Research Article

Exploiting the Chain Convenience Store Supplier Selection Based on ANP-MOP Model

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The purchase cost of chain convenience stores accounts for a large proportion of the total cost. Enterprises are facing the problem of how to reasonably reduce the purchase cost while ensuring the quality of service. This paper first considers the uniqueness of chain convenience stores, draws on existing research results, and establishes an evaluation index system for chain convenience store suppliers through field research. Then, we use the principal component analysis method of selection to determine the weight of each index and make a preliminary ranking of the importance of chain convenience store suppliers. Secondly, according to the relevant weights determined by the network hierarchy method, the collected data are substituted into the multiobjective mathematical programming model to analyze the distribution of supplier procurement and calculate the procurement cost. The level of procurement expenditures accounted for by suppliers confirms the importance of suppliers. The results show that through the evaluation and ranking of suppliers and the effective management of suppliers according to the ranking results, not only the goal of cost minimization is achieved but also the reasonable service level is guaranteed, which is scientific.

1. Introduction

The beginning of the entire supply chain management is the selection of suppliers. Among all types of enterprises, the purchase cost of chain retail accounts for the largest total cost. The current research on supplier evaluation and selection in chain retail is not thorough enough. Especially in chain retail, the research on supplier selection based on the two major factors of procurement cost and service level, procurement allocation, and follow-up management is very much lacking [1–3].

Guo used AHP to conduct preliminary supplier selection and comprehensive supplier selection and determined its primary and alternative suppliers [4]. Liao and Zhang adopted the AHP-TOPSIS composite method to determine the weight of each index, thus constructing a standardized model for evaluating and selecting green suppliers for papermaking enterprises. And through the application of empirical examples, the feasibility of the way is verified, and an effective method is

provided for papermaking enterprises to choose green suppliers [5]. Zhou and Liao used the analytic hierarchy process (AHP) to calculate the weight of a total of 14 indicators in 5 categories, including green environmental indicators, and built an objective and operable supplier evaluation process [6]. Song used the AHP and took candy products as an example to conduct an empirical analysis of the supplier evaluation index system [7]. From the current research on the evaluation of supplier selection by scholars, most scholars still use AHP to construct the supplier index system; still, AHP cannot fully consider the interrelationship between the various index systems. More importantly, most of the scholars' evaluation and selection of suppliers is aimed at manufacturing companies, ignoring the high proportion of chain retail purchase costs in total costs [8–12].

From the existing supply chain management research, according to the current supply chain management research, there is not much research on the selection management of chain retail suppliers whose procurement costs account for the

total costs. Therefore, it is necessary to further explore the evaluation and selection of chain retail suppliers. This paper takes chain convenience stores in chain retail as an example to examine the evaluation choices of chain convenience store suppliers. The content of this paper is arranged as follows. In Section 2, ANP is described in detail and is used to construct, select, and determine the weight of the supplier's index system. In Section 3, firstly, MOP model is constructed based on ANP model; secondly, taking Rosen, the leader in chain convenience stores, as an example, the collected relevant data which are substituted into the MOP to determine the weight of its supplier evaluation index system and the allocation of procurement volume. The empirical results analysis is presented in Section 4, and a summary of this paper is given in Section 5.

2. ANP Model Construction

2.1. ANP Model Construction and Index Optimization. The elements $p_1, p_2, \dots, p_n$ are in the ANP control layer, and the elements $c_1, c_2, \dots, c_n$ are in network layer, where c_1 has elements $e_{i1}, e_{i2}, \dots, e_{in_i}$, where $i = 1, 2, \dots, N$. The criterion is the control layer p_s ($s = 1, 2, \dots, m$), and the secondary criterion is the element e_{jl} ($l = 1, 2, \dots, n_j$). The elements in the element group c_i are compared according to their influence on e_{jl} , and the judgment matrix [13, 14] is constructed under the criterion p_s , as shown in Table 1.

$$W_{ij} = \begin{bmatrix} w_{i1}^{(j1)} & w_{i1}^{(j2)} & \dots & w_{i1}^{(jni)} \\ w_{i2}^{(j1)} & w_{i2}^{(j2)} & \dots & w_{i2}^{(jni)} \\ \vdots & \vdots & \ddots & \vdots \\ w_{in_i}^{(j1)} & w_{in_i}^{(j2)} & \dots & w_{in_i}^{(jni)} \end{bmatrix}, \quad (1)$$

$$W = \begin{matrix} & \begin{matrix} C_1 & & C_2 & & C_N \end{matrix} \\ \begin{matrix} C_1 \\ C_2 \\ \vdots \\ C_N \end{matrix} & \begin{bmatrix} e_{11} & \dots & e_{1n_1} & e_{21} & \dots & e_{2n_2} & e_{N1} & \dots & e_{Nn_n} \\ e_{11} & \dots & e_{1n_1} & e_{21} & \dots & e_{2n_2} & e_{N1} & \dots & e_{Nn_n} \\ \vdots & \vdots & \vdots & \vdots & \vdots & \vdots & \vdots & \vdots & \vdots \\ e_{N1} & \dots & e_{Nn_n} & e_{21} & \dots & e_{2n_2} & e_{N1} & \dots & e_{Nn_n} \end{bmatrix} \end{matrix} \quad (2)$$

The weight vector is obtained by the characteristic-root method. Repeat the above steps to obtain the matrix record as shown in formula (1):

The column vector of here is the sorting vector of the influence degree of the element in the element. If the middle element is not affected by the middle element, then = 0. Repeat the above steps for $i = 1, 2, \dots, N$, $j = 1, 2, \dots, N$. Finally, the supermatrix under the criterion can be obtained as equation (2). There are m of these supermatrices, and they are all non-negative matrices.

TABLE 1: Judgment matrix between each element.

e_{ij}	$e_{i1}, e_{i2}, \dots, e_{in_i}$	Normalized feature vector
e_{i1}		$w_{i1}^{(ji)}$
e_{i2}		$w_{i2}^{(ji)}$
$\vdots$		$\vdots$
e_{in_i}		$w_{in_i}^{(ji)}$

2.2. Construction and Optimization of Evaluation Index System. On the basis of summarizing the research of scholars, a questionnaire was designed in combination with the characteristics of chain convenience stores; after distribution, recovery, and calculation, the evaluation index system of chain convenience store procurement suppliers was initially constructed [9–13] (as shown in Table 2).

In response to the initially constructed indicator system, a questionnaire on the importance of indicators was designed and distributed to multiple experts to score them. Then, the questionnaire was returned to the minimum and maximum statistics of all indicators, and mean and standard deviation were calculated. By comparing and analyzing the results, the criterion layer and the index layer are selected to obtain a new and more realistic index system [14–17], and then the data on the importance of the criterion layer and the index layer are sorted out.

Table 3 shows the mean and standard deviation of the importance scores of the five categories of indicators by respondents. It can be seen from the table that the mean (8.13) of the price factor is the largest, which is almost close to the maximum value of 9.00, which also shows that price is the most crucial consideration. Secondly, the larger mean is cooperation ability (7.31), which shows that the cooperation ability is also vital. The mean of technical ability (7.11) and the mean of cooperation ability (7.31) are very close in size, so they are even more important. However, the internal competitiveness (3.11) and external competitiveness (4.07) have a smaller mean.

The standard deviation of price factor, cooperation ability, and internal competitiveness is relatively small. It can be seen that the respondents have basically no objection to the importance of these three indicators, while the standard deviation of external competitiveness and technical ability is relatively large, indicating that interviewers have a specific difference in their opinions on the importance of these two indicators.

In the same way, the subdivision secondary indicators of other standard levels are shown in Table 4.

2.3. Establishment of the Index Weights for Supplier Evaluation Index System. The following only lists the evaluation data of one group of five groups of experts on the pairwise comparison matrix of the criterion-level indicators. The evaluation data of all indicators are directly input into the software for calculation [18–21]. The calculation results are shown in Table 5. The indicators of the standard level in the software are technical capabilities B_1 , cooperation capabilities B_2 , external competitiveness B_3 , internal competitiveness B_4 , and price factors B_5 .

TABLE 2: Evaluation index system for purchasing suppliers of chain convenience store.

Target layer	Criterion layer	Index layer	Indicator type
Supplier selection evaluation	Technical skills B1	Logistics facilities and equipment C1	Qualitative
		Information team processing ability C2	Qualitative
		Proportion of supply chain management professionals C3	Qualitative
		Scheme design ability C4	Qualitative
		Process integration capability C5	Qualitative
	Teamwork ability B2	Supply capacity C6	Qualitative
		Reliability C7	Qualitative
		After-sales service C8	Qualitative
		Delivery accuracy C9	Quantitative
		Quick response ability C10	Qualitative
	Internal competitiveness B3	Operating resources C11	Qualitative
		R & D capabilities C12	Qualitative
		Production management ability C13	Qualitative
		Organizational effectiveness analysis C14	Qualitative
		Operational capability C15	Qualitative
	External competitiveness B4	Market environment and competition C16	Qualitative
		Customer needs and feedback C17	Qualitative
		Economic environment C18	Qualitative
		Social environment C19	Qualitative
		Transportation cost C20	Quantitative
	Price factor B5	Product cost C21	Quantitative
		Storage cost C22	Quantitative
		Quality cost C23	Quantitative
		Out-of-stock cost C24	Quantitative

TABLE 3: Descriptive statistical analysis of criterion-level indicators.

	Technical skills	Teamwork ability	Internal competitiveness	External competitiveness	Price factor
Number	100	100	100	100	100
Minimum	4	5	2	3	7
Maximum	9	9	5	8	9
Mean (mean)	7.11	7.31	3.11	4.07	8.13
Standard deviation	0.877	0.803	0.810	1.143	0.802

TABLE 4: The optimized index system.

Target	Criterion layer	Index layer	Indicator type	Data sources
Supplier selection evaluation	Technical skills	Logistics facilities and equipment	Qualitative	Scoring by experts
		Proportion of supply chain management	Quantitative	Formula calculation
		Process integration capability	Qualitative	Scoring by experts
	Teamwork ability	Supply capacity	Qualitative	Scoring by experts
		Reliability	Qualitative	Scoring by experts
		Delivery accuracy	Quantitative	Formula calculation
	Internal competitiveness	Operating resources	Qualitative	Scoring by experts
		Production management ability	Qualitative	Scoring by experts
		Organizational effectiveness analysis	Qualitative	Scoring by experts
	External competitiveness	Customer needs and feedback	Qualitative	Scoring by experts
		Transportation cost	Quantitative	Formula calculation
		Storage cost	Quantitative	Formula calculation
	Price factor	Quality cost	Quantitative	Formula calculation
		Out-of-stock cost	Quantitative	Formula calculation

TABLE 5: Pairwise comparison matrix of expert group 1's evaluation of criterion-level indicators.

B_i	B_1	B_2	B_3	B_4	B_5	W_i
B_1	1	3	2	2	1/2	0.252
B_2	1/3	1	1	3	1/2	0.173
B_3	1/2	1	1	2	1/3	0.143
B_4	1/2	1/3	1/2	1	1/4	0.076
B_5	2	2	3	4	1	0.356

Note: the eigenvalue of the matrix is 5.200; the matrix consistency is 0.045 which is less than 0.1. Expert Group 1: = (0.252, 0.173, 0.143, 0.076, 0.356). Expert Group 2: = (0.220, 0.228, 0.099, 0.065, 0.388). Expert Group 3: = (0.187, 0.348, 0.063, 0.107, 0.295). Expert Group 4: = (0.241, 0.199, 0.118, 0.072, 0.370). Expert Group 5: = (0.241, 0.115, 0.076, 0.199, 0.369).

Expert Group 1: $w_i = (0.252, 0.173, 0.143, 0.076, 0.356)$

Expert Group 2: $w_i = (0.220, 0.228, 0.099, 0.065, 0.388)$

Expert Group 3: $w_i = (0.187, 0.348, 0.063, 0.107, 0.295)$

Expert Group 4: $w_i = (0.241, 0.199, 0.118, 0.072, 0.370)$

Expert Group 5: $w_i = (0.241, 0.115, 0.076, 0.199, 0.369)$

Using the geometric mean, the final weight of the B-level indicators can be determined as

$$u_j = \left[\prod_{i=1}^m w_i \right] \frac{1}{m}, \quad (3)$$

$$u_B = (0.231, 0.210, 0.105, 0.100, 0.354).$$

The same method is used to calculate the weighted hypermatrix of all indicators. From the limit matrix, all indicator weights between indicators can be obtained as shown in Table 6 and Figure 1.

The top seven indicators are product cost, out-of-stock cost, transportation cost, quality cost, delivery accuracy, supply capacity, and reliability.

3. MOP Model Construction

We establish a specific model for chain convenience store purchasing supplier selection and purchasing volume allocation.

3.1. Meaning of Symbols. The mathematical symbols of the following model are defined as follows:

(1) Two types of decision variables:

One is the allocation ratio x_{ij} ($0 < x_{ij} < 1$) of the purchased quantity when purchasing goods from each candidate supplier g_i ; the other is the variable $y_{ij} = 1$ that indicates whether the company purchases product j from a supplier g_i , if the company purchases product j from that supplier, then $y_{ij} = 1$, otherwise $y_{ij} = 0$, where i is the serial number of the supplier, $i = 1, 2, \dots, m$, j is the serial number of the purchased product, $j = 1, 2, \dots, n$.

(2) Parameter description:

c_j : the total amount of the company's purchase of product j during the planning period; u_{ij} : the minimum purchase cost required for the product j purchased by the supplier g_i ; k_{ij} : the maximum supply of product j provided by the supplier g_i ;

TABLE 6: Index weights of the index layer.

Name	Weighted value	Limit value
Logistics facilities and equipment	0.30647	0.04045
Proportion of supply chain management	0.28752	0.04076
Process integration capability	0.40601	0.04385
Supply capacity	0.35325	0.05102
Reliability	0.22543	0.05023
Delivery accuracy	0.42132	0.06102
Operating resources	0.54124	0.00731
Production management ability	0.45876	0.03621
Organizational effectiveness analysis	0.44676	0.00821
Customer needs and feedback	0.55324	0.03205
Transportation cost	0.22432	0.13385
Storage cost	0.33492	0.24137
Quality cost	0.21975	0.11265
Out-of-stock cost	0.22101	0.14102

FIGURE 1: Index weight distribution chart of the index layer.

n_i : the company can choose the number of suppliers; n : the number of products that the company intends to purchase; q_{ij} : the importance factor of the products provided by the supplier g_i ; j_{ij} : the product cost of buying j products from the

supplier g_i ; j_i : the company expects to limit the maximum cost of the supplier's product j ; t_{ij} : the out-of-stock cost when the g_i supplier provides the j product; t_j : the maximum out-of-stock cost when the company limits the g_i supplier to provide the j product; d_{ij} : the transportation of the j product purchased from the g_i supplier cost; d_j : the highest transportation cost of the company's purchase of j product limited by the g_i supplier; l_{ij} : the quality cost of the j product purchased by the g_i supplier; l_j : the highest quality cost of the company's limited g_i supplier j product; r_{ij} : g_i supplier j product delivery accuracy rate; r_j : represents the lowest delivery accuracy rate that the company expects supplier j 's product; e_{ij} : g_i supplier j 's product supply capacity; e_j : the company expects the minimum supply capacity of g_i supplier; n_{ij} : the reliability of the product provided by the supplier g_i ; n_j : indicates the lowest limit of the reliability of the product expected by the supplier g_i to provide j ; p_{ij} : the proportion of the purchase cost of the g_i supplier's purchase of j products.

3.2. Model Establishment. According to the concept and symbolic assumptions of cooperation with essential suppliers, the following MOP models for supplier selection can be established:

(1) Objective function:

$$\max Z_1 = - \sum_{i=1}^m \sum_{j=1}^n p_{ij} x_{ij}, \quad (4)$$

$$\max Z_2 = \sum_{i=1}^m \sum_{j=1}^n q_{ij} x_{ij}. \quad (5)$$

(2) Constraints:

St:

$$u_{ij} \leq c_j x_{ij} \leq k_{ij}, \quad (6)$$

$$\sum_{i=1}^m \sum_{j=1}^n f_{ij} x_{ij} \leq f_j, \quad (7)$$

$$\sum_{i=1}^m \sum_{j=1}^n t_{ij} x_{ij} \leq t_j, \quad (8)$$

$$\sum_{i=1}^m \sum_{j=1}^n d_{ij} x_{ij} \leq d_j, \quad (9)$$

$$\sum_{i=1}^m \sum_{j=1}^n l_{ij} x_{ij} \leq l_j, \quad (10)$$

$$\sum_{i=1}^m \sum_{j=1}^n r_{ij} x_{ij} \leq r_j, \quad (11)$$

$$\sum_{i=1}^m \sum_{j=1}^n e_{ij} x_{ij} \leq e_j, \quad (12)$$

$$\sum_{i=1}^m \sum_{j=1}^n r_{ij} x_{ij} \leq r_j, \quad (13)$$

$$\sum_{i=1}^m x_{ij} = 1, \quad (14)$$

$$x_{ij}(y_{ij} - 1) = 0, \quad (15)$$

$$x_{ij} \in (0, 1), \quad (16)$$

$$y_{ij} \in (0, 1). \quad (17)$$

(3) Formula meaning:

Formula (4): represents the lowest purchasing cost.

Formula (5): represents the amount of priority to purchase from g_i suppliers when purchasing product j .

Formula (6): the upper and lower limits of the ability of supplier g_i to provide products.

Formula (7): the product cost constraint when supplier g_i purchases product j .

Formula (8): the constraint of the out-of-stock cost when supplier g_i purchases product j .

Formula (9): the transportation cost constraint when supplier g_i purchases product j .

Equation (10): constraint of quality cost when g_i supplier purchases product j .

Equation (11): constraint on the delivery accuracy of product j of g_i supplier.

Formula (12): requirements for the supply capacity of g_i supplier j 's products.

Formula (13): g_i supplier provides product j reliability requirements.

Equation (14): when purchasing product j from the g_i supplier, y_{ij} must be 1.

4. Lawson Convenience Store Supplier Evaluation Selection

4.1. The Weight of Index System Determined Based on ANP Model. According to the indicator system constructed in the previous paper and the determination of related weights, the relevant data are substituted for the evaluation and selection of Lawson convenience store suppliers [22–26], and now 5 suppliers = (g_1, g_2, g_3, g_4, g_5) are screened and one is selected as a partner of the company; a tripartite group (p_1, p_2, p_3, p_4, p_5) is formed by a team of senior purchasers, a team of logistics managers, and a team of experts in related industries. The expert group decided to select the top seven indicators to evaluate the five suppliers. The weights of the tripartite experts in the decision-making are: senior purchaser team $\omega = 0.5$, logistics manager team $\omega = 0.3$, and related industry expert team $\omega = 0.2$. In the evaluation index, the evaluation data of five quantitative indicators come from 5 procurement suppliers, where product cost, out-of-stock cost, quality cost, and transportation cost are the ratios of the

average cost of the four products to the related expenses in the same industry, which are shown in Table 7 and Figure 2.

The tripartite experts score the supplier's performance under the qualitative indicators and the data of all qualitative indicators. The scoring adopts a nine-point system. The supplier's performance is represented by 9-1 from high to bottom. 9 points means very good, and 1 point represents

extremely poor performance. The larger the score, the better the performance.

The three-party experts' specific scores on the 5 candidates for selection and the final scores after calculation are shown in Table 8 and Figure 3.

The first step is to determine the weights. In the previous paper, the results of ANP have been obtained and the weights of the seven evaluation indicators are

$$W = (0.24137, 0.14102, 0.13385, 0.11265, 0.06102, 0.05102, 0.05023). \quad (18)$$

The second step is to construct an evaluation matrix of five procurement suppliers under seven evaluation indicators in the software.

The third step is to define the attributes of the index evaluation. For each evaluation index, define its evaluation attribute and construct the evaluation attribute matrix for pairwise comparison.

The fourth step is to sort the suppliers, input the final score value of each supplier, and further comprehensively calculate the corresponding ranking result: $g_1 > g_2 > g_5 > g_3 > g_4$, and you can get 5 purchases. The supplier's importance coefficient is $q = (0.23310, 0.23193, 0.18241, 0.17214, 0.21423)$.

4.2. Purchase Volume Allocated Based on MOP

4.2.1. Data Collection. There are too many types of chain convenience stores. Here, 4 of them are selected as an example [27]. Substitute the 5 buyers qualified in the preliminary selection and sorted into the model and calculate and evaluate further. The parameter values and evaluation information of each supplier's supply capacity and level and the parameter values required by retail enterprises for the supplier's supply capacity and level are shown in Tables 9 and 10.

4.2.2. Data Processing. According to the symbols established in formulas (4) to (17) and the supplier's importance coefficient established in the previous article, the MOP model that can be established is as follows:

$$\begin{aligned} \max z_1 &= (0.12x_{11} + 0.11x_{21} + 0.15x_{32} + 0.14x_{52} + 0.13x_{23} + 0.12x_{33} + 0.11x_{14} + 0.12x_{44}) \\ \max z_2 &= 0.233x_{11} + 0.232x_{21} + 0.18x_{32} + 0.214x_{52} + 0.232x_{23} + 0.182x_{33} + 0.233x_{14} + 0.138x_{44} \\ &9 \leq 20x_{11} \leq 15, 7 \leq 20x_{21} \leq 13, x_{32} \leq 10, 8 \leq x_{52} \leq 11 \\ &5 \leq 15x_{23} \leq 12, 5 \leq 20x_{21} \leq 13, 6 \leq 10x_{14} \leq 8, 4 \leq 10x_{44} \leq 5 \\ &6x_{11} + 4x_{21} \leq 7, 5x_{32} + 4x_{52} \leq 5, 3x_{23} + 3x_{33} \leq 6, 3x_{14} + 2x_{44} \leq 5 \\ &x_{11} + 0.5x_{21} \leq 1.2, x_{32} + 0.5x_{52} \leq 0.8, 0.5x_{32} + 0.5x_{33} \leq 1, 0.5x_{14} + 0.5x_{44} \leq 0.7 \\ &0.2x_{11} + 0.1x_{21} \leq 0.5, 0.2x_{32} + 0.1x_{52} \leq 0.4, 0.1x_{32} + 0.1x_{33} \leq 0.4, 0.1x_{14} + 0.1x_{44} \leq 0.3 \\ &0.9x_{11} + 0.95x_{21} \geq 0.95, 7x_{32} + 7x_{52} \geq 9, 8x_{32} + 6x_{33} \geq 9.7x_{14} + 6x_{44} \geq 8 \\ \text{s.t.} \quad &7x_{11} + 8x_{21} \geq 8, 7x_{32} + 6x_{52} \geq 9, 7x_{32} + 6x_{33} \geq 9.6x_{14} + 7x_{44} \geq 8 \\ &x_{11} + x_{21} = 1, x_{32} + x_{52} = 1, x_{23} + x_{33} = 1, x_{14} + x_{44} = 1 \\ &x_{11} \times (y_{11} - 1) = 0, x_{21} \times (y_{21} - 1) = 0, x_{32} \times (y_{32} - 1) = 0, x_{52} \times (y_{52} - 1) = 0 \\ &x_{23} \times (y_{23} - 1) = 0, x_{33} \times (y_{33} - 1) = 0, x_{14} \times (y_{14} - 1) = 0, x_{44} \times (y_{44} - 1) = 0 \\ &0 \leq x_{ij} \leq 1, 0 \leq y_{ij} \leq 1 \\ &i = 1, 2, \dots, 5, j = 1, 2, \dots, 4. \end{aligned} \quad (19)$$

TABLE 7: Five quantitative indicators of five suppliers.

	g_1	g_2	g_3	g_4	g_5
Storage cost	65%	60%	70%	58%	76%
Out-of-stock cost	60%	64%	65%	70%	66%
Transportation cost	60%	58%	60%	68%	59%
Quality cost	59%	67%	72%	55%	75%
Delivery accuracy	97%	96%	92%	92%	91%

FIGURE 2: Distribution map of five quantitative indicators of five suppliers.

TABLE 8: Specific scoring results of 5 candidate suppliers.

	g_1	g_2	g_3	g_4	g_5
Storage cost	8	7.7	6.3	3.8	6.5
Out-of-stock cost	7.7	6.8	5	4.5	7.1
Transportation cost	7.3	8	6.4	6.5	7
Quality cost	6.7	5.9	6	6.7	6.7
Delivery accuracy	6.6	7.3	5.7	6.2	6.5
Supply capacity	8.5	7.2	5.5	6.4	6.5
Reliability	7.1	6.8	6.4	5.7	7.1

4.2.3. *Solution.* According to the algorithm introduced in the previous paper, we can solve

$$\begin{aligned}
 z_1^* &= 49.1\%, \\
 x_{11} &= 0.427, \\
 x_{21} &= 0.573, \\
 x_{32} &= 0.516, \\
 x_{52} &= 0.484 \\
 x_{23} &= 0.785, \\
 x_{33} &= 0.215, \\
 x_{14} &= 0.548, \\
 x_{44} &= 0.452 \\
 y_{11} &= 1, \\
 y_{21} &= 1, \\
 y_{32} &= 1, \\
 y_{52} &= 1, \\
 y_{23} &= 1, \\
 y_{33} &= 1, \\
 y_{14} &= 1, \\
 y_{44} &= 1,
 \end{aligned} \tag{20}$$

and adopt $\lambda = 0.05$. Then, the above model can be further transformed into the following form:

$$\begin{aligned}
 \max z_2 &= 0.233x_{11} + 0.232x_{21} + 0.182x_{32} + 0.214x_{52} \\
 &\quad + 0.232x_{23} + 0.182x_{33} + 0.233x_{14} + 0.138x_{44}.
 \end{aligned} \tag{21}$$

The constraint condition is added on the original basis, namely:

FIGURE 3: Distribution of specific scoring results of 5 candidate suppliers.

TABLE 9: Parameter values and evaluation information for marking the supply capacity and level of each supplier.

Product serial number	Supplier	p_{ij} (%)	q_{ij} (%)	k_{ij} (ten thousand yuan)	u_{ij} (ten thousand yuan)	f_{ij} (ten thousand yuan)	t_{ij} (ten thousand yuan)	d_{ij} (ten thousand yuan)	l_{ij} (ten thousand yuan)	r_{ij} (%)	e_{ij}	n_{ij}
1	1	12	23.3	15	9	6	1	0.2	0.1	90	6	7
	2	11	23.2	13	7	4	0.5	0.1	0.1	95	8	8
2	3	15	22.3	10	8	5	1	0.2	0.12	90	7	7
	5	14	22.5	11	8	4	0.5	0.1	0.15	90	7	6
3	2	13	18.9	12	5	3	0.5	0.1	0.1	95	8	7
	3	12	19.2	8	5	3	0.5	0.1	0.12	90	6	6
4	1	11	21.5	8	6	3	0.5	0.1	0.05	90	7	6
	4	12	20.2	5	4	2	0.5	0.1	0.05	95	6	5

TABLE 10: The requirements of a retail company on the supply capacity of its suppliers.

Purchase products (ten thousand yuan)	c_j	f_j	t_j	d_j	r_j	e_j	l_j	n_j
1	20	7	1.2	0.5	95	8	0.5	8
2	12	5	0.8	0.4	92	9	0.3	9
3	15	6	1	0.4	95	9	0.2	9
4	10	5	0.7	0.3	95	8	0.3	8

$$0.12x_{11} + 0.11x_{21} + 0.15x_{32} + 0.14x_{52} + 0.13x_{23} + 0.12x_{33} + 0.11x_{14} + 0.12x_{44} \leq (1 - \lambda) \times 49.1\%. \quad (22)$$

The solution of the single objective mathematical programming model is

$$\begin{aligned} x_{11} &= 0.712, \\ x_{21} &= 0.288, \\ x_{32} &= 0.195, \\ x_{52} &= 0.805, \\ x_{23} &= 0.751, \\ x_{33} &= 0.249, \\ x_{14} &= 0.378, \\ x_{44} &= 0.622, \\ y_{11} &= 1, \\ y_{21} &= 1, \\ y_{32} &= 1, \\ y_{52} &= 1, \\ y_{23} &= 1, \\ y_{33} &= 1, \\ y_{14} &= 1, \\ y_{44} &= 1. \end{aligned} \quad (23)$$

5. The Data Analysis

From the above calculation results, it can be seen that the best procurement plan for the company when purchasing product 1 is to choose g_1 and g_2 suppliers, and the optimal procurement volume is 71.2% for g_1 and 28.8% for g_2 ; when the company purchases product 2, the best procurement plan is to choose g_3 and g_5 suppliers. The best procurement volume is 19.5% for g_3 and 80.5% for g_5 . The best solution for the company to purchase product 3 is to choose g_2 and g_3 as suppliers, and the optimal purchase quantity is 75.1% for g_2 and 24.9% for g_3 . The best solution for the company to purchase product 4 is to choose g_1 and g_4 as suppliers, and the optimal purchase quantity is 37.8% for g_1 and 62.2% for g_4 .

Based on the above analysis, the total procurement costs of these five suppliers are calculated as follows:

$$\begin{aligned} M(g_1) &= 0.712 \times 20 + 0.378 \times 10 = 19.02, \\ M(g_2) &= 0.288 \times 20 + 0.751 \times 15 = 17.025, \\ M(g_3) &= 0.195 \times 12 + 0.249 \times 15 = 6.075, \\ M(g_4) &= 0.622 \times 10 = 6.22, \\ M(g_5) &= 0.805 \times 12 = 9.66. \end{aligned}$$

Through the calculation of the procurement costs of the above suppliers, when the purchase cost is constant, the higher the company's purchase cost for a certain supplier,

the more transactions the supplier has with the company, and the more important it is to the company. [28–31], so it can be concluded that the order of the 5 suppliers to be selected is $g_1 > g_2 > g_5 > g_3 > g_4$. According to the situation of these 5 suppliers, a multiobjective mathematical programming model is established to calculate the distribution of the calculated purchase amount. From the above calculation results, it can be seen that the procurement expenditures of the 5 suppliers are basically in line with the importance of the suppliers in the previous section, and the amount is g , which accounts for 190,200 RMB, 170,250RMB, 60,750 RMB, 62,200RMB, and 96,600 RMB.

6. Conclusion

Reasonably reducing the purchase cost while ensuring the level of service quality is always a problem to be solved by chain convenience stores. This paper constructs ANP to select the chain convenience store supplier indicators, takes the Lawson convenience store as an example to collect relevant data, and combines the MOP to choose and rank Lawson chain convenience store suppliers. Then, the reasonable selection of Rosen's suppliers is carried out to determine the procurement allocation of each supplier, to provide a theoretical basis for the later maintenance of suppliers, which is helpful for the supervision and classification management of suppliers, ensuring the supply quality of suppliers, deepening the cooperation with suppliers, controlling the procurement cost, and effectively improving the service level and competitiveness of enterprises. Existing research has neglected the importance of suppliers and later management. This article considers the service level quality while considering the purchase cost, which has certain guiding significance for the development of modern enterprises. At the same time, it also verified that the established model is scientific and practical. With the continuous changes in consumer demand, multiple goals can be incorporated in the future to select and manage the suppliers of chain retail stores.

Data Availability

All of the underlying data supporting the results of this study are publicly available online and can be easily accessed.

Conflicts of Interest

The authors declare that they have no conflicts of interest.

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