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Study on Supplier Selection of GM Supermarket Chain

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Abstract

Supply chain management has attracted wide attention from scholars and industry in recent years. In the fierce business competition environment, enterprise organizations rely more on their supply chain as a source of competitive advantage.It is well known that suppliers play an important strategic role in the supply chain and have an impact on the supply chain and, to a large extent, they are involved in creating competitive advantages.Supplier selection needed to provide enterprises with products or services, it is an effective supply chain is one of key activities.In short, supplier evaluation and selection is an important enterprise strategic decision to reduce operating costs and improve the core competitiveness of the organization.In fact, the selection of suppliers requires the evaluation of multiple choice supplier selection schemes with the support of multiple evaluation indexes, which is a typical multi-attribute decision making problem.Questions about the choice of evaluation index, this paper on the basis of previous studies, according to the summary of the various indicators, select the actual enterprise GM supermarket chain indicators for the final after experts using Delphi method.Selection in the multiple attribute decision making method, this article chooses the hierarchy model of AHP to calculate the weight and TOPSIS ranking (close to ideal solution) to combine the final supplier selection method, the final will be the method used in the GM supermarket chain commodity P the supplier of choice.

Keywords

Chain supermarket; Supplier selection; AHP; TOPSIS method.

1. Introduction

In recent years, supply chain management has received extensive attention from scholars and the industry. In the fierce business competition environment, enterprises and organizations rely more on their supply chain as a source of competitive advantage.It is well known that suppliers play an important strategic role and influence the supply chain, and to a large extent, they are involved in creating a competitive advantage[1].Supplier selection is one of the key activities in establishing an effective supply chain.

In the context of supply chain management, it is particularly important for chain retail industry to establish a reasonable and efficient supplier evaluation system[2].Supermarket is an enterprise that adopts image, price, purchase, management, sales and service.For enterprise procurement, normal circumstances, a product needs to have one or more suppliers to meet the needs of the consumers, so for the enterprise, to find long-term cooperation supplier is very advantage, if supplier selection is undeserved, can appear goods quality problems such as instability, not timely delivery, for the supermarket chain's operation is very bad., on the other hand, the choice and stable supplier is a very difficult problem, because the supplier selection is usually a multiple attribute decision making problems, depending on the enterprise development stage and even sometimes involves several

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conflicting criteria, and the objective, the knowledge of the decision makers are often vague and imprecise, no decision makers can fully grasp all valid information about the all suppliers.For example, when enterprises need to carry out supplier relationship management in a certain stage of development, they need to carry out a series of behaviors such as supplier development, selection and evaluation.In order to develop suppliers, it is necessary to broaden the sources of supplier information. However, in reality, due to various restrictions, only one part of the approaches can be chosen, which leads to inaccurate information.Therefore, it is particularly important for supermarket chains to establish an effective supplier evaluation system.

Mentioned above supplier selection is a multi-attribute decision making problems, so choose a different supplier evaluation method, and the choice of different indicators and index weight and may not come to the same result, this article after comparing various methods to choose to use TOPSIS and AHP analysis hierarchy process method to carry out the construction of a model.

TOPSIS[3, 4] method was first proposed by C.L.Wang and K.OON in 1981.This method is to evaluate the relative merits of the existing indicators, Ideal (Ideal Solution), there are two, one is the Ideal Solution or the best target, and an Ideal target is no (negative Ideal Solution) or the worst of target, and the result of selection should be the best distance with recent goals recently, and the worst recent goal and the negative Ideal Solution, as long as can use distance calculation test distance, usually using Euclidean distance to measure.TOPSI method is a method of multi-attribute decision making, which is widely used in the fields of benefit assessment, health decision-making and health service management. Its advantage is that it has no special requirements for materials and is flexible and feasible.

AHP [5](The Analytic Hierarchy Process) was formally proposed by American operational research scientist T.L. Saaty in The mid-1970s. It can not only be used to make decisions on issues with strong subjectivity, but also can be used to make decisions with weak logicality and make important judgments based on feelings, which is highly practical.

This paper surrounding GM retail chains of supplier evaluation and selection problem, first according to the investigation and study, understand the relevant industry background, retail chains and related concepts of supplier evaluation, analysis of the classical theory and methods of the new trend in recent years, and then analyzes the choice of supplier evaluation method, namely the research method of evaluating suppliers in this article.The status quo of SUPPLIER evaluation of GM chain retail supermarket was analyzed again, and the evaluation index system was established through the relevant evaluation indexes used by the enterprise.Then, based on the above analysis, the supplier evaluation index system was constructed. According to the actual situation of the enterprise, TOPSIS and AHP were used to evaluate the suppliers of general supermarket chains and Excel was used to solve the model.Finally, based on the evaluation results, Suggestions are put forward for GM supermarket chain to select suppliers, which is conducive to the cooperation between the two sides and the development of the enterprise.

2. Problem description

2.1 GM Company Profile

As a medium-sized retail chain, GM provides hundreds of products and has thousands of corresponding suppliers. Therefore, GM needs and must do effective supplier management.At present, GM supermarket chain in order to win more market share, is pressing for a new round of supplier development.At this point, supplier evaluation becomes a key issue.With the advent of the information age, GM has greatly realized the ability to discover, research and jointly meet consumer demand with suppliers through the ERP system. On the ERP system platform, consumer demand and market data are Shared by both retailers and suppliers.In the relationship with suppliers, GM has done a very good job. However, in the selection of suppliers, it still follows the old methods. Under the background of the rapid development of information and the frequent replacement of information, trying to develop new evaluation methods will bring NEW business opportunities to GM.

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2.2 Principles of supplier selection

Supplier selection, should according to the principle of comprehensive specific choice, which is reasonably and objectively as possible to collect all related indicators, also considering the supplier's relative performance, equipment conditions, the enterprise human resources development situation, the product quality problems, cost budget and related technology development, customer satisfaction, delivery agreement may affect numerous indicators in the field of supply chain partnership.Practical experience shows that many successful enterprises should have clear goals, in-depth investigation and research, and a comprehensive understanding of the situation.Generally speaking, the selection of suppliers should follow the following principles:

(1) Target positioning principle

This principle is based on customer satisfaction and target group.In terms of target customer groups, we should select some product suppliers whose sales volume is favorable to the enterprise based on the previous sales data. These products meet the needs of the public and have considerable sales volume.In terms of customer satisfaction, we should choose suppliers with good evaluation, which in the final analysis are those with good product quality.Furthermore, the size and level of the supplier selected should be similar to that of the buyer, and the quantity purchased should not exceed 50% of the production capacity of the alternative supplier.For enterprises, against the supply of sufficient, so you can choose the best supplier of similar materials about 2 ~ 3 can, the rest can be undertaken by those small and medium-sized enterprises.

(2) The principle of complementary advantages

Each enterprise has its own advantages and disadvantages, so it should choose to develop the business and technical capabilities of suppliers to meet the expected requirements. Suppliers in some regions should have advantages stronger than procurement, and they can be complementary to some extent in future cooperation.Especially for the selection of core competitive products of enterprises, we should have a very clear understanding of suppliers' supply capacity and long-term cooperation.

(3) Employment principle based on merit

When choosing suppliers, various factors are usually taken into account. However, under the same price and delivery commitment, a person with a good corporate image is undoubtedly a supplier who can provide world-renowned enterprises for enterprises, and a reputable enterprise is more likely to fulfill its promise.

(4) The principle of common development

Nowadays, the market is becoming more and more competitive.The cooperation between suppliers and enterprises can only be successful if it is beneficial to both parties. If the development of one party does not cooperate with the development of the other party and the two parties have different demands for development, the cooperation will naturally lead to crisis.Therefore, enterprises and suppliers should pay close attention to the market and the development trend of cooperative companies at the same time, so as to increase the guarantee for the future cooperation between both sides.

3. Construct evaluation and selection system

3.1 Construct evaluation index system

By analyzing the actual situation of GM supermarket suppliers, the evaluation index system is established in this paper as shown in Table 3.1.This evaluation index is determined by GM supermarket according to the actual operating situation of the company, and several experts are invited to use Delphi method.The purpose of this paper is to study the supplier selection system suitable for GM chain supermarkets, so the indicators provided by enterprises are adopted.

P: The best supplier;

A: Enterprise environment;

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B: Profitability;

C: Performance Evaluation;

D: Development potential;

A1: Corporate ReputationA1;

A2: Brand influence;

B1：Gross margin ;

B2：Order quantity discount;

B3：Overdue goods processing ;

C1：Product quality;

C2：Delivery capacity ;

C3：Distribution capacity;

C4：Order processing time;

C5：After sales ;

D1：Information Capability;

D2：Facility equipment capability;

D3：Enterprise Development Plan.

Table 1 Evaluation index system

The target	Level indicators	The secondary indicators
Select *P*	A	A1
		A2
	B	B1
		B2
		B3
	C	C1
		C2
		C3
		C4
		C5
	D	D1
		D2
		D3

3.2 Construct supplier evaluation and selection system

Combining the evaluation index system and referring to the 1-9 scale method[7], the judgment matrix of each level index is obtained, and the analytic hierarchy process is used to analyze and calculate the corresponding index weight.

The judgment matrix composed of first-level indicators is as follows:

A: Enterprise environment;

B: Profitability;

C: Performance Evaluation;

D: Development potential.

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$$P=\begin{pmatrix}1 & 1/2 & 1/2 & 1\\ 2 & 1 & 1/3 & 2\\ 2 & 3 & 1 & 3\\ 1 & 1/2 & 1/3 & 1\end{pmatrix}$$

The judgment matrix formed by the secondary indexes is as follows:

$$A=\begin{pmatrix}1 & 2\\ 1/2 & 1\end{pmatrix}$$

$$B=\begin{pmatrix}1 & 3 & 5\\ 1/3 & 1 & 2\\ 1/5 & 1/2 & 1\end{pmatrix}$$

$$C=\begin{pmatrix}1 & 2 & 1 & 3 & 4\\ 1/2 & 1 & 2 & 2 & 3\\ 1 & 1/2 & 1 & 2 & 1\\ 1/3 & 1/2 & 1/2 & 1 & 1/2\\ 1/4 & 1/3 & 1 & 2 & 1\end{pmatrix}$$

$$D=\begin{pmatrix}1 & 1/2 & 1\\ 2 & 1 & 3\\ 1 & 1/3 & 1\end{pmatrix}$$

This paper USES the square root method to calculate the weight of each index.Take the calculation process of single ranking of first-level indicators as an example, the specific process is as follows:

(1) Calculate the geometric average value of each row of each judgment matrix ($\overline{W_i}$).

a_{ij}: The value of the ith row and JTH column in the original judgment matrix;

n: Index number

$\overline{W_i}$: The geometric mean of the ith row data of the original judgment matrix.

$$\overline{W_i}=\left(\prod_{j=1}^{n}a_{ij}\right)^{\frac{1}{n}} \quad \text{i, j =1,2, } \cdots\text{, n} \tag{1}$$

Thus:

$$\overline{W}=\begin{pmatrix}0.7071\\ 1.0746\\ 2.0598\\ 0.6389\end{pmatrix}$$

(2) The above results are normalized to obtain the eigenvector, namely the weight coefficient:

W_i: Denotes the weight of the 1th index.

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$$W_i = \frac{\overline{W_i}}{\sum_{j=1}^{n} \overline{W_j}} \quad \text{i, j =1,2, } \cdots \text{, n} \tag{2}$$

Get the weight of the first-level index:

$$W = \begin{pmatrix} 0.1578 \\ 0.2398 \\ 0.4597 \\ 0.1426 \end{pmatrix}$$

In order to ensure the validity of test data and results, consistency test is required for the judgment matrix, as shown below:

(1) Calculate the maximum eigenvalue of the judgment matrix.

$$\lambda_{\max} = \frac{1}{n} \sum_{i=1}^{n} \frac{(\sum_{j=1}^{n} a_{ij} W_j)}{W_i} \quad \text{i, j =1,2, } \cdots \text{, n} \tag{3}$$

This formula can be used to calculate the maximum eigenvalue of the judgment matrix of first-order indicators:

$$\lambda_{\max} = 4.1171$$

(2) Calculate consistency ratio (CR). The formula is as follows:

$$CR = \frac{CI}{RI} \tag{4}$$

$$CI = \frac{\lambda_{\max} - n}{n-1} \tag{5}$$

It's important to note here that the second order reciprocal matrices are always consistent and do not require a consistency check. When n is greater than 2, CR represents the consistency of the matrix.CR = CI/RI.RI values are shown in Table 2.

Table 2. Mean random consistency index

Order number	1	2	3	4	5	6	7	8
RI	0.00	0.00	0.58	0.90	1.12	1.24	1.32	1.41

It is calculated that:

CR=<0.1, Therefore, the judgment matrix of first-level index meets the requirements with the consistency test.

The above results are sorted out, and the weight and consistency of the remaining matrix can be calculated by using the same principle. The results are shown below. Where n is the matrix order, $\lambda_{\max}$ is the maximum characteristic root, W is the weight coefficient, CI is the consistency index, CR is the random consistency ratio.

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(1) The consistency test results between the overall level and the single ranking of each factor are as follows:

$$W = (0.1578,0.2398,0.4597,0.1426)^{T}$$

$$\lambda_{max} = 4.1171$$

$$CI=0.0390$$

$$CR=0.0434<0.1$$

Pass the conformance test.

(2) The consistency test results of the hierarchical single ranking of enterprise environment A and second-level indicators are as follows:

$$W_A = (0.6667,0.3333)^{T}$$

$$\lambda_{max} = 2$$

$$CI=0$$

Pass the conformance test.

(3) The consistency test results of profitability B and second-level index single ranking are as follows:

$$W_B = (0.6483,0.2297,0.1220)^{T}$$

$$\lambda_{max} = 3.0037$$

$$CI=0.0018$$

$$CR=0.0032<0.1$$

Pass the conformance test.

(4) The consistency test results of performance evaluation C and second-level index single ranking are as follows:

$$W_C = (0.3404,0.2579,0.1803,0.0955,0.1260)^{T}$$

$$\lambda_{max} = 5.2879$$

$$CI=0.0720$$

$$CR=0.0643<0.1$$

Pass the conformance test.

(5) The consistency test results of development potential D and second-level index single ranking are as follows:

$$W_D = (0.2402,0.5499,0.2098)^{T}$$

$$\lambda_{max} = 3.0183$$

$$CI=0.009$$

$$CR=0.0158<0.1$$

Pass the conformance test.

The total ranking of a hierarchy is the result of a single ranking of all indicators in the same hierarchy, and the weight of the importance of all factors in this hierarchy can be calculated relative to that of the previous hierarchy. As shown below:

The results of this example are shown in Table 3, in which the total ranking is the comprehensive weight corresponding to each index.

Finally, consistency check should be carried out for the calculated total hierarchical order, as shown below:

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W_i : The weight of the ith index in the first-level index;

CI_i : The consistency index of the ith index corresponding matrix of the first-level index;

RI_i : The average random consistency index of the ith index corresponding matrix of the first-level index.

Table 3. Comprehensive weight

The target	Level indicators	The secondary indicators	A separate order	Total sorts
A	0.1578	A1	0.6667	0.1052
		A2	0.3333	0.0526
B	0.2398	B1	0.6483	0.1555
		B2	0.2297	0.0551
		B3	0.1220	0.0293
C	0.4597	C1	0.3404	0.1565
		C2	0.2579	0.1186
		C3	0.1803	0.0829
		C4	0.0955	0.0439
		C5	0.1260	0.0579
D	0.1426	D1	0.2402	0.0343
		D2	0.5499	0.0784
		D3	0.2098	0.0299

$$CI_T=\sum_{i=1}^{4} W_i CI_i =0.1578*0+0.2398*0.0018+0.4597*0.0720+0.1426*0.0091=0.0348$$

$$RI_T=\sum_{i=1}^{4} W_i RI_i =0.1578*0+0.2398*0.58+0.4597*1.12+0.1426*0.58=0.7367$$

$$CR_T=CI_T/RI_T=0.0348/0.7367=0.0472<0.1$$

Conformance test.

4. Use TOPSIS method to evaluate suppliers

Because there are so many kinds of goods in supermarkets, only four suppliers of one commodity are selected in this paper. However, the selection method used in this paper can also be applied to other commodities. There are four suppliers S1, S2, S3 and S4 as alternative partners. By collecting relevant information of these four suppliers, the specific information of the final four winners is shown in Table 4.

It can be seen from the below table that the dimensionality of each index varies greatly. In order to eliminate the influence of dimensionality, this paper USES the maximum value method to normalize the original data. The formula is as follows:

x_{ij} : The original value of the ith supplier's jth indicator;

x_{ij}' : The normalized value of the ith supplier's jth indicator;

$\max(x_{ij})$: The jth index' max;

$$x_{ij}'=\frac{x_{ij}}{\max(x_{ij})} \qquad i=1,2,...n;\ j=1,2,...,m \tag{6}$$

The normalized data can be obtained as shown in Table 5 below:

Combined with the comprehensive weight value of each index calculated above, the weighted normalized matrix can be obtained, as shown in Table 6.

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Table 4. Raw data of alternative suppliers

The secondary indicators	S_1	S_2	S_3	S_4
A1	7	9	7	8
A2	6	8	7	6
B1	10.14	9.98	10.11	10.06
B2	6%	8%	5%	5.50%
B3	7	9	7	6
C1	7	9	7	7
C2	90%	87%	80%	78%
C3	8	7	8	9
C4	8	7	8	8
C5	9	9	8	7
D1	7	9	7	8
D2	7	8	6	5
D3	7	8	7	9

Table 5. Normalized data

The secondary indicators	S_1	S_2	S_3	S_4
A1	0.7778	1.0000	0.7778	0.8889
A2	0.7500	1.0000	0.8750	0.7500
B1	1.0000	0.9842	0.9970	0.9921
B2	0.7500	1.0000	0.6250	0.6875
B3	0.7778	1.0000	0.7778	0.6667
C1	0.7778	1.0000	0.7778	0.7778
C2	1.0000	0.9667	0.8889	0.8667
C3	0.8889	0.7778	0.8889	1.0000
C4	1.0000	0.8750	1.0000	1.0000
C5	1.0000	1.0000	0.8889	0.7778
D1	0.7778	1.0000	0.7778	0.8889
D2	0.8750	1.0000	0.7500	0.6250
D3	0.7778	0.8889	0.7778	1.0000

Table 6. Weighted normalized matrix

The secondary indicators	S_1	S_2	S_3	S_4
A1	0.0818	0.1052	0.0818	0.0935
A2	0.0395	0.0526	0.0460	0.0395
B1	0.1555	0.1530	0.1550	0.1543
B2	0.0413	0.0551	0.0344	0.0379
B3	0.0228	0.0293	0.0228	0.0195
C1	0.1217	0.1565	0.1217	0.1217
C2	0.1186	0.1146	0.1054	0.1028
C3	0.0737	0.0645	0.0737	0.0829
C4	0.0439	0.0384	0.0439	0.0439
C5	0.0579	0.0579	0.0515	0.0450
D1	0.0266	0.0343	0.0266	0.0304
D2	0.0686	0.0784	0.0588	0.0490
D3	0.0233	0.0266	0.0233	0.0299

(1) Determine the positive and negative ideal solutions of the matrix:

The positive ideal solution is a virtual best solution, and the negative ideal solution is a virtual worst solution. In the weighted normalized matrix, the maximum value of each index represents the corresponding optimal solution Z+, and the minimum value of each index is the worst solution Z-.

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Z^+=
(0.1052,0.0526,0.1555,0.0551,0.0293,0.1565,0.1186,0.0829,0.0439,0.0579, 0.0343,0.0784, 0.0299) (2)

Z^-=
(0.0818,0.0395,0.1530,0.0344,0.0195,0.1217,0.1028,0.0645,0.0384,0.0450, 0.0266,0.0490,0.0233) (2)

(2) Determine the distance between alternative suppliers and positive and negative ideal solutions:

The following formula is used to calculate the distance between each unit index value and the optimal value and the worst value (D^+ , D^-).

$$D_i^+ = \sqrt{\sum_{j=1}^{m}(z_{ij} - z_j^+)^2} \tag{7}$$

$$D_i^- = \sqrt{\sum_{j=1}^{m}(z_{ij} - z_j^-)^2} \tag{8}$$

It can be calculated as follows:

D_1^+=0.010158，D_2^+=0.00438，D_3^+=0.02081，D_4^+=0.02081

D_1^-=0.01737，D_2^-=0.01974，D_3^-=0.00223，D_4^-=0.00223

(4) Calculate the relative proximity between suppliers and the optimal value.That is, the degree of closeness between suppliers and positive and negative ideal solutions:

$$T_i = \frac{D_i^-}{D_i^+ + D_i^-} \tag{9}$$

It can be calculated as follows:

T_1=0.88004，T_2=0.93499，T_3=0.68802，T_4=0.68802

Table 7 is obtained after sorting out the above results:

Table 7. Dimensionless results of each service provider's distance to positive and negative ideal and correlation degree

Suppliers	S_1	S_2	S_3	S_4
D^+	0.0494	0.0200	0.0553	0.0566
D^-	0.0313	0.0608	0.0178	0.0240
T_i	0.3876	0.7519	0.2437	0.2980

Comparison of paste progress shows that S_2>S_1>S_4>S_3, so it is recommended to select S_2 as its supplier.

5. Conclusion

On the basis of previous studies, according to the summary of a variety of indicators, the actual enterprise GM chain supermarkets selected by experts using Delphi method to determine the final indicators to establish the index system. When making decisions, this paper chooses to combine AHP with TOPSIS (approach to ideal solution sorting method), and finally applies this method to the supplier selection of GM chain supermarkets, and provides a simple and feasible method for supermarkets to select suppliers, which achieves the purpose of this paper.

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China's chain retail enterprises supplier evaluation and selection research while there are a lot of related literature, but not form a system of research and the method system, which is based on is currently in China and will be in the primary stage of socialism in developing countries for a long time the basic national conditions that the vigorous development of chain retail enterprises need of such a study. Although this paper provides one of the many methods, there are still many shortcomings. It is hoped that in the future research, the deficiencies mentioned above can be overcome to provide a better method for the selection of supermarket chain suppliers.

References

[1] Jafar Rezaeia, Thomas Nispeling, Joseph Sarkis, Lori Tavasszy, A supplier selection life cycle approach integrating traditional and environmental criteria using the best worst method[J]. Journal of Cleaner Production, Journal of Cleaner Production 135 (2016) 577-588.

[2] De Boer L, Van der Wegen L, Telgen, J. Outranking methods in support of supplier selection.European Journal of Purchasing and Supply Management, [M]4(2–3), 109–118.2016

[3] D.L.Olson,Comparison of Weights in TOPSIS Models[J],Mathematical and Computer Modelling 40, (2004) 721-727

[4] Zichang He,Wen Jiang,Evidential supplier selection based on interval data fusion[D],School of Electronics and Information, Northwestern Polytechnical University, Xi'an, Shaanxi, 710072, China,2017.

[5] Kijung Park, Gül E. Okudan Kremer, Junfeng Ma,A regional information-based multi-attribute and multi-objective decision-making approach for sustainable supplier selection and order allocation [J],Journal of Cleaner Production, 2018, S0959-6526(18)30686-3.

[6] Jr Jung Lyu, Jyh-Hong Ding, Ping-Shun Chen. Coordinating replenishment mechanisms in supply chain: From thecollaborative supplier and store-level retailer perspective.[J] International Journal of Production Economics 123, 2010, 221-234.

[7] Zhipeng Ma. Research on Supplier Selection and Evaluation of Z Group [D]. Beijing Jiao tong University, 2017.