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SERVICE OUTSOURCER SELECTION BASED ON INDIVIDUAL INFORMATION AND COLLABORATIVE INFORMATION

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Abstract

Outsourcing have been paid many attentions along with the intense market competition of service industry growth. A suitable pattern for enhancing outsourcer selection is crucial for service industry development. This study proposed a service outsourcer selection method to solve the service outsourcer selection problem based on individual information and collaborative information. The individual information and collaborative information for service outsourcer selection is described by using individual matrix and collaborative matrix. The multi-index decision method is set up for service outsourcer selection which considering both of individual information and collaborative information, and the integrated value of service outsourcers are calculated by synthesize individual evaluation and collaborative evaluation. Finally, an illustrative example is given to illustrate the potential application of the proposed method.

Keywords: Management; Marketing; Service Outsourcer Selection; Individual Information; Collaborative Information

Introduction

Along with the intense market competition, service industry has rapidly developed. The outsourcing is applied by more and more enterprises as a pattern for enhancing their development speed [17]. At present, plenty of

research studies could be found on service outsourcing vendor selection [1,14,25,26,31]. For example, Ceyhun proposed a service outsourcing vendor selection method by using fuzzy goal programming [21], Maggie took AHP method to select a service outsourcing vendor for a telecommunications system [32], Wang develop fuzzy TOPSIS approach to select service outsourcing vendor [6]. The existing methods illuminate our research greatly. However, the outsourcing details require the joint effort of more than just one outsourcing partner sometimes, such as the production outsourcing of wheels which needs the service outsourcers for producing wheels, steel rings and bearings. Aiming at this type of outsourcing business, the corporation should be able to select the best service outsourcer among multiple service outsourcers as cooperation partner and the service outsourcer will subcontract the tasks that unable to complete without others. Based on the delegate model of outsourcing, in order to select the best service outsourcer, the corporation has to consider their individual performance as well as their collaborative performance with other service outsourcers. Few existing researches consider both individual and collaborative information situation.

This paper presents a service outsourcer selection method considering both individual information and collaborative information. An evaluation matrix of service outsourcing business collaboration performance for service outsourcing providers has been proposed. With application of different initial information, this study further includes personal performance evaluation information and collaborative performance evaluation information. According to the difference of initial information, a comprehensive evaluation method based on individual performance coordination performance is given.

Literature Review

Choosing the right partner will play a very important role in improving the performance of collaborative innovation and overall operation of all the enterprises in the alliance [6,18,24]. At the same time, as one of the basic activities that constitute the supply chain, the choice of partners affects the immediate interests of every member of the chain, and the choice of the appropriate or not mainly by the evaluation of candidate partners to determine the accuracy or not. Therefore, it is extremely important if studies could pay more attention to subjects including reorganization, evaluation and selection of supply chain partners.

Scholars have taken different view of the relationship of supply chain partnerships. Maloni et al. consider supply chain partnerships as a relationship between two separate entities in a supply channel that achieve specific goals and benefits. This relationship can normally improve each member's financial and business performance by reducing overall costs, inventory, and increasing the level of information sharing [22]. Macbeth and others believe that the establishment of a close and long-term partnership with suppliers is in order to ensure the most likely commercial advantage [2]. Rackham sees real business change as a shift in the way organizations work together to create value rationally and companies issue new ways of collaborating to work together to achieve

unprecedented levels of dynamism and competitiveness. This new relationship is called "partnership" [16]. Robert J. Vlkurka et al. Point out that partnership is a long-time commitment and agreement between buyers and suppliers that includes information sharing and sharing of the benefits and risks associated with partnerships, that is, the notion of partner must be based on cooperation and trust [27].

Further, the selection of strategic partners should comprehensively analyze various factors such as the strength of the partners, consistency with the business strategy of the enterprise and the history of cooperation in the past, including the basic information of cooperative enterprises, previous cooperation information and product information. Past service information and environmental information of cooperative enterprises. Each category can be subdivided according to the actual situation to form a comprehensive evaluation index system for supply chain partners. As for the selection criteria of strategic partners in the supply chain, both domestic and foreign experts and scholars have conducted extensive and in-depth research and obtained some valuable achievements. Weber et al. Studied 74 articles related to supplier selection since 1996, and proposed 23 standards such as quality, delivery, price and attitude [28]; Dickson proposed a wider range of 50 standards [4]. Professor Ma Shihua led his students to study the main factors to be considered when choosing strategic partners [11,12]; Wang Han, Huang Ming and other scholars also conducted research and exploration in this respect, put forward their own supply chain strategic partner choice Evaluation system [30].

Literatures [9,10] has put forward the steps to establish a partnership. Ma Xin and other partners [15] proposed a four-stage process of establish a partnership. As business practices deepen their dynamic alliance, more and more enterprises will disclose their strengths and advantages in a dedicated enterprise network. The core enterprises will find many outstanding enterprises to choose from. When facing a large number of potential partners, in order to reduce the workload of evaluation, core enterprises should first reduce the number of candidate partners to a suitable range through a fast filtering method, for example, using a qualitative screening plan Method, advantage method, satisfaction value method or logic sum method [13] Second, the core enterprises can take a quantitative and comprehensive evaluation method to further reduce the number of suppliers. At this stage, how to effectively integrate a large number of partners' selection criteria will become a major issue. At present, most of the research work is focused on this stage. Third, an optimal composition should be established in such a way that according to a certain criterion, the number of suppliers will be reduced to the optimal number and a formal partnership will be established. At this stage there is no common method and need to be structured according to actual problems.

Chen et al [3] think it is necessary to distinguish between the two basic stages of the process of partner selection and evaluation static evaluation stage and dynamic evaluation stage. In the daily operation of the supply chain, the core enterprises should keep track of the performance of suppliers, establish corresponding evaluation mechanism and increase or reduce the num-

ber of partners at any time according to the changes of market conditions and opportunities. However, some partners can be selected in the first two phases of the first three phases, while some of the key ones have to go through all three of the above stages before they can be truly identified. Especially in the selection of suppliers of key components, supplier capabilities and past performance records will be an important reference.

It can be seen from the above literature that the evaluation index system must comprehensively reflect the comprehensive level of the evaluation objects and include all aspects of the development prospects of the enterprise. At the same time, the size of the evaluation index system must be appropriate, and the setting of the index system should be scientific. If the index system is too large, the index system is too many levels and the indicators are too small, the evaluator's attention will be diverted to minutiae, affecting the objective and fair evaluation. If the index system is too small, indicators too coarse, but also can not reflect the true level of evaluation object. Flexible and operational principle. The evaluation index system should be flexible enough so that the evaluation subject can be applied according to its own characteristics and actual conditions. Supply chain strategic partner evaluation index system should include the strategic value of partners, business value, willingness to cooperate and comprehensive ability.

Many evaluation methods of strategic partners in supply chain have been used in practice. Except for the most commonly used methods are intuitionistic judgment, ABC cost analysis and analytic hierarchy process, such evaluation methods as genetic algorithm, neural network algorithm and game method are also proposed. Schinnar proposed to solve the supplier selection problem by using data envelopment analysis model with only input indicators [20]. He turns the supplier output index into the smaller and better representation, which is consistent with the characteristics of inputs in the production process. Therefore, it is more appropriate to use the DEA model with only input index to solve the selection problem. Roodhoft & Konings proposed a job-based costing approach to supplier selection and evaluation [19], which chooses the best supplier from a group of suppliers for a single order.

On the basis of activity-based costing, Wang analyzed the general model of using activity-based costing when evaluating and selecting suppliers. Analyzes the applicability of ABC in evaluating and selecting suppliers and analyzes the general framework of DSS based on ABC in supplier evaluation and selection. lsao Shiromaru et al. used fuzzy theory to deal with the fuzzy objective problem in supplier selection. The fuzzy model is built by taking the coal procurement in Japan's power plant as an example, and the genetic algorithm is used to solve the model [23]. However, due to the particularity of the enterprise and the uncertainty of the environment, the fitness function f (x) Naturally, the results obtained are not convincing. Weber and Current use the multi-objective linear programming model to select suppliers that target price, quality, delivery, supplier capacity, needs, policies, funding, Supplier number, etc. [29]. Manoj Kumar used fuzzy opti-

mization theory to select suppliers and set up the constraints in three aspects: the minimum net cost, the maximum satisfaction and the minimum delay time [8]. Joe Zhu used two buyers and sellers Stage game model to simplify the DEA method and establish an efficiency interval to choose suppliers [33]. Huang and Zhao proposed a AHP / random DEA method of supplier selection. Through the introduction of random variables, it solves the shortcomings of weight selection in data envelopment analysis, and chooses the supplier process Subjective judgment into a credibility judgment, improve the reliability of the supplier evaluation [7]

Although above researches have done an intensive research on identification of factors and evaluation of index system of suppliers. And they also pay some attentions to the steps of build partnership and the evaluation methods as well. Previous studies are mainly based on individual information without consideration of collaborative information. The outsourcing details require the joint effort of more than one outsourcing partner sometimes, such as the production outsourcing of wheels which needs the service outsourcers for producing wheels, steel rings and bearings. Aiming at this type of outsourcing business, the corporation has to select the best service outsourcer among multiple service outsourcers as cooperation partner and the service outsourcer will subcontract the tasks that unable to complete without others.

In order to select the best service outsourcer, the corporation has to consider their individual performance as well as their collaborative performance with other service outsourcers. Only few existing researches consider individual and collaborative information [5].

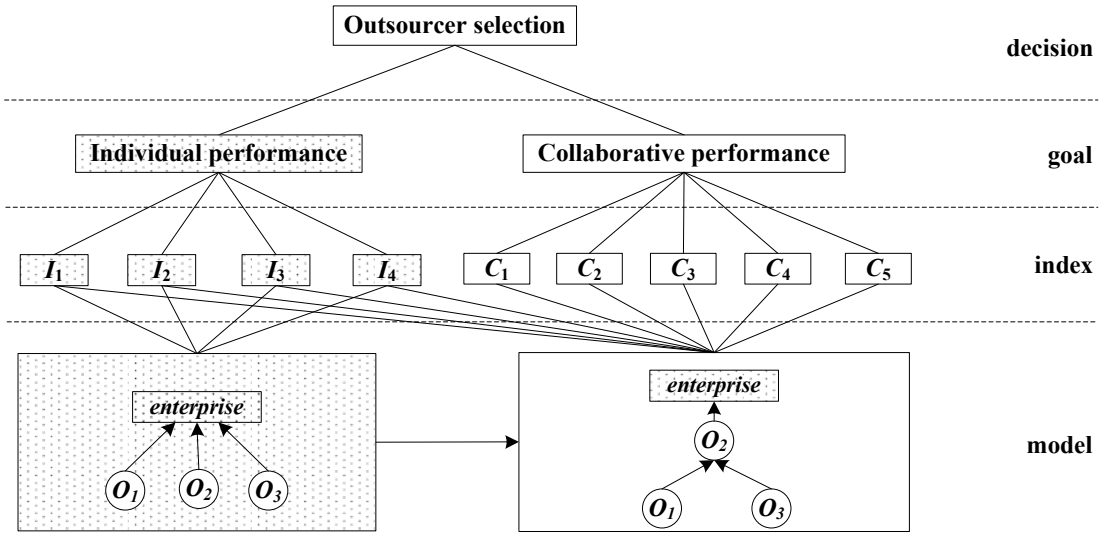
The lack of consideration of both individual information together with collaborative information on service outsourcer selection allow this paper to propose a service outsourcer selection method reflecting both individual information and collaborative information with suggested an evaluation matrix of service outsourcing contractors' performance. It used different initial information, including personal performance evaluation information and collaborative performance evaluation information, and according to the difference of initial information, proposed a comprehensive evaluation method based on individual performance coordination performance.

Index System of Service Outsourcer Evaluation

According to above studies, there has to be a serious consideration of the corporation with the individual performance as well as collaborative performance when selecting service outsourcers. In order to further clarify the evaluation index for service outsourcer based on individual performance and collaborative performance, this paper also presents a framework for service outsourcer evaluation index in figure 1. In the frame, 5 alternative service outsourcers are taken as examples to describe the problem.

The framework shown in Figure 1 includes four layers: goals, sub-goals, index and program. Brief descriptions of each layer are as follows:

Figure 1. A framework for service outsourcer selection



Decision: select the service outsourcer that the corporation expects in a set of service outsourcers

Goals: it includes individual performance and collaborative performance, meaning that in order to achieve the goal of decision analysis, it is necessary to consider these two goals.

Index: aiming at the 2 goals of decision analysis, it can effectively measure the property and criteria of individual performance and collaborative performance.

Model: it refers to the 3service outsourcers. In the left rectangle frame, the measurement of individual index information is in connection with the single model of outsourcing. In the right frame, the measurement of collaborative index information is aiming at the delegate model of outsourcing.

(Editor's Note: the following sections use single column format to facilitate easier viewing of the mathematical formulas.)

Decision Analysis Method

Symbols and Problem Description

To facilitate the analysis, the following symbols are used to describe the involved sets and amounts when considering the service outsourcer selection of index collaborative information.

- $U = \{U_1, U_2, \ldots, U_m\}$: set of alternative service outsourcers ($m \geq 2$), wherein, U_i refers to the service outsourcer. $i \in \{1, 2, \ldots, m\}$.
- $C = \{C_1, C_2, \ldots, C_n\}$: set of individual evaluation index of service outsourcers ($n \geq 2$),

wherein, C_j refers to the *j* th index. $j \in \{1,2,\ldots,n\}$.

- $C' = \{C'_1, C'_2, \ldots, C'_h\}$: set of collaborative evaluation index of service outsourcers ($h \geq 2$), wherein, C'_k refers to the k th index, $k \in \{1,2,\ldots,h\}$.

- $W = (w_1, w_2, \ldots, w_n)^T$: weight vector of individual evaluation index, wherein, w_j refers to the *j* th weight of individual evaluation index, and satisfies $0 \leq w_j \leq 1$, $\sum_{j=1}^{n} w_j = 1$, $j \in \{1,2,\ldots,n\}$. The vector W can generally be given by the expert group directly or AHP method.

- $W' = (w'_1, w'_2, \ldots, w'_n)^T$: weight vector of collaborative evaluation index, wherein, w'_k refers to the k th weight of collaborative evaluation index, and satisfies $0 \leq w'_k \leq 1$, $\sum_{k=1}^{h} w'_k = 1$, $k \in \{1,2,\ldots,h\}$. The vector W' can generally be given by the expert group directly or through AHP method.

- $L = \{L_0, L_1, ..., L_t\}$: set of language phrases, wherein, L_q refers to the q th language phrase, $q \in \{0,1,\ldots,t\}$.

- $P = [p_{ij}]_{m \times n}$: individual index evaluation matrix, wherein, p_{ij} is the evaluation information given by the expert group according to the actual performance of alternative service outsourcers V_i at the index C_j, $p_{ij} \in L$, $i = 1,2,\ldots,m$, $j = 1,2,\ldots,n$.

- $P'_k = [p_{ifk}]_{m \times m}$: collaborative index evaluation matrix, wherein, p'_{ifk} is the evaluation information given by the expert group according to the actual performance of alternative service outsourcers V_i at the collaborative index C'_k, $p'_{ifk} \in L$, $i = 1,2,\ldots,m$, $f = 1,2,\ldots,m$, $k = 1,2,\ldots,h$.

The problem that needs to be solved in this chapter in regards to the delegate model of outsourcing is how to select the ideal service outsourcer from the alternative service outsourcers set U based on the individual and collaborative evaluation information given by the expert group.

The matrix form of collaborative information

To clear the individual evaluation information and collaborative evaluation information, this paper used the matrix form to show. The individual information can be used in the traditional decision matrix as formula 1, where p_{ij} describe the result of service outsourcer U_i in individual index

C_j, $i = 1,\ldots,m$; $j = 1,\ldots,n$.

$$P=[p_{ij}]_{m\times n}=\begin{array}{c} \\ U_1 \\ U_2 \\ \vdots \\ U_m \end{array}\begin{array}{c} \begin{array}{cccc} C_1 & C_2 & \cdots & C_n \end{array} \\ \begin{bmatrix} p_{11} & p_{12} & \cdots & p_{1n} \\ p_{21} & p_{22} & \cdots & p_{2n} \\ \vdots & \vdots & \ddots & \vdots \\ p_{m1} & p_{m2} & \cdots & p_{mn} \end{bmatrix} \end{array} \quad (1)$$

At the same time, collaborative information was described by reach ability matrix as formula 2：

$$P'_k=[p_{ifk}]_{m\times m}=\begin{array}{c} \\ U_1 \\ U_2 \\ \vdots \\ U_m \end{array}\begin{array}{c} \begin{array}{cccc} U_1 & U_2 & \cdots & U_m \end{array} \\ \begin{bmatrix} p_{11k} & p_{12k} & \cdots & p_{1mk} \\ p_{21k} & p_{22k} & \cdots & p_{2mk} \\ \vdots & \vdots & \ddots & \vdots \\ p_{m1k} & p_{m2k} & \cdots & p_{mmk} \end{bmatrix} \end{array} \quad (2)$$

where, p_{ifk} describe the result of service outsourcer U_i with U_f in collaborative index C'_k, $i=1,\ldots,m$； $f=1,2,\ldots,m$, $k=1,2,\ldots,h$ .Without loss of generality, This assumes $p_{ifk}\geq 0$, bigger value of p_{ifk} means better performance of the collaboration between U_i and U_f . $p_{ifk}="-"$ means service outsourcer U_i with himself. For considering service outsourcer selection problem with collaborative index information, further description information form is showing in the following table 1.

Table 1. Information of collaboration and individual

individual information					collaborative information								
					C'_1				……	C'_h			
	C_1	C_2	…	C_n	U_1	U_2	…	U_m	……	U_1	U_2	…	U_m
U_1	p_{11}	p_{12}	…	p_{1n}	p_{111}	p_{121}	…	p_{1m1}	……	p_{11h}	p_{12h}	…	p_{1mh}
U_2	p_{21}	p_{22}	…	p_{2n}	p_{211}	p_{221}	…	p_{2m1}	……	p_{21h}	p_{22h}	…	p_{2mh}
	⋮	⋮		⋮	⋮	⋮		⋮		⋮	⋮		⋮
U_m	p_{m1}	p_{m2}	…	p_{mn}	p_{m11}	p_{m21}	…	p_{mm1}	……	p_{m1h}	p_{m2h}	…	p_{mmh}

Transform Collaborative Information

According to the individual evaluation index and collaborative evaluation index, expert convenient language phrases are given in the form of evaluation information, because they can effectively deal with qualitative statement which cannot be well defined conditions. Language variables can be transformed into fuzzy number. The triangular fuzzy number is usually used. In addition, in order to obtain the sort of the projects by value, the fuzzy number is usually mapping for a clear value. $P=[p_{ij}]_{m\times n}$ and $P'_k=[p_{ifk}]_{m\times m}$ transform into triangular fuzzy number $\hat{P}=[\hat{p}_{ij}]_{m\times n}$ and $\hat{P}'_k=[\hat{p}_{ifk}]_{m\times m}$ by using formula 3 ,where $\hat{p}_{ij}=\left(p_{ij}^L,p_{ij}^M,p_{ij}^R\right)$, $\hat{p}_{ifk}=\left(p_{ifk}^L,p_{ifk}^M,p_{ifk}^R\right)$.

$$\tilde{L}_q=(L_q^1,L_q^2,L_q^3)=\left(\max\{(q-1)/t,0\},q/t,\min\{(q+1)/t,1\}\right),\quad q\in\{0,1,\ldots,t\} \quad (3)$$

The triangular fuzzy number transform into clear numerical for ease of processing,

For any triangular fuzzy number $h=(\alpha,\beta,\gamma)$,let the clear numerical be $h^{'}$, $h=(\alpha,\beta,\gamma)$ can be transformed into $h^{'}$ by using formula 4 as follow:

$$h^{'}=(\alpha+2\beta+\gamma)/4 \quad (4)$$

$\hat{p}_{ij}$ can be transformed into $\overline{p}_{ij}$ by using formula 5.

$$\overline{p}_{ij}=(\hat{p}_{ij}+2\hat{p}_{ij}+\hat{p}_{ij})/4 \quad (5)$$

As the same, $\hat{p}_{ifk}$ can be transformed into $\overline{p}_{ifk}$ y using formula 6.

$$\overline{p}_{ifk}=(\hat{p}_{ifk}+2\hat{p}_{ifk}+\hat{p}_{ifk})/4 \quad (6)$$

Through the above calculation, language forms of assessment information given by experts in individual performance and collaborative performance can be transformed into clear numerical. This chapter provide decision-making basis for service outsourcer evaluation.

Comprehensive Evaluation Value Of Service Outsourcer

To appoint service outsourcer sorting, need to rally all service outsourcer individual performance and collaborative performance, specifically, the evaluation information of individual evaluation index can be gathered through the formula 7 on, the. Get the individual value x_i of U_i.

$$x_i=\sum_{j=1}^{n} w_j\overline{p}_{ij}\ ,\ j=1,\ldots,n \quad (7)$$

And then, get integrated collaborative evaluation matrix through the formula 8, where, y_{if} delegate the integrated performance value of service outsourcer U_i and U_f in h collaborative index.

$$y_{if}=\sum_{k=1}^{h} w_k'\overline{p}_{ifk}\ ,k=1,\ldots,h \quad (8)$$

integrated collaborative evaluation y_i of service outsourcer U_i with other service outsourcers can be calculated as follow：

$$y_i=(1/m)\otimes[y_{i1}\oplus y_{i2}\oplus\cdots\oplus y_{im}],\quad i=1,\cdots,m \quad (9)$$

In order to get the comprehensive evaluation value of the service outsourcer, synthesize comprehensive evaluation value of individual performance and the comprehensive evaluation value of collaborative performance comprehensively. Considering preference of decision makers to individual performance and collaborative performance is different, the importance of collaborative performance and individual performance α and β are given. The comprehensive evaluation value of the service outsourcer from formula 10 as follow:

$$\varphi_i=\alpha x_i+\beta y_i,\quad i=1,\cdots,m \quad (10)$$

According to the comprehensive evaluation value φ_i, service outsourcer sequence can be got, and choose the ideal alternation.

Illustrative Example

To coincide with the new development strategy layout, a company of wheel production outsourcing looks for professional contractors. Service outsourcers known as individual evaluation index set include professional level (C1), industry influence (C2), cooperation experience (C3), organization scale (C4) and integrity (C5), strategic consistency (C6), development potential (C7) and quality of employees (C8). Collaborative evaluation index set include resource complementary (C_1'), overlapping knowledge base (C_2'), consistency motives (C_3'), technical compatibility (C_4') and harmonious culture (C_5'). The index weight vectors given by expert team is $W' = (0.20, 0.1, 0.30, 0.20, 0.20)^T$, $W = (0.10, 0.18, 0.14, 0.12, 0.12, 0.08, 0.10, 0.16)^T$ .Expert group company after several rounds of discussion that comprehensive performance of the individual and collaborative integrated performance weight value of 0.5, namely $\alpha = 0.5$, $\beta = 0.5$. Company adopted by the expert panel language phrase set for L={L_0=VL(very low), L_1=L(low), L_2=M(medium), L_3=H(high), L_4=VH(very high)}.

Expert group according to the seven alternative service outsourcers in 8 individual evaluation indexes and five collaborative research situations of evaluation of actual performance language phrases form the index assessment information are given. By formula (5.1), the phrase language forms of assessment information are transformed into triangular fuzzy Numbers. By formula (6.3) - (6.5), the triangle fuzzy numbers are transformed into clear values. By formula (6.6) - (6.9), calculate the service outsourcer comprehensive performance of the individual and collaborative integrated performance value and final value. Details are shown in table 2.

From Table 2 we can know the comprehensive evaluation value of service outsourcer U3 is the highest, so it is the enterprise most ideal service outsourcer. Here is a need of explanation is the different value of α and β will make sort results change. Such as when $\alpha = 0.8$, $\beta = 0.2$, service outsourcer U4 will be the best service outsourcer. According to the method, the enterprise managers focus on individual performance or collaborative performance according to enterprise strategic goals, and choose the best service outsourcer.

Table 2. The value of integrated performance

	U_1	U_2	U_3	U_4	U_5	U_6	U_7
x_i	0.67375	0.58375	0.48875	0.1525	0.585	0.355	0.2875
y_i	0.453571	0.4125	0.664286	0.491964	0.403571	0.541071	0.500893
φ_i	0.563661	0.498125	0.576518	0.322232	0.494286	0.448036	0.394197

Conclusion

This paper proposed a method for service outsourcer selection based on individual information and cooperative information. According to the fuzzy individual information and cooperative information given experts, the method described cooperative information by using matrix of cooperation, and determined the comprehensive evaluation value of each service outsourcer considering both individual information and cooperative information. Experimental results show that the proposed method can calculate the integrated value of each service outsourcer, which accurately provided a service outsourcer selection reference for the enterprise.

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