Analysis on Competitiveness of Service Outsourcing Industry in Yangtze River Delta Region

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1 Introduction

After manufacturing outsourcing, service outsourcing refers to a new management model in which enterprises outsource their own non-professional business and complete their business on their behalf with the help of excellent teams of external professionals, thus enabling enterprises to focus on their core business. According to the different contents of service outsourcing, it can be divided into three categories: information technology outsourcing service (ITO), business process outsourcing service (BPO) and technical knowledge process outsourcing service (KPO).

In the past 10 years, China's service outsourcing industry has entered a rapid period of development. Driven by the "the belt and road initiative" strategy, the amount of service outsourcing contracts related to it reached 17.83 billion US dollars in 2015 alone, up 42.6% year-on-year, with an average annual growth rate of 40~60% in the past 5 years. China's service outsourcing industry has made remarkable achievements and is striving to become a major service outsourcing country.

The Yangtze River Delta region is one of China's economic cores, with dense population and industrial agglomeration. The development of its service outsourcing industry is unique and has attracted the attention of many experts and scholars. Xie Rongjian et al. (2017) used fuzzy analytic hierarchy process to study the competitiveness of service outsourcing industry in the Yangtze River Delta region, and built a two-level index evaluation system. It was concluded that the competitiveness of service outsourcing industry in the Yangtze River Delta was evaluated well in terms of human resources, transportation and communication

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facilities and economic environment. Xu Shan and Li Rongrou (2020) used factor analysis to measure the competitiveness of service outsourcing industry in major cities in Yangtze River Delta region, and found out the most critical factors that affect each region to undertake international service outsourcing. Dai Jun et al. (2015) has constructed a set of competitive ecological evaluation index system with 4 ecological dimensions and 31 consideration indicators, and made ecological measurement and situation analysis on Jiangsu's competitiveness in undertaking international service outsourcing of "the belt and road initiative". Through research, Di Changya and Xu Ying (2018) found that human capital, labor cost, infrastructure construction and supporting industry level played a positive role in promoting the development of service outsourcing competitiveness in Jiangsu Province. Shao and Chan (2011) pointed out the need to develop diversified international markets, establish outsourcing strategies, increase talent recruitment and training. Regarding the outsourcing strategy, Erna (2014) believes that the company must outsource to a company with a competitive advantage and continuously verify. He You-Shi and Qin Yong (2009) take the capacity of urban offshore software outsourcing as a research object and evaluate the capacity of offshore software outsourcing in Nanjing, Wuxi, Suzhou, and Changzhou by constructing a TOPSIS value function model. Regional competitiveness provides important guidance. At present, domestic and foreign experts and scholars have made some achievements in the research of the service outsourcing industry, but the research on the regional competitiveness of the service outsourcing industry in the Yangtze River Delta region is still relatively lacking. Therefore, this paper takes the service outsourcing industry in the Yangtze River Delta region as the research object, focuses on analyzing the competitiveness of service outsourcing industry in Jiangsu, Zhejiang and Shanghai provinces, finds out the difficulties and bottlenecks in the current industry development, and gives relevant suggestions for the future development of service outsourcing industry.

2 Building Evaluation Index System Based on the Diamond Model

2.1 Diamond Model Theory

Michael Porter believes that the competitiveness of a country or a region's industry mainly refers to the competitiveness reflected in the sales of the industry's products and the service provider of a specific industry (Shao-Wen & Wu-Chao, 2012). Factor conditions, demand conditions, related and supporting industries, corporate strategic structures, and peer industries The four factors of competition affect, the two variables of government and opportunity simultaneously affect the four factors, forming a diamond-like structural framework, called the diamond model (Fig. 1).

The diamond model theory provides a theoretical basis for analyzing the competitiveness of the service outsourcing industry. Based on this, considering

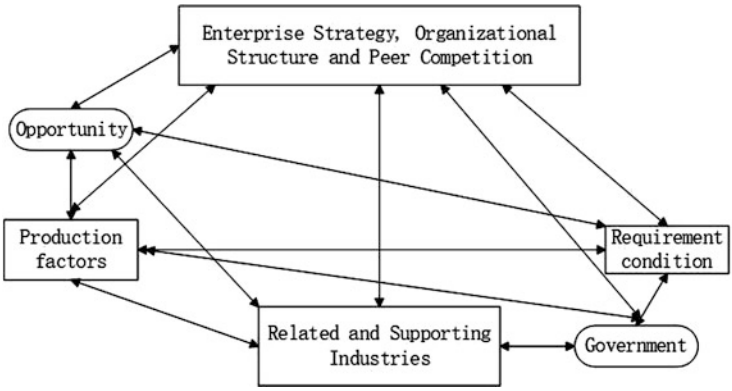

Fig. 1 Diamond model

the principles of comprehensiveness and completeness, Based on the existing research results and literature on service outsourcing at home and abroad, the competitiveness evaluation indexes of the service outsourcing industry are sorted out and summarized, as shown in Table 1.

2.2 Selection of Service Industry Competitiveness Indicators Based on Grey Correlation Degree

1. Improve the grey correlation model

Grey correlation degree analysis is a method to judge the correlation degree between each influencing factor and the given factor in a given system (Bing-Jun et al., 2005). The main idea of this method is to determine the correlation degree between each factor by experts scoring each index according to experience. The greater the final weight of each index, the higher the correlation degree, and the more important it is in the whole evaluation system. The specific steps are as follows:

In step 1, m experts are invited to score n indexes, i.e. weight assignment is performed to obtain an index weight matrix D, which can be expressed as

$$D = \begin{bmatrix} d_{11} & d_{12} & \cdots & d_{1m} \\ d_{21} & d_{22} & \cdots & d_{2m} \\ \vdots & \vdots & \vdots & \vdots \\ d_{n1} & d_{n2} & \cdots & d_{nm} \end{bmatrix} \tag{1}$$

Among them, d_{nm} is the empirical evaluation value of the *m-th* expert on the n-th index.

Table 1 Evaluation index of competitiveness of service outsourcing industry

	Primary indicator	Secondary index	Remarks
Regional Competitiveness of Service Outsourcing Industry	Element condition	Number of employees in the service outsourcing industry	X_1
		Assets of Service Outsourcing Enterprises	X_2
		Number of ports	X_3
	Requirement condition	Execution Amount of Offshore Service Outsourcing Contract	X_4
		The proportion of tertiary industry	X_5
		Foreign capital utilization	X_6
	Related and Supporting Industries	Number of ordinary colleges and universities	X_7
		Total freight volume	X_8
		Number of Internet Users	X_9
		Per capita GDP	X_{10}
	Enterprise strategic structure	Number of service outsourcing enterprises	X_{11}
		Operating Profit of Service Outsourcing Enterprises	X_{12}
	Government	Financial Allocation for Service Outsourcing Industry	X_{13}
	Opportunity	Number of service outsourcing demonstration cities	X_{14}
		International Service Outsourcing Contract Signing Amount	X_{15}

Step 2: Select the maximum scoring value from each column in the matrix D to become a reference weight vector D_0, which can be expressed as

$$D_0 = (d_{01}, d_{02}, \ldots, d_{0m}) \tag{2}$$

Among them, d_{0m} is the weight determined for the *m-th* expert.

Step 3: Find each index vector, that is, the distance between each row D_i and D_0 of D, that is

$$D_{0i} = \sum_{k=1}^{m} (d_{0k} - d_{ik})^2 \tag{3}$$

Where D_{0i} represents the distance between the index vector D_i and the reference weight vector D_0. d_{ik} indicates the weight given by the *k-th* expert to the *i-th* index.

Step 4: Calculate the weight of each index and normalize it, that is

$$\omega_i = 1/(1 + D_{0i}) \tag{4}$$

$$\overline{\omega}_i = \omega_i / \sum_{i=1}^{n} \omega_i \tag{5}$$

Among them, ω_i is the correlation degree between the *i-th* index and the maximum evaluation value of all exports, and $\overline{\omega}_i$ is the normalized *i-th* index weight.

2. Selection of competitiveness indicators for service outsourcing industry

Based on the grey relational grade analysis, three senior experts in the industry are invited to grade the index system shown in Table 1 by means of expert discussion, and the evaluation indexes are reasonably weighted and quantified by referring to relevant literature (Cao Tingting, 2014; Zhu Fulin, 2015; Chen Nana & He Zhixia, 2018), so as to avoid subjective assumptions caused by qualitative analysis and ensure the scientific and fair evaluation indexes. The weighting results are shown in the following table.

Further, according to Eqs. (3), (4) and (5) and the empirical matrix D shown in Table 2, the reference vector D_0 is formed by selecting the largest weight value

$$D_0 = (0.34, 0.3, 0.33)$$

At the same time, the calculation results of the corresponding index weight values are shown in Table 3.

From Table 3, we can see that the indicators that are highly correlated with the level of service outsourcing include: the amount of offshore service outsourcing contracts executed, the number of employees in the service outsourcing industry, the number of service outsourcing enterprises, and the assets of service outsourcing enterprises.

Table 2 Empowerment of competitiveness indicators of service outsourcing industry

	X_1	X_2	X_3	X_4	X_5	X_6	X_7	X_8	X_9	X_{10}	X_{11}	X_{12}	X_{13}	X_{14}	X_{15}
M_1	0.21	0.07	0.02	0.34	0.02	0.04	0.02	0.03	0.01	0.02	0.11	0.04	0.02	0.03	0.02
M_2	0.18	0.08	0.01	0.3	0.03	0.03	0.01	0.02	0.02	0.03	0.2	0.05	0.01	0.02	0.01
M_3	0.24	0.04	0.02	0.33	0.02	0.03	0.01	0.03	0.03	0.02	0.15	0.04	0.01	0.02	0.01

Table 3 Index weight value

Distance	Numerical	ω	Numerical	$\overline{\omega}$	Numerical
$\boldsymbol{D_{01}}$	0.0394	ω_1	0.9621	$\overline{\omega}_1$	0.0779
$\boldsymbol{D_{02}}$	0.2054	ω_2	0.8294	$\overline{\omega}_2$	0.0672
$\boldsymbol{D_{03}}$	0.2826	ω_3	0.7797	$\overline{\omega}_3$	0.0631
$\boldsymbol{D_{04}}$	0	ω_4	1	$\overline{\omega}_4$	0.0810
$\boldsymbol{D_{05}}$	0.2714	ω_5	0.7865	$\overline{\omega}_5$	0.0637
$\boldsymbol{D_{06}}$	0.2529	ω_6	0.7981	$\overline{\omega}_6$	0.0646
$\boldsymbol{D_{07}}$	0.2889	ω_7	0.7759	$\overline{\omega}_7$	0.0628
$\boldsymbol{D_{08}}$	0.2645	ω_8	0.7908	$\overline{\omega}_8$	0.0640
$\boldsymbol{D_{09}}$	0.2773	ω_9	0.7829	$\overline{\omega}_9$	0.0634
$\boldsymbol{D_{010}}$	0.2714	ω_{10}	0.7654	$\overline{\omega}_{10}$	0.0637
$\boldsymbol{D_{011}}$	0.0953	ω_{11}	0.9130	$\overline{\omega}_{11}$	0.0739
$\boldsymbol{D_{012}}$	0.2366	ω_{12}	0.8087	$\overline{\omega}_{12}$	0.0655
$\boldsymbol{D_{013}}$	0.2889	ω_{13}	0.7759	$\overline{\omega}_{13}$	0.0628
$\boldsymbol{D_{014}}$	0.2706	ω_{14}	0.7870	$\overline{\omega}_{14}$	0.0637
$\boldsymbol{D_{015}}$	0.2889	ω_{15}	0.7759	$\overline{\omega}_{15}$	0.0628

3 Competitiveness Evaluation Based on Global Principal Component Analysis

3.1 Global Principal Component Analysis

Global Principal Component Analysis (GPCA) is based on the traditional principal component analysis method and integrates the idea of time series, which is suitable for evaluation from both vertical and horizontal aspects (Li Yangjie & Li Jing, 2020). The construction principle is as follows: Suppose K is a series of planar data tables arranged by time t: $K = \{X^t \in R^{n*p}, t = 1, 2, ..., T\}$. All data tables have sample points a_i with the same name and normalized variable indexes $X_1, X_2, ..., X_p$ in the same direction. It involves changes in time, so the sample group point at time t is expressed as: $a_i^t = \left\{a_i^t, i = 1, 2, \ldots, n\right\}$ and the global sample group point is $A_i = \bigcup_i T = 1\ A_i^t$. The center of gravity of the global data table can be expressed as $g = \sum_t T = 1\ \sum_i n = 1\ p_i^t a_i^t$, Where p_i^t is the weight of a_i^t and satisfied $\sum_t T = 1\ \sum_i n = 1\ p_i^t = 1$. Therefore, $g^1, g^2, \ldots \ldots, g^T$ represents a time series at the overall level (Table 4).

3.2 Empirical Analysis

The test results show that the KMO value is 0.856, which is greater than 0.8, indicating that the constructed indexes have correlation and contain more common factors. Bartlett sphericity test value is 0.000, which is less than 1% significance

Table 4 KMO and Bartlett tests

KMO text		0.856
Bartlett sphericity test	Approximate chi-square	2250.086
	Variance	95
	Significant	0.000

Table 5 Global principal component eigenvalue and variance contribution rate

Principal component	Characteristic value	Contribution rate	Cumulative contribution rate
F_1	6.37	51.45%	51.45%
F_2	2.83	25.31%	76.76%
F_3	1.21	11.03%	87.79%

level, indicating that the indexes are independent of each other and pass the test, so the indexes and data can be analyzed by global principal component analysis.

After passing the test, three global principal components are extracted by principal component analysis according to the criterion that the characteristic value is greater than 1. The global principal component load matrix is established and rotated by the maximum variance method to calculate the eigenvalue, contribution rate and cumulative contribution rate of each global principal component.

As can be seen from Table 5, the cumulative variance contribution rate of the three global principal components F_1, F_2 and F_3 reached 87.79%, close to 90%, which shows that the changes of the values of these three principal components can almost replace the changes of the original nine indexes, which is sufficient to reflect the regional competitiveness of the service outsourcing industry.

By calculating the factor load of each index in the three principal components, it is found that: (1) The seven indicators X_4 (0.956), X_1 (0.925), X_{11} (0.902), X_2 (0.834), X_{12} (0.743), X_7 (0.731), X_{14} (0.722) have a larger load in the first global principal component, The production factors, demand structure, human resources and market scale that can represent the service outsourcing industry can be attributed to the industrial-strength factor. (2) In the second global principal component, the five indicators of X_{13} (0.856), X_8 (0.845), X_9 (0.807), X_6 (0.782), and X_5 (0.754) have a larger load, indicating government and related support Industry is an important factor in promoting the development of service outsourcing industry, and it can be attributed to the industry driving factor. (3) In the third global principal component, X_{15} (0.864), X_{10} (0.765), and X_3 (0.752) can be attributed to the industry potential factor.

3.3 Empirical Results

In this paper, the proportion of variance contribution rate of each global principal component to the total variance contribution rate is taken as the weight, and the comprehensive score of service outsourcing industry competitiveness is obtained by

Table 6 Comprehensive scores and rankings of service outsourcing industries in Jiangsu, Zhejiang, and Shanghai, 2013–2017

	2013		2014		2015		2016		2017	
	Score	Ranking	Score	Ranking	Score	Ranking	Score	Ranking	Score	Ranking
Jiangsu	0.847	1	0.956	1	1.155	1	1.346	1	1.612	1
Zhejiang	0.753	3	0.879	3	0.996	3	1.215	3	1.456	3
Shanghai	0.837	2	0.941	2	1.026	2	1.301	2	1.579	2

weighted calculation. It is expressed by F value. The higher the F value, the stronger the competitiveness of the service outsourcing industry, and vice versa. F_1, F_2 and F_3 respectively represent the scores of industrial-strength factor, industrial power factor and industrial potential factor.

Calculation steps: $F = 0.5145F_1 + 0.2531F_2 + 0.1103F_3$.

$$F_k = \sum_{i=1}^{9} \lambda_{ki} \times Y_i$$

F_k is the value of the *k-th* principal component; λ_{ki} is the factor load of the i index on the k principal component, and Y_i is the normalized value of the i index. The comprehensive scores and rankings of Jiangsu, Zhejiang, and Shanghai service outsourcing industries from 2013 to 2017 are calculated as shown in Table 6.

According to the comprehensive scores and rankings of service outsourcing industries of Jiangsu, Zhejiang, and Shanghai from 2013 to 2017 calculated in Table 6, it can be seen that the comprehensive scores of service outsourcing industries of the three provinces show an increasing trend in terms of time, which fully reflects the good development trend of service outsourcing industries in the Yangtze river delta region. Comparing the rankings of Jiangsu, Zhejiang, and Shanghai, it can be found that the comprehensive scores of service outsourcing industries of Jiangsu province have always been ahead of those of Zhejiang and Shanghai. In the increasingly fierce industrial competition, the service outsourcing industry in Jiangsu province has become the leader of the whole Yangtze River Delta region.

4 Summary and Thinking

4.1 Status and Challenges

1. Intensified internal and external competition

Although the service outsourcing industry in the Yangtze River Delta has a large number of enterprises and a large number of employees, it has a high degree of

homogeneity, mainly concentrated in animation, software, finance, medicine, and other industries. The internal competition is increasingly fierce and lacks innovation and difference. India has an absolute advantage in human costs. According to relevant data, India's service outsourcing industry will save at least 50% of the cost for the world's multinational companies, which is an important reason why India's outsourcing industry is favored by the world's multinational companies.

2. Financing Difficulties for Service Outsourcing Enterprises

According to statistics, more than 90% of service outsourcing enterprises in the Yangtze River Delta region are emerging small and medium-sized enterprises. In small and medium-sized enterprises, due to their weak credibility, it is generally difficult to gain the trust of banks and investment institutions. Even if they can obtain financing, the amount of funds is very limited. Therefore, financing difficulty and expensive financing are common phenomena in the service outsourcing industry, which are also important factors restricting the further development and technological innovation of outsourcing enterprises.

3. Impact of Artificial Intelligence on Service Outsourcing Industry

With the continuous progress of Artificial Intelligence, it is not impossible for many traditional services in the service outsourcing industry to be replaced by intelligent robots in the future, which is also the inevitable trend of industrial transformation and upgrading. In the service outsourcing industry, the pace of development is fast, and the innovation ability of enterprises is crucial. Only a timely transformation can seize a piece of space in the fierce market competition.

4.2 Countermeasures and Suggestions

Because of the current development situation and challenges in the Yangtze River Delta region, this paper will give relevant suggestions from the aspects of talents, financing and industrial environment.

1. Strengthen talent training and introduction

Talent is the most critical factor in the outsourcing industry, which is different from other traditional resource-based industries. In the service outsourcing industry, talent represents the core competitiveness of enterprises. Therefore, colleges and universities should vigorously strengthen the training of outsourcing talents, establish and improve the professional skills training of service outsourcing. Besides, service outsourcing needs more practice and should increase the investment in the construction of service outsourcing practice bases to realize the seamless connection between college training and enterprise application. At the same time, the government should issue corresponding supporting policies, build a better development platform for talents, connect with the international community, strive

to attract international talents based on preventing brain drain, and establish an international service outsourcing talent network.

2. Guarantee Funds, Form Industrial Scale and Build Brand Enterprises

Most of the service outsourcing enterprises in the Yangtze River Delta are small and medium-sized enterprises, which are small and scattered and lack influential leading enterprises. Therefore, it is difficult to contract large orders. The government should issue corresponding financial support policies to reduce the pressure on small and medium-sized enterprises and set up special funds to promote the development of small and medium-sized enterprises. For example, Wuxi has set up a special fund of 1.5 billion yuan, Suzhou and Hangzhou will invest a special fund of 100 million yuan every year to guarantee the financing of small and medium-sized outsourcing enterprises. Banks and financial institutions should also vigorously support the loans of enterprises, promote the formation of industrial-scale in the service outsourcing industry, change the current situation of operating independently, and strive to build brand enterprises with international competitiveness and improve their visibility.

3. Strengthen infrastructure construction and optimize industrial structure

The service outsourcing industry has very high requirements for the perfection of infrastructures, such as geographical conditions, logistics, and transportation, information network, labor force, etc., which will be directly linked to costs. The level of the cost will directly determine the development advantages of the industry. Experts point out that in the Yangtze River Delta region, service outsourcing enterprises in Nanjing, Shanghai, Hangzhou, and other cities have higher costs, while Suzhou and Changzhou have obvious advantages in costs. Therefore, the government can integrate enterprise resources, build a service outsourcing industry demonstration park, and improve the supporting construction of the industrial environment to reduce the costs of enterprises. At the same time, to optimize the industrial structure, enterprises must be innovative and constantly open up new markets to avoid internal homogeneous competition.

4. Vigorously support related and supporting industries

The development of service outsourcing industry is inseparable from related and supporting industries. Therefore, in the future industrial development, the government should vigorously support manufacturing, information technology, transportation, finance and other related supporting industries, improve the industrial layout, strengthen industrial cooperation, appropriately relax the industrial threshold, let more resources and service outsourcing industries develop, realize resource sharing among provinces and cities, build an internationally influential service outsourcing industrial cluster, and continuously enhance the comprehensive competitiveness of the service outsourcing industry in the Yangtze River Delta region.

5. Strengthen market supervision and improve relevant laws and regulations

Service outsourcing industry is a modern high-end service industry. With the rapid development of the industry, many problems and loopholes in market supervision have been exposed, the most obvious of which is the protection of intellectual property rights. Therefore, the government must improve the relevant laws and regulations, strengthen the protection of intellectual property rights, reduce property disputes, and establish a safe and healthy market environment, so that the service outsourcing industry can develop healthily and stably.

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