIs under the background of rapid industrialization, which has its unique development path and characteristics. Therefore, taking Shanghai as an example to study the influencing factors of the development of CCIs is of great importance and has reference value for promoting the sustainable and healthy development of CCIs in developing countries. However, relevant literatures concerning the influencing factors of CCIs development in Shanghai is very rare, only Chu [4] analyzes the rules in the spatial agglomeration of CCIs in Shanghai, and Chu and Huang [5] taking Shanghai as a case study to analyze the geographical location factors that shape the In-city location of CCI parks. Both of them only focus on the geographical distribution of Shanghai's CCIs while ignoring the influencing factors and their impacts.

The contribution of this paper is as follows: first, as CCIs are highly valued worldwide and taking Shanghai, a newly developed center of CCIs in an emerging country, as an example, this article gives the environmental factors that affect the development of CCIs, which has reference value for promoting the sustainable and healthy development of CCIs elsewhere. Second, compared with the existing research on the development of Shanghai's CCIs, this article puts forward some innovative views and suggestions. It is pointed out that "innovative R&D" indicators such as the amount of city patent grants, the total amount of enterprise R&D investment in science and technology, and the total amount of government R&D investment in science and technology are highly correlated with the added value of the CCIs, and the government's financial support and investment in the CCIs play an important role. Third, this paper is also innovative in the research method, gray factor analysis can better find out the factors that affect the development of Shanghai's CCIs and analyze its relevance and relative importance.

3. Indicator Selection and Methodology

3.1. Selection of Indicators

Selection of indicator is an important step in the analysis of impact factors, which is directly related to the reliability and scientific nature of the research results. Based on relevant research of scholars at home and abroad, following the principles of comprehensiveness, authenticity, comparability and availability, after investigation and consultation with industry experts in the cultural industry, this paper selects 30 indicators closely related to CCIs development to analyze, which is shown in Table 1 (taking Shanghai as an example). The comprehensive principle in this paper refers to the fact that the entire indicator system should reflect the development status of the CCIs and the predictable development capabilities in the future. The principle of authenticity means that the selected indicators should truly reflect the development of the CCIs, try to eliminate the individual's subjective preference for indicators and choose an objective and fair indicator system. The principle of comparability means that each element in the set of indicators must be consistent in terms of calculation caliber, measurement time and measurement unit; while the principle of availability refers to whether the relevant data of the indicator is available when the indicator is selected.

3.2. Selection of Methods

Grey Relational Analysis. With the complexity of social and economic systems, the structural relationship between them constantly changes and the data of various indicators are characterized by incompleteness and uncertainty. As a new industrial form of social and economic development, indicators for CCIs also possess characteristics of incompleteness and uncertainty. Therefore, this paper uses the Grey Relational Analysis (GRA) to empirically analyze the impacting factors of Shanghai CCIs. GRA is a multi-factor statistical analysis approach (Yin, 2018), by analyzing the

sample data of each factor, the relational degree between the factors such as strength, weakness, size and order is measured by the grey relational degree according to the similarity between the developmental trends of the factors. If the trend of the two factors reflected by the sample data is basically the same, the degree of relation between the factors is relatively large; conversely, the relational degree is small.

Table 1. Main Indicators Affecting CCIs

Code	Impact indicator	Code	Impact indicator	Code	Impact indicator
X_1	The city's art performances	X_{11}	Infrastructure construction investment in the city	X_{21}	Number of employees in the city's CCIs
X_2	Variety of books published in culture, education, science and sports	X_{12}	The average number of mobile phones per 100 households in the city	X_{22}	Number of students in regular HEIs in the city
X_3	Number of international exhibitions held in the city	X_{13}	Urban per capita parks and green areas	X_{23}	Number of ordinary colleges and universities in the city
X_4	Share of registered population to permanent resident population	X_{14}	The main business income of the city's cultural and entertainment institutions	X_{24}	Number of international students in the city
X_5	Per capita disposable income of urban residents in the city	X_{15}	Labor productivity of the tertiary industry in the city	X_{25}	Number of scientific research personnel in the city
X_6	Per capita annual cultural and entertainment service expenditure	X_{16}	Import and export of cultural products and services in Shanghai	X_{26}	The total amount of enterprise technology R&D in the city
X_7	Consumer price index of entertainment, education, cultural goods and services for city residents	X_{17}	Government investment in technology R&D	X_{27}	Number of cultural industry research institutions in the city
X_8	Percentage of family culture consumption in the total consumption in the city	X_{18}	Government spending on environmental protection	X_{28}	Total technology contract value in the city
X_9	Per capita GDP of the city	X_{19}	Government expenditure on cultural sports and media	X_{29}	The number of patent grants in the city
X_{10}	Number of cultural creative industrial parks in the city	X_{20}	The actual amount of foreign capital utilized in the city	X_{30}	The output value of new products of large and medium-sized industrial enterprises in the city

Since the “added value of CCIs” can measure the development level of Shanghai’s CCIs to a large extent, this sequence of variables is used as a reference series of model, and is recorded as X_0 . The sequence represented by the 30 indicators is selected as the comparison series of the model, and each series is listed as $X_i = (i = 1, t..30)$. We use GRA to analyze the correlation between reference series and comparison series. First, we average the values of each series, and then calculate the absolute value difference between the two series in the same period. Let $H_{0i}(t)$ be the relational degree between variable i and X_0 (the added value of CCIs) at period t .

$$H_{0i}(t) = \frac{\Delta \min + \rho \Delta \max}{\Delta o_i(t) + \rho \Delta \max} \tag{1}$$

$\Delta oi(t)$ is the absolute value difference between variable i series and reference series, while Δmin and Δmax represent the minimum and maximum absolute value difference of each period separately, and ρ is the resolution coefficient.

By calculating the relational degree between the reference series and variables in the comparison series, the relational degree and ranking between Shanghai's CCIs and the related indicators are explored. After that, the impact factors and their rankings that affect the development of Shanghai's CCIs are analyzed

Grey Factor Analysis. Based on the GRA of the added value of Shanghai CCIs and related indicators, the Grey Factor Analysis method is used to analyze the factors affecting the added value of Shanghai CCIs, and to find out the grey common factors and main influencing factors. Assume series $X_i = [x_i(1), x_i(2) \dots x_i(n)]^T$, ($i = 1, 2, \dots, p$), and $X = (X_1, X_2, \dots, X_n)^T$, let $V = (\varepsilon_{ij})_{p \times p}$ be the grey absolute relational matrix of X , then:

$$V = \begin{bmatrix} 1 & \varepsilon_{12} & \varepsilon_{13} \dots \varepsilon_{1p} \\ \varepsilon_{21} & 1 & \varepsilon_{23} \dots \varepsilon_{2p} \\ \dots & \dots & \dots \dots \dots \\ \varepsilon_{p1} & \varepsilon_{p2} & \varepsilon_{p3} \dots 1 \end{bmatrix} \tag{2}$$

Set $X = (X_1, X_2, \dots, X_n)^T$ be a random vector of P measurable indicators, and then the mathematical model of Grey Factor Analysis can be expressed as:

$$X_{p \times 1} = A_{p \times m} F_{m \times 1} + \varepsilon_{p \times 1} \tag{3}$$

Where $p \leq m$; $F = (F_1, F_2 \dots F_m)^T$ and $\varepsilon = (\varepsilon_1, \varepsilon_2 \dots \varepsilon_p)^T$ are both random vectors. $A = (a_{ij})_{p \times m}$ is a constant matrix. F is the common factor of X , ε is the special factor of X , a_{ij} refer to the factor load, while matrix A is the factor load matrix.

4. Empirical Analysis

4.1. Data Processing

Data Selection. This paper selects data of 30 indicators closely related to the development of CCIs in Shanghai from 2013 to 2017, and analyzes the environmental factors affecting the development of Shanghai's CCIs through empirical analysis. All data are from documents or reports of the Shanghai Municipal Bureau of Statistics and relevant government sectors. Due to statistical limitations, data from certain years are lost, but this has little effect on the results of statistical analysis and can be ignored. The specific data is shown in Table 2.

Table 2. Relevant Indicator Data of Shanghai CCIs from 2013-2017

Item	Year	Year				
		2013	2014	2015	2016	2017
X_0	Value added in cultural and creative industries (billion Yuan)	250.00	282.00	302.00	330.00	339.50
X_1	The city's art performances (times)	33910	27970	28730	22930	26140
X_2	Variety of books published in culture, education, science and sports	24969	24676	25954	27462	27772
X_3	Number of international exhibitions held in the city (times)	247	258	292	287	293
X_4	Share of registered population to permanent resident population	0.5930	0.5931	0.5974	0.5992	0.6017
X_5	Per capita disposable income of urban residents in the city (Yuan)	43851	47710	52962	57692	62596
X_6	Per capita annual cultural and entertainment service expenditure (Yuan)	4122	4931	3718	4174	4686
X_7	Consumer price index of entertainment, education, cultural goods and services for city residents	100.1	101.8	100.3	102.7	100.9
X_8	Percentage of family culture consumption in the total consumption in the city (%)	14.6	16.2	15.0	15.8	16.4
X_9	Per capita GDP of the city (Yuan)	90993	97370	106009	116582	126634
X_{10}	Number of CCI parks in the city	139	158	165	174	183
X_{11}	Infrastructure construction investment in the city (billion Yuan)	104.331	105.725	142.508	155.187	170.522
X_{12}	The average number of mobile phones per 100 households in the city	279	298	292	301	303
X_{13}	Urban per capita parks and green areas (square meters)	13.38	13.79	7.6	7.8	8.1
X_{14}	The main business income of the city's cultural and entertainment institutions (billion Yuan)	49.222	50.585	27.329	193.415	65.140
X_{15}	Labor productivity of the tertiary industry in the city (Yuan/person)	200121	213541	22043	22969	235500
X_{16}	Import and export of cultural products and services in Shanghai (billion Yuan)	26.96	27.94	30.28	32.13	33.74
X_{17}	Government investment in technology R&D (billion Yuan)	77.678	86.195	93.614	104.932	120.521
X_{18}	Government spending on environmental protection (billion Yuan)	60.788	69.989	70.883	82.357	92.353
X_{19}	Government spending on cultural sports and media (billion Yuan)	3.13	3.22	3.53	3.85	4.13
X_{20}	The actual amount of foreign capital utilized in the city(billion US\$)	16.780	18.166	13.013	1.867	1.876
X_{21}	Number of employees in the city's CCIs (10,000)	130.00	135	257758	248322	222667

X_{22}	Number of students in regular higher education institutions in the city (10,000)	50.48	50.66	51.16	51.47	51.49
X_{23}	Number of ordinary colleges and universities in the city	68	68	67	64	64
X_{24}	Number of international students in the city	18970	23702	29242	31416	31941
X_{25}	Number of scientific research personnel in the city	590	595	602	623	636
X_{26}	The total amount of enterprise technology R&D in the city (billion Yuan)	40.478	44.922	47.424	49.008	54
X_{27}	Number of cultural industry research institutions in the city	10	12	12	14	15
X_{28}	Total technology contract value in the city (billion Yuan)	62.087	66.799	70.799	82.286	86.753
X_{29}	The number of patent grants in the city	48680	50488	60623	64230	72806
X_{30}	The output value of new products of large and medium-sized industrial enterprises in the city (billion Yuan)	681.102	740.799	731.224	779.449	915.991

Source: Shanghai Statistical Yearbook (2013-2018) and CCIs Statistics Bulletin.

4.2. Empirical Analysis

CCIs rely on human skills, creativity and wisdom to process and create cultural resources through high tech means, and use intellectual property rights to protect cultural creative products to meet people's cultural needs. The development of CCIs is related to various factors. Through the analysis of the grey relational degree between the added value of Shanghai CCIs and various related indicators, the relational degree and ranking of each relevant indicator are obtained, as shown in Table 3.

It can be seen from Table 3 that if the GRA analysis is only performed on the added value of CCIs and related indicators, main factors affecting Shanghai's CCIs cannot be clearly seen. Therefore, this paper uses SAS 9.2 software to further analyze the grey factors of various environmental indicators affecting CCIs. The cumulative contribution rate of the first six principal components has reached 84.775%, and the interpretation effect is good. In order to further grasp the economic significance of each grey factor, orthogonal rotation processing of the factor load matrix is performed to obtain a rotating load matrix, we get 6 grey common factors that affect Shanghai's CCIs, and name them according to their intrinsic characteristics. The details are shown as in Table 4.

Table 3. Ranking of Relational Degree between Shanghai CCIs and Related Indicators

Rank	Impact indicator	Relational degree	Rank	Impact indicator	Relational degree
1	The number of patent grants in the city (X_{29})	0.6689	16	Total technology contract value in the city (X_{28})	0.4187
2	The total amount of enterprise technology R&D in the city (X_{26})	0.6467	17	Variety of books published in culture, education, science and sports (X_2)	0.3998
3	Government investment in technology R&D (X_{17})	0.5895	18	Urban per capita parks and green areas (X_{13})	0.3975
4	The main business income of the city's cultural and entertainment institutions (X_{14})	0.5113	19	The average number of mobile phones per 100 households in the city (X_{12})	0.3888
5	The output value of new products of large and medium-sized industrial enterprises in the city (X_{30})	0.5098	20	Number of ordinary colleges and universities in the city (X_{23})	0.3831
6	Number of employees in the city's CCI (X_{21})	0.4938	21	Per capita GDP of the city (X_9)	0.3765
7	Per capita disposable income of urban residents in the city (X_5)	0.4879	22	Percentage of family culture consumption in the total consumption in the city (X_8)	0.3789
8	The city's art performances (X_1)	0.4789	23	Consumer price index of entertainment, education, cultural goods and services for city residents (X_7)	0.3787
9	The actual amount of foreign capital utilized in the city (X_{20})	0.4786	24	Share of registered population to permanent resident population (X_4)	0.3661
10	Number of cultural creative industrial parks in the city (X_{10})	0.4687	25	Number of cultural industry research institutions in the city (X_{27})	0.3657
11	Government spending on environmental protection (X_{18})	0.4536	26	Number of scientific research personnel in the city (X_{25})	0.3635
12	Number of international students in the city (X_{24})	0.4501	27	Number of students in regular higher education institutions in the city (X_{22})	0.3543
13	Labor productivity of the tertiary industry in the city (X_{15})	0.4468	28	Number of international exhibitions held in the city (X_3)	0.3345
14	Per capita annual cultural and entertainment service expenditure (X_6)	0.4446	29	Infrastructure construction investment in the city (X_{11})	0.2885
15	Import and export of cultural products and services in Shanghai (X_{16})	0.4256	30	Government expenditure on cultural sports and media (X_{19})	0.2395

Source: Authors' calculation

Table 4. Classification of Each Indicator and Naming of Grey Factors

Factor name	Indicators	Factor load	Factor name	Indicators	Factor load
Cultural industry science and technology environment factor	Number of scientific research personnel in the city (X_{25})	0.738	Cultural consumption environment factor	Share of registered population to permanent resident population (X_4)	0.732
	The total amount of enterprise technology R&D in the city (X_{26})	0.887		Per capita disposable income of urban residents in the city (X_5)	0.878
	Number of cultural industry research institutions in the city (X_{27})	0.746		Per capita annual cultural and entertainment service expenditure (X_6)	0.879
	Total technology contract value in the city (X_{28})	0.789		Consumer price index of entertainment, education, cultural goods and services for city residents (X_7)	0.923
	The number of patent grants in the city (X_{29})	0.897			
	The output value of new products of large and medium-sized industrial enterprises in the city (X_{30})	0.793			
Cultural industry infrastructure environment factor	Number of CCI parks in the city (X_{10})	0.874	Percentage of family culture consumption in the total consumption in the city (X_8)		
	Infrastructure construction investment in the city (X_{11})	0.879	Per capita GDP of the city (X_9)	0.815	
	The average number of mobile phones per 100 households in the city (X_{12})	0.715			
	Urban per capita parks and green areas (X_{13})	0.779	Cultural industry human resource environment factor	Number of employees in the city's CCIs (X_{21})	0.815
	The main business income of the city's cultural and entertainment institutions (X_{14})	0.798		Number of students in regular higher education institutions in the city (X_{22})	0.832
	Labor productivity of the tertiary industry in the city (X_{15})	0.778		Number of ordinary colleges and universities in the city (X_{23})	0.782
	Import and export of cultural products and services in Shanghai (X_{16})	0.867		Number of international students in the city (X_{24})	0.756
Funding and policy environment	Government investment in technology R&D (X_{17})	0.935	Socio-cultural environment factor	The city's art performances (X_1)	0.867
				Variety of books published in culture, education, science and	0.756

factor				sports (X_2)	
	Government spending on environmental protection (X_{18})	0.878		Number of international exhibitions held in the city (X_3)	0.817
	Government expenditure on cultural sports and media (X_{19})	0.847			
	The actual amount of foreign capital utilized in the city (X_{20})	0.765			

4.3. Result Analysis

Analysis of Various Environmental Factors of High Relevance. As can be seen from the analysis results, factors that have a high relational degree with Shanghai’s CCIs development are $X_{29}, X_{26}, X_{17}, X_{14}$ and X_{30} , with the relational coefficient being 0.6689, 0.6467, 0.5859, 0.5113 and 0.5098 separately, indicating that these five indicators have a greater impact on the development of Shanghai’s CCIs. The “innovative R&D” indicators, such as (The number of patent grants in the city), (The total amount of enterprise technology R&D in the city), (Government investment in technology R&D), (The output value of new products of large and medium-sized industrial enterprises in the city) have a high relational degree with the added value of Shanghai’s CCIs, indicating that the government is very important in providing financial support and investment to Shanghai’s CCIs development. This shows that the government’s support policies, science and technology R&D, cultural industry foundation and cultural environment are closely related to the development of CCIs, which is also an important focus for enhancing the competitiveness of Shanghai’s CCIs.

Analysis of Environmental Factors of Medium and Low Relevance. As is shown in Table 3, X_{25} (Total technology contract value in the city), X_{22} (Number of students in regular higher education institutions in the city), X_3 (Number of international exhibitions held in the city), X_{11} (Infrastructure construction investment in the city) and X_{19} (Government expenditure on cultural sports and media) rank the last five in relational degree, with the relational coefficient being 0.3635, 0.3543, 0.3345, 0.2885 and 0.2395 separately, indicating that these five indicators do not contribute much to the development of Shanghai’s CCIs. Among them, X_{19} has the lowest relational degree with Shanghai’s CCIs, only 0.2395, signifying that the government’s investment in CCIs is not balanced, and that government investment is generally insufficient relative to industry demand. Enterprises in the CCIs need more financing channels and a more relaxed financing environment. The government should try its best to meet the financing requirements of SMEs in the industry through policy guidance and mechanism design in the process of supporting the development of CCIs. At the same time, the relational degree of X_{11} (Infrastructure construction investment in the city) and X_{10} (Number of CCI parks in the city) are both not very high, being 0.2885 and 0.4687 separately, demonstrating that Shanghai’s good cultural industry infrastructure construction and the existence of numerous creative industrial parks do not play an important role in the

development of Shanghai's CCIs. After careful studying, we found that although the industrial agglomeration of the park has begun to take shape and the infrastructure in the park is good, due to problems in the management system and operation mechanism, the clustering effect of the park has not been fully exerted. Furthermore, the development of the parks is uneven, the function of the park is not accurate, with a lack of rational overall strategic planning and refined management, which may explain medium and low relevance of X_{10} and X_{11} .

The relational coefficient of X_8 (Percentage of family culture consumption in the total consumption in the city) and X_7 (Consumer price index of entertainment, education, cultural goods and services for city residents) are 0.3789 and 0.3787 respectively, representing a low degree of relevance, indicating that there is still much room for Shanghai urban residents to improve in cultural consumption. The relational coefficient of X_{27} (Number of cultural industry research institutions in the city) and X_{25} (Number of scientific research personnel in the city) are 0.3657 and 0.3635 separately, representing a relatively low degree. Despite that the output value of the CCIs in Shanghai has increased year by year, Shanghai's research strength and investment in the industry have not kept up with the actual needs of it, therefore, more investment and support should be encouraged. Meanwhile, relational coefficients of X_2 (Variety of books published in culture, education, science and sports), X_3 (Number of international exhibitions held in the city) and X_4 (Share of registered population to permanent resident population) are all below 0.4, showing that the socio-cultural environment and cultural consumption environment for the development of Shanghai's CCIs need to be further ameliorated.

Main environmental factors affecting Shanghai's CCIs development. Table 4 shows that factors affecting Shanghai's CCIs development can be attributed to six grey common factors, namely: Cultural industry science and technology environment factor, Cultural industry infrastructure environment factor, Cultural consumption environment factor, Cultural industry human resource environment factor, Funding and policy environment factor and Socio-cultural environment factor. Among them, cultural industry science and technology R&D, government policy and financial support, cultural industry human resources and cultural consumption environment are important factors for Shanghai's CCIs development. For further promoting the sustainable and healthy development of CCIs, efforts must be made to improve the socio-cultural environment, build a good cultural consumption environment, vigorously cultivate the innovative and professional talents of the cultural industry, and provide human resources support for Shanghai CCIs. Moreover, policy guidance and financial support for CCIs also need to be strengthened.

5. Conclusions and Discussion

CCIs play a vital role in promoting coordinated economic and social development, stimulating economic restructuring and upgrading, and strengthening urban soft power. To enhance the core competitiveness of the CCIs, make full use of it in the construction of urban culture, promote the regional economy of "innovation-driven and transformational development", this paper proposes countermeasures for the

environmental construction that promotes the sustainable and healthy development of CCIs based on the above research results.

First, a good cultural creative environment should be cultivated and a vibrant cultural consumption atmosphere should be built. It can be seen from the above research that among the impact factors of Shanghai's CCIs, the "cultural consumption environment factor" is an important one. Moreover, the various components of the cultural consumption environment factor (see Tables 3 and 4) are highly related to Shanghai CCIs. Since its inception, Shanghai has been the forefront of the collision between Chinese and Western cultures, forming a Shanghai culture with innovative ideas and inclusive characteristics. In addition to that, Shanghai also has a wealth of revolutionary cultural resources and historical cultural resources. Consequently, to promote the development of CCIs, Shanghai needs to comprehensively utilize and integrate cultural resources, creatively promote the transformation of cultural resources into cultural products and their derivatives, actively introduce excellent cultural products from abroad to meet people's demand, at the same time, to construct a vigorous cultural consumption atmosphere to constantly enrich the cultural life of the masses, and improve people's quality of life and living standards.

Second, emphasis should be put on the cultivation and introduction of creative talents to build a talent highland for CCIs. As the CCI is based on human creativity, the quality of talents determines the development level of a region's CCIs. This study shows that cultural creative talent resource index is not highly related to the development of Shanghai's CCIs (relational degree is only 0.4896), and the supply of creative industry talent cannot keep up with the rapid development of Shanghai's CCIs. The lack of talents, especially the complex and professional senior management talents, and the incomplete talent cultivation mechanism have become the bottleneck restricting the development of Shanghai's CCIs. Therefore, nurturing and introducing creative talent is the key. On the one hand, advanced experience of cultural creative talents training should be learned, the new training mode of "production-study-research" should be used to strengthen the school-enterprise cooperation and establish a talent practice base to cultivate more professional talents who are familiar with cultural attributes and operational rules, as well as cultural enterprises management. On the other hand, the government and enterprises should broaden their horizons, provide relevant preferential policies and treatments, strengthen cooperation internationally, and vigorously introduce talents with outstanding cultural industry creativity and cultural enterprise management, so as to build a CCI highland and promote the industry develop healthily and rapidly.

Third, the main body of the cultural market should be cultivated and diversified. Cultural creative enterprises are the main force and carrier to promote the development of CCIs. Only by vigorously cultivating CCI enterprises with distinctive characteristics and strong strength, and promoting the diversification of the main body of CCIs, can we more effectively promote the rapid development of CCIs. The research shows that the number of cultural creative enterprises in Shanghai is very large, but there are not many strong cultural creative enterprises. Therefore, a fairer and more open market competition mechanism should be established to encourage the healthy competition and interdependence of all kinds of market subjects, and promote the diversification of cultural industry subjects. At the same time, the government should give cultural enterprises more supportive policies in various aspects, such as finance, taxation, land, etc., and cultivate a number of large cultural enterprise groups with international competitiveness and influence to play a leading role in the development of CCIs.

Fourth, financing channels of creative industry should be broadened and a diversified investment and financing pattern should be constructed. Strong financial support and multi-channel sources of funds are important basis for the development of CCIs. The results of this study also show that financial support is closely related to the development of CCIs in Shanghai, and the government financial support is an important driving force for CCI development. However, relying mainly on the input and support of the government, not widening the financing channels and building a diversified investment and financing situation is bound to affect the future development of Shanghai's CCIs. Moreover, the CCI in most places consists mainly of SMEs, which have limited financing channels, and relatively high financing threshold. Therefore, to promote the development of CCIs, focus should be put on promoting the construction of financial markets related to CCIs, encouraging financial institutions to develop financing products suitable for SMEs and broadening the financing channels for SMEs. Meanwhile, the government should improve its financial support planning, strengthen its financial support for small and medium-sized cultural enterprises with potential and innovation, and form a number of investment and financing platforms for the development of cultural industries led by the government to absorb social capital into CCIs.

Fifth, creative industrial park resources should be integrated and the agglomeration advantage of industrial park should be given full play. There are many problems in cultural creative parks in China, such as "emphasizing form, neglecting business form", low level of professional services in the region, serious homogeneous competition among parks, unsound management standards in the region, and uneven development of various parks. This study also shows that the relational degree between the infrastructure construction index of Shanghai's cultural industry and the development of Shanghai's CCIs is low (0.2885), which is one of the five indicators with the weakest correlation. While the relational degree of the number of cultural creative industrial parks and industrial agglomeration area of Shanghai is 0.4687, which is in the middle of the ranking table of the overall index relational degree. This is not in line with the good infrastructure construction of Shanghai's cultural industry and the fact that there are many creative industrial parks in Shanghai. Therefore, adopting various effective measures to integrate various resources of existing creative industrial parks and bring into play the clustering effect of industrial parks is an important path for the development of CCIs. First of all, efforts should be made to expand and strengthen a number of enterprises with international influence, form a driving role, and improve the overall competitiveness of the industrial park. Secondly, improve the infrastructure construction in the existing park, avoid repeated construction and integrate current clusters with the same functional orientation, transform the development model of the cluster, strengthen the individualized management of enterprises in the park, and stimulate the innovation ability of enterprises. Thirdly, clarify characteristics of the park under construction, try the third-party audit system for the park's efficiency, pay attention to fostering the symbiotic relationship between the enterprises in the park, focus on the integration and development of the CCIs and other industries, and take full advantage of the gathering function of the creative industry park.

Finally, efforts should be made to constantly improve the policy and regulation system, and build a good business environment. As a new industry, CCI needs government's policy support and guidance. It can be seen from this study that the rapid development of Shanghai's CCIs cannot be realized without the government's vigorous

promotion or even direct leadership; and the government has served an important role in guiding and promoting the construction of cultural industry infrastructure and social and cultural environment. However, the government should respect the market position of enterprises, work hard to improve the market environment for CCIs, strengthen the infrastructure construction for the development of CCIs, formulate and improve the regulatory system for cultural market and optimize the ecological environment for CCIs. Relevant government departments should, in light of the actual situation of CCIs in the region, formulate various regulatory systems and policy regulations that promote the development of CCIs with local regional characteristics. Meanwhile, it is necessary to strengthen the intellectual property rights protection, encourage the export of cultural creative products, and promote CCI enterprises to go global. Actively attract and utilize foreign capital to invest in CCIs in the region, strengthen exchanges and cooperation between international advanced cultural creative enterprises and local cultural creative enterprises, and build a large market environment that is open, transparent, efficient and fair in favor of the development of CCIs.

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