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Study on the Improvement of the Performance Appraisal of Company A Based on FAHP

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Abstract: With the accelerating globalization in recent years, market competition has become more intense, consumer demand has become more complex, and lead time has gradually shortened, enterprises have to cope with the opportunities and challenges of economic development. There are many enterprises with more serious inventory problems, minimal and medium-sized enterprises. In this paper, we conducted a field study and in-depth research on the inventory management of the Black Forest Department of Company A. We found some problems in the daily incoming and outgoing operations of the department's warehouse and analyzed and researched these problems, and finally, adopted Fuzzy Set Theory-based and improved the evaluation system for inventory management efficiency in this department, and propose specific optimization solutions. In this paper, we apply our knowledge in this field to the optimization of inventory management in the Black Forest department of Company A by combining the research method with actual case studies, using practical examples to detail the relevant inventory management aspects, so as to take targeted optimization measures for the problems in the Black Forest department regarding inventory management.

1. Introduction

Due to the rapid growth of our economy and the increasingly competitive market, companies must have a more specific and in-depth understanding of market characteristics in order to improve their responsiveness to market changes. [1] Manufacturing companies, as the big head, to promote the development of our economy, we need to improve their competitiveness in it, they need to control and manage their inventory effectively, which has a huge impact on their business operation. Inventory management is one of the most important aspects of business management, and its inventory assets occupy a significant share of the total assets of the enterprise, so to reduce the need for liquidity faster, the implementation of effective management of inventory is one of the direct methods, so inventory management is being paid attention to by more and more major participants in the supply chain and enterprises in other industries.

The main purpose of taking inventory management measures is to effectively reduce the cost of inventory, which is not only reflected in the reduction of cash asset outflow, but also in the standardization of inventory product classification, order rationalization, and replenishment timeliness, etc. In short, it is expressed in the rapid capital turnover and the increase in profit. [2] Therefore, the good or bad of inventory management largely determines the good or bad of enterprise management. No matter whether small, medium, or large enterprises of any size, it is necessary to consider how to establish a scientific inventory level and what is the ultimate goal of inventory management, so as to make the most suitable inventory management decisions.

This paper is based on a field study of the Black Forest department of Company A. After understanding the specific operation process of the department, we found out the deficiencies of the department in inventory management. In this paper, we choose to use fuzzy set theory to calculate the order volume of the department under uncertainty. In the performance assessment of the Black Forest department, the managers do not have a scientific standard for each operation index in inventory management and do not conduct a strict performance assessment. Therefore, when controlling the inventory, it is likely to be influenced by their personal subjective factors and confuse the importance degree of each index, thus wasting too much energy on unimportant work or ignoring some important work. So this paper uses the fuzzy FAHP-based theory to list the relevant indicators involved in inventory management by calculating them one by one, and then just by specifying the relevant weights, the assessment will know which work needs to be focused on so as to strengthen the inventory control.

2. Fuzzy Hierarchy Analysis (FAHP) Theory

2.1. FAHP Basic Idea

The traditional laminar analysis method uses a scale of 1-9 to evaluate the importance degree of two indicators, then derives the judgment matrix, and then synthesizes it to get the quantified weights, and finally decides the optimal solution by ranking. Then, since the construction of the judgment matrix only by a number like 1-9 does not fully reflect the realistic situation of fuzzy indicators, Dutch scholar Van Laarhoven improved the AHP analysis method by using fuzzy triangular numbers to represent the fuzzy matrix of two-by-two comparison of fuzzy judgment. [3] The operation of fuzzy triangular numbers is used to obtain the ranking of indicators, thus constructing a fuzzy hierarchical analysis that can be utilized in fuzzy situations.

2.2. FAHP Definition

Suppose F(R) is the entire fuzzy set on R. Let M be contained in F(R) if: the affiliation function u M , R ∈ [0,1] of M is denoted as

$$\mu_M(\boldsymbol{x})=\begin{cases}\frac{l}{m-l}x-\frac{l}{m-l}, x\in[l,m]\\ \frac{l}{m-u}x-\frac{u}{m-u}, x\in[m,u]\\ 0, other\end{cases} \tag{1}$$

In the formula l≤m≤u, l and u represent the upper and lower limits of M, respectively, and m is the median of M. Then M is said to be the triangular fuzzy number, expressed by (l, m, u). [4] In the triangular fuzzy number, the difference between l and u reflects the fuzzy degree of judgment, the larger the difference, the higher the degree of fuzziness, and vice versa, the smaller and more accurate. If the two values are equal, the difference is 0, it means that the function is non-fuzzy. [5-6]

2.3. Arithmetic Rules for Trigonometric Fuzzy Numbers

Set. $$M_1 = [l_1, m_1, u_1], M_2 = [l_2, m_2, u_2] \tag{2}$$

$$M_1 + M_2 = [l_1 + l_2, m_1 + m_2, u_1 + u_2] \tag{3}$$

$$M_1 \times M_2 = [l_1 \times l_2, m_1 \times m_2, u_1 \times u_2] \tag{4}$$

$$M_1 \div M_2 = [l_1 \div l_2, m_1 \div m_2, u_1 \div u_2] \tag{5}$$

$M_1 \geq M_2$ The degree of likelihood is defined as $M_1 \geq M_2$ The degree of probability is defined:

$$V(M_1 \geq M_2) = \begin{cases} 1, & M_1 \geq M_2 \\ \dfrac{l_2 - u_1}{(m_1 - u_1) - (m_2 - l_2)}, & m_1 < m_2, l_1 < u_2 \\ 0, & other \end{cases} \tag{6}$$

2.4. Fuzzy Integrated Degree Value

Let $X = [x_1, x_2, \dots x_n]$ be a set of objects and $U = [u_1, u_2, \dots u_m]$ be a target set. The degree value of the ith object satisfying the target is respectively $M_{E_i}^1, M_{E_i}^2, \dots M_{E_i}^m (i = 1,2, \dots n)$ Here. The $M_{E_i}^j$ are the fuzzy triangular numbers. From this, the integrated degree value of the ith object with respect to the m objectives can be defined.

$$S_i = \sum_{j=1}^{m} M_{E_i}^j \times \left(\sum_{i=1}^{n} \sum_{j=1}^{m} M_{E_i}^j\right)^{-1} \tag{7}$$

2.5. FAHP Fuzzy Step

(1) To establish a general objective for the existing problems, which belongs to the objective layer of the hierarchy, and then set up more detailed indicators as the guideline layer according to the general objective, and then detail each indicator to get the indicator layer, then the hierarchy with the objective layer, guideline layer and indicator layer is established.

(2) A two-by-two comparison of different indicators at each level is performed by professionals to obtain a fuzzy judgment matrix composed of fuzzy triangular numbers, and if there are n experts, there will be n rows of the matrix. Generally, l and u represent the upper and lower boundaries of the triangular fuzzy number, respectively, and the highest weight of indicators will not be higher than the upper boundary, and the lowest will not be lower than the lower boundary, but the smaller u-l means the more accurate judgment, and the more fuzzy judgment, the larger u-l. (Sij)_(n×n) The element in Sij = [lij, mij, uij] is a closed interval with mij as the median of the closed interval, and mij used is the integer from 1 to 9 for comparing judgments in the hierarchical analysis method. Let m - l = u - m = a, generally 0 < a < 0.5.

(3) According to the fuzzy matrix given by the experts, the fuzzy values of each index in the fuzzy matrix are calculated by the method of averaging, and then the formula is applied to calculate its comprehensive importance value Si, and the possibility degree value is calculated by comparing two by two S .i

(4) Calculate the importance d of each indicator over the other indicators, then normalize this d to obtain the weight coefficients of each indicatord_i^' = min (V (S_i1 ⩾ S_i2), Si(3) (4) calculate the importance of each indicator over the other indicators, and then normalize these d to obtain the weight coefficients of each indicator.W_i^' = (d_1^', d_2^', d_3^', …d_n^'). Then normalize them to obtain the final weight vector W_i = (d_1, d_2, d_3, …d_n).

(5) Repeat the above calculation methods and steps for the remaining sub-indicators, and finally, obtain the weights of all indicators.

(6) Evaluate the importance of each indicator based on the overall weighting ratio. Next, managers can find out which indicators have a greater impact on the inventory according to the importance of each indicator, so that they can find a breakthrough to solve the problem. [7-8]

3. Analysis of the Current Situation and Problems of Inventory Management in the Black Forest department of Company A

3.1. Overview of Company A

Company A was founded in 1983 and is located in Zhangjiagang Free Trade Zone, Jiangsu Province. It is a high-tech private technology enterprise integrating R&D, production, trade and service across three industries: fabric, high-end auto parts, and home appliances. With a registered capital of 30 million RMB, 325 employees, and a total scale of 56,290 square meters, the company can achieve an annual output value of more than 600 million RMB. Its workshop for the home appliance industry has five production lines, including a Daikin production line, with an annual output of over 80,000 pieces. The business scope involves many countries such as Korea, Japan, the United States, and Germany. The cooperative customers also include many famous brands such as Daikin, Haier, Carrier, Sharp, and Addis Ababa.

Company A has more than 40 patents, such as utility model patents, design patents and invention patents, etc.; the company has also obtained IS09000 quality system certification, IATF16949 (former TS16949) system certification; product certification has also passed CE, CQC, CB, ROHS, ETL, and many other certifications; in addition, company A has also obtained Jiangsu Private Technology Enterprise", "High-tech Enterprise", "Suzhou Famous Brand", "China New Air Association Director Unit In addition, A has also won many honors such as "private technology enterprise in Jiangsu Province", "high-tech enterprise", "Suzhou famous brand", "director unit of China Fresh Air Association", "passive house fresh air professional committee".

3.2. Current Status of Inventory Operation Efficiency in Black Forest Department of Company A

The upper management of the Black Forest department of Company A was relatively relaxed towards the employees underneath, which led to the low motivation of the employees and low efficiency of the inventory operation. When the leaders supervise and review the work of the employees, they only look at whether the products arriving from the suppliers have been successfully warehoused and whether the products that should be sent to the customers have been loaded and discharged, but there are no specific indicators to evaluate and assess whether the incoming products are neatly arranged and standardized and whether the outgoing products are broken.

3.3. Job Performance Appraisal System Unscientific

Company A's Black Forest department nowadays does not implement effective performance appraisal formulation, which makes some employees not serious in their work, not active in their work, lazy in their behavior, and inefficient. For example, when warehouse clerks do warehousing operations for goods, although they are placed in the corresponding storage and shelves, the goods are placed in a messy and untidy way, which will affect the subsequent inventory and material collection work. The Black Forest department needs to re-standardize the performance appraisal system to make it more scientific and more motivated to mobilize the employees.

4. Using FAHP to Strengthen the Performance Appraisal of the Black Forest Department of Company A

If you want to improve the level of inventory management, you need to use a reasonable method of evaluation, only to quantify the management indicators to achieve the most efficient management. However, it is not enough to rely only on the physical inventory management to achieve high turnover operation, a more reasonable method is to take the whole supply chain as the management object, so that the whole process of logistics, capital flow, and information flow to achieve the most optimal, change the management concept, establish a "big logistics The concept of "big logistics" is to make logistics lead the whole value stream. The comprehensive level of each link determines the inventory turnover rate, and any problem in any link will affect the inventory turnover rate. By using FAHP's comprehensive fuzzy evaluation method, we can derive the performance assessment index weights that constitute the Black Forest department of Company A. The performance management of the Black Forest department is thus targeted according to the allocation ratio of the weights.

4.1. Constructing A Performance Evaluation Index System for Inventory Management in the Black Forest Department of Company A

The first step of applying FAHP is to establish an inventory management performance evaluation index system for the Black Forest department of Company A. It is divided into three levels: target level, criterion level, and indicator level. Based on the analysis of inventory management-related performance indicators, customer service level, inventory control cost, and inventory control quality are set as the criterion layers (S1, S2 and S3). Under each criterion layer, there are other subsidiary indicators as indicator layers (S11 -S13, S21 -S23, S31 - S33), as shown in Table 1 below.

Table 1: Performance evaluation index system of inventory management in Black Forest department of Company A

Target layer	Guideline layer	Indicator layer
Inventory Management Objective S	Customer Service Level S_1	Order completion rate S_{11}
		On-time delivery rate S_{12}
		Order return rate S_{13}
	Inventory control cost S_2	Order cost S_{21}
		Storage cost S_{22}
		Out-of-stock cost S_{23}
	Inventory Control Quality S_3	Inventory turnover rate S_{31}
		Inventory control level S_{32}
		Inventory material availability rate S_{33}

4.2. Determine the Weight of the Criterion Layer Relative to the Target Layer

Using the Delphi method, the fuzzy judgment matrix of the criterion layer relative to the target layer is constructed by making a mutual comparison of the importance degree between each criterion layer after communication and exchange with the management staff of the Black Forest department. Among them, the scores of the matrix are based on the 9-scale indicator method of improving the traditional AHP, taking into account the fuzziness of human judgment, and expressing the meaningful relationship between each indicator as a numerical value, as shown in Table 2.

Table 2: Using FAHP language to describe the score table

Comparative scoring of evaluation indicators	Definition	Description
0.5	Equally important	i and j have the same degree of importance
1.5	Slightly more important	i is more important than j
2.5	Important	i is more important than j
3.5	Obviously important	i is significantly more important than j
4.5	Very important	i is very important than j
1, 2, 3, 4	Intermediate importance	Scale values in the intermediate states of i and j

Based on the description of the above table, the criterion-level fuzzy judgment matrix for two-by-two comparison is constructed, as shown in Table 3.

Table 3: Fuzzy judgment matrix of S1 -S3 for S

S	S_1	S_2	S_3
S_1	(1,1,1)	(4/5,1,3/2) (1,4/3,2) (4/3,2,5/2)	(1/3,3/4,3) (2/5,1,3/2) (5/4,7/2,9/2)
S_2	(1/3,1,5/4) (1/2,3/4,1) (2/5,1/2,3/4)	(1,1,1)	(2/3,3/2,7/3) (5/4,5/3,5/2) (1/2,2/3,2)
S_3	(1/3,4/3,3) (2/3,1,5/2) (2/9,2/7,4/5)	(3/7,2/3,3/2) (2/5,3/5,4/5) (1/2,3/2,2)	(1,1,1)

According to the nature of FAHP, the fuzzy comprehensive evaluation matrix of the criterion layer is calculated. The comparison data of S_1 and S_2 are given by three managers, and these three comparative fuzzy values can be synthesized into one fuzzy value according to their nature, and other fuzzy values are obtained in the same way, and finally, Table 4 is obtained.

$$(4/5+1+4/3) / 3 \approx 1.04$$

$$(1+4/3+2) / 3 \approx 1.44$$

$$(3/2+2+5/2) / 3 = 2$$

Then the integrated fuzzy value of S_1 for S_2 is (1.04, 1.44, 2), and the integrated fuzzy judgment matrix of S_1 -S_3 for S is calculated in the same way, as shown in Table 4.

Table 4: Integrated fuzzy judgment matrix of S_1 -S_3 on S

S	S_1	S_2	S_3
S_1	(1,1,1)	(1.04,1.44,2)	(0.66,1.75,3)
S_2	(0.41,0.75,1)	(1,1,1)	(0.81,1.28,2.28)
S_3	(0.41,0.87,2.1)	(0.44,0.92,1.43)	(1,1,1)

According to the formula $S_i = \sum_{j=1}^{3} M_{E_i}^{j} \times (\sum_{i=1}^{3}\sum_{j=1}^{3} M_{E_i}^{j})^{-1}$ Calculate the combined importance value of each criterion in comparison with the others.

$$\sum_{i=1}^{3}\sum_{j=1}^{3} M_{E_i}^{j} = (1,1,1)+(1.04,1.44,2)+\ldots+(1,1,1) = (6.77,10.02,14.81)$$

$$\sum_{j=1}^{3} M_{E_1}^{j} = (1,1,1)+(1.04,1.44,2)+(0.66,1.75,3) = (2.71,4.19,6.00)$$

$$\sum_{j=1}^{3} M_{E_2}^{j} = (0.41,0.75,1)+(1,1,1)+(0.81,1.28,2.28) = (2.22,3.03,4.28)$$

$$\sum_{j=1}^{3} M_{E_3}^{j} = (0.41,0.87,2.1)+\ (0.44,0.92,1.43)+\ (1,1,1)(1.85,2.80,4.53)$$

$$S_1 = (2.71,4.19,6.00)/\ (6.77,10.02,14.81) = (0.183,0.419,0.886)$$

$$S_2 = (2.22,3.03,4.28)/\ (6.77,10.02,14.81) = (0.150,0.302,0.632)$$

$$S_2 = (2.22,3.03,4.28)/\ (6.77,10.02,14.81) = (0.150,0.302,0.632)$$

$$S_3 = (1.85,2.80,4.53)/\ (6.77,10.02,14.81) = (0.125,0.279,0.669)$$

Compare S_1 and S_2: because m1=0.419>m2=0.302,so
$V(S_1 \geq S_2) = 1$ The same reasoning leads to.

$$V(S_1 \geq S_3) = 1$$

$$V(S_2 \geq S_1) = \frac{l_1 - u_2}{(m_2 - u_2) - (m_1 - l_1)} = 0.793$$

$$V(S_2 \geq S_3) = 1$$

$$V(S_3 \geq S_1) = \frac{l_1 - u_3}{(m_3 - u_3) - (m_1 - l_1)} = 0.776$$

$$V(S_3 \geq S_2) = \frac{l_2 - u_3}{(m_3 - u_3) - (m_2 - l_2)} = 0.958$$

Calculate the degree of likelihood that each criterion indicator is more important than the other indicators. d

$$d_1^{'} = \min(V(S_1 \geq S_2, S_3) = \min(1,1) = 1$$

$$d_2^{'} = \min(V(S_2 \geq S_1, S_3) = \min(0.793,1) = 0.793$$

$$d_3^{'} = \min(V(S_3 \geq S_1, S_2) = \min(0.776,0.958) = 0.776$$

Therefore, the un-normalized weighting coefficients

$$W^{'} = (1, 0.793, 0.776)$$

After normalization, the weights of the criterion layer relative to the target layer are

$$W = (0.389, 0.309, 0.302)$$

From the above calculation results, we can see that the customer service level is more important than inventory control cost and inventory control quality in the weight of the criterion layer relative to the target layer. Next, we calculate the consequences of the indicator layer close to the criterion layer, again using the Delphi method, and finally arrive at the fuzzy judgment matrix.

4.3. Determine the Weight of the Indicator Layer Relative to the Criterion Layer

4.3.1. Determine the Fuzzy Judgment Matrix of the Indicator Layer S1

(1) According to Table 2, the fuzzy judgment matrix of the two-by-two comparison index layer S_1 is constructed, as shown in Table 5.

Table 5: Fuzzy judgment matrix of S11 -S13 to S1

S_1	S_{11}	S_{12}	S_{13}
S_{11}	(1,1,1)	(1/3,2/3,1) (1/2,3/4,5/4) (1/4,1/2,2/3)	(3/2,2,7/3) (5/4,3/2,5/3) (4/5,3/2,5/2)
S_{12}	(1/3,3/2,3) (4/5,4/3,2) (3/2,2,4)	(1,1,1)	(4/5,3/2,2) (2/3,4/3,3/2) (1/3,1,5/4)
S_{13}	(3/7,1/2,2/3) (3/5,2/3,4/5) (3/5,2/3,5/4)	(1/2,2/3,5/4) (2/3,3/4,3/2) (4/5,1,3)	(1,1,1)

(2) According to the nature of FAHP, the fuzzy integrated judgment matrix of indicator layer S_1 is calculated, and the fuzzy values of S_{11} and S_{12} contrast can be integrated into one fuzzy value, and other fuzzy values are obtained in the same way, and finally, Table 6 is obtained.

$$(1/3+1/2+1/4) / 3 \approx 0.36$$

$$(2/3+3/4+1/2) / 3 \approx 0.64$$

$$(1+5/4+2/3) / 3 \approx 0.97$$

Then the integrated fuzzy value of S_1 for S_2 is (0.36,0.64.0.97), and the fuzzy integrated judgment matrix of the criterion layer is calculated similarly, as shown in Table 6.

Table 6: Integrated fuzzy judgment matrix of S11 -S13 to S1

S_1	S_{11}	S_{12}	S_{13}
S_{11}	(1,1,1)	(0.36,0.64,0.97)	(1.18,1.67,1.89)
S_{12}	(0.88,1.61,3)	(1,1,1)	(0.6,1.28,1.58)
S_{13}	(0.54,0.61,0.91)	(0.66,0.81,1.92)	(1,1,1)

(3) Follow the formula $S_i = \sum_{j=1}^{3} M_{E_i}^{j} \times (\sum_{i=1}^{3} \sum_{j=1}^{3} M_{E_i}^{j})^{-1}$ Calculate the combined importance value of each criterion compared to the others.

$$\sum_{i=1}^{3}\sum_{j=1}^{3} M_{E_i}^{j} = (7.22, 9.61, 13.27)$$

$$\sum_{j=1}^{3} M_{E_{11}}^{j} = (2.54, 3.31, 3.86)$$

$$\sum_{j=1}^{3} M_{E_{12}}^{j} = (2.48, 3.89, 5.58)$$

$$\sum_{j=1}^{3} M_{E_{13}}^{j} = (2.20, 2.42, 3.82)$$

$$S_{11} = (2.54, 3.31, 3.86) / \ (7.22, 9.61, 13.27) = (0.192, 0.344, 0.535)$$

$$S_{12} = (2.48, 3.89, 5.58) / \ (7.22, 9.61, 13.27) = (0.187, 0.405, 0.773)$$

$$S_{13} = (2.20, 2.42, 3.82) / \ (7.22, 9.61, 13.27) = (0.166, 0.251, 0.529)$$

Compare S_{11} and S_{12}: because $m_{11} < m_{12}$, so

$$V(S_{11} \geq S_{12}) = \frac{l_{12} - u_{11}}{(m_{11} - u_{11}) - (m_{12} - l_{12})} = 0.851$$

$$V(S_{11} \geq S_{13}) = 1$$

$$V(S_{12} \geq S_{11}) = 1$$

$$V(S_{12} \geq S_{13}) = 1$$

$$V(S_{13} \geq S_{11}) = \frac{l_{11} - u_{13}}{(m_{13} - u_{13}) - (m_{11} - l_{11})} = 0.785$$

$$V(S_{13} \geq S_{12}) = \frac{l_{12} - u_{13}}{(m_{13} - u_{13}) - (m_{12} - l_{12})} = 0.691$$

(4) Calculate the degree of likelihood that each criterion indicator is more important than the other indicators. d

$$d_{11}^{'} = \min(V(S_{11} \geq S_{12}, S_{13}) = \min(0.851, 1) = 0.851$$

$$d_{12}^{'} = \min(V(S_{12} \geq S_{11}, S_{13}) = \min(1, 1) = 1$$

$$d_{13}^{'} = \min(V(S_{13} \geq S_{11}, S_{12}) = \min(0.785, 0.691) = 0.691$$

Therefore, the un-normalized weighting coefficients

$$W^{'} = (0.851, 1, 0.691)$$

(5) After normalization, the weights of the criterion layer relative to the target layer are obtained as

$$W = (0.335, 0.393, 0.272)$$

4.3.2. Determine the Fuzzy Judgment Matrix of the Indicator Layer S 2

(1) Construct the fuzzy judgment matrix of S_{21} -S_{23} to S_2, as shown in Table 7.

Table 7: Fuzzy judgment matrix of S21 -S23 to S2

S_2	S_{21}	S_{22}	S_{23}
S_{21}	(1,1,1)	(1/3,1/2,2/3)	(1/4,1/2,3/4)
		(1/2,2/3,1)	(1/2,4/5,3/2)
		(3/4,5/4,3/2)	(1/4,1/3,1/2)
S_{22}	(1/3,2,3)	(1,1,1)	(1/2,2/3,5/4)
	(1/2,1,3/2)		(1/5,1/3,2/3)
	(1,3/2,2)		(3/4,1,3/2)
S_{23}	(4/3,2,4)	(4/5,3/2,2)	(1,1,1)
	(2/3,5/4,2)	(3/2,3,5)	
	(2,3,4)	(2/3,1,4/3)	

(2) Calculate the fuzzy comprehensive judgment matrix of the index layer S_2 according to the nature of FAHP, as shown in Table 8.

Table 8: Integrated fuzzy judgment matrix of S21 -S23 to S 2

S_2	S_{21}	S_{22}	S_{23}
S_{21}	(1,1,1)	(0.53,0.81,1.06)	(0.33,0.54,0.92)
S_{22}	(0.67,1.43,2.11)	(1,1,1)	(0.48,0.67,1.14)
S_{23}	(1.33,2.08,3.33)	(0.99,1.83,2.78)	(1,1,1)

(3) According to the formula $S_i = \sum_{j=1}^{3} M_{E_i}^{j} \times (\sum_{i=1}^{3}\sum_{j=1}^{3} M_{E_i}^{j})^{-1}$ Calculate the combined importance value of each criterion in comparison with the others.

$$S_{21}=(1.86,2.35,2.97)/\ (7.33,10.37,14.33)=(0.130,0.227,0.405)$$

$$S_{22}=(2.15,3.10,4.25)/\ (7.33,10.37,14.33)=(0.150,0.299,0.580)$$

$$S_{23}=(3.32,4.92,7.11)/\ (7.33,10.37,14.33)=(0.232,0.474,0.970)$$

$$V(S_{21}\geq S_{22})=\frac{l_{22}-u_{21}}{(m_{21}-u_{21})-(m_{22}-l_{22})}=0.779$$

$$V(S_{21}\geq S_{23})=\frac{l_{23}-u_{21}}{(m_{21}-u_{21})-(m_{23}-l_{23})}=0.412$$

$$V(S_{22}\geq S_{21})=1$$

$$V(S_{22}\geq S_{23})=\frac{l_{23}-u_{22}}{(m_{22}-u_{22})-(m_{23}-l_{23})}=0.665$$

$$V(S_{23}\geq S_{21})=1$$

$$V(S_{23}\geq S_{22})=1$$

(4) Calculate the degree of likelihood that each criterion indicator is more important than the other indicators. d

$$d'_{21}=\min(V(S_{21}\geq S_{22},S_{23})=\min(0.779,0.412)=0.412$$

$$d_{22}^{'} = \min(V(S_{22} \geq S_{21}, S_{23}) = \min(1, 0.665) = 0.665$$

$$d_{23}^{'} = \min(V(S_{23} \geq S_{21}, S_{22}) = \min(1,1) = 1$$

Therefore, the un-normalized weighting coefficients

$$W^{'} = (0.412, 0.665, 1)$$

(5) After normalized calculation, the weight of the criterion layer relative to the target layer is obtained as

$$W = (0.198, 0.320, 0.481)$$

4.3.3. Determine the Fuzzy Judgment Matrix of the Indicator Layer S 3

(1) Construct the fuzzy judgment matrix of S_{31} -S_{33} to S_3 , as shown in Table 9.

Table 9: Fuzzy judgment matrix of S31 -S33 to S3

S_3	S_{31}	S_{32}	S_{33}
S_{31}	(1,1,1)	(1,5/2,4) (1/2,3/2, 2) (1,2,3)	(1/2,3/2,5/4) (1/2,1,3/2) (1,2,3)
S_{32}	(1/3,2/5,1) (1/2,2/3,2) (1/3,1/2,1)	(1,1,1)	(2/9,2/7,5/2) (2/7,2/5,3/2) (1/4,1/3,3)
S_{33}	(2/5,2/3,2) (2/3,1,2) (1/3,1/2,1)	(2/5,7/2,9/2) (2/3,5/2,7/2) (1/3, 3,4)	(1,1,1)

(2) Calculate the fuzzy comprehensive judgment matrix of the index layer S_3 according to the nature of FAHP, as shown in Table 10.

Table 10: Integrated fuzzy judgment matrix of S31 -S33 to S3

S_3	S_{31}	S_{32}	S_{33}
S_{31}	(1,1,1)	(0.83,2,3)	(0.67,1.5,2.33)
S_{32}	(0.39,0.52,1.33)	(1,1,1)	(0.25,0.34,2.33)
S_{33}	(0.47,0.72,1.67)	(0.47,3,4)	(1,1,1)

(3) According to the formula $S_i = \sum_{j=1}^{3} M_{E_i}^{j} \times (\sum_{i=1}^{3} \sum_{j=1}^{3} M_{E_i}^{j})^{-1}$ Calculate the combined importance value of each criterion in comparison with the others.

$$S_{31} = (2.5, 4.5, 6.33) / \ (6.07, 11.08, 17.67) = (0.142, 0.406, 1.043)$$

$$S_{32} = (1.64, 1.86, 4.67) / \ (6.07, 11.08, 17.67) = (0.093, 0.168, 0.768)$$

$$S_{33} = (1.93, 4.72, 6.67) / \ (6.07, 11.08, 17.67) = (0.109, 0.426, 1.097)$$

$$V(S_{31} \geq S_{32}) = 1$$

$$V(S_{31} \geq S_{33}) = \frac{l_{33} - u_{31}}{(m_{31} - u_{31}) - (m_{33} - l_{33})} = 0.979$$

$$V(S_{32} \geq S_{31})=\frac{l_{31}-u_{32}}{(m_{32}-u_{32})-(m_{31}-l_{31})}=0.725$$

$$V(S_{32} \geq S_{33})=\frac{l_{33}-u_{32}}{(m_{32}-u_{32})-(m_{33}-l_{33})}=0.529$$

$$V(S_{33} \geq S_{31})=1$$

$$V(S_{33} \geq S_{32})=1$$

(4) Calculate the degree of likelihood that each criterion indicator is more important than the other indicators d.

$$d_{31}^{'}=\min(V(S_{31} \geq S_{32}, S_{33})=\min(1, 0.979)=0.979$$

$$d_{32}^{'}=\min(V(S_{32} \geq S_{31}, S_{33})=\min(0.725, 0.529)=0.529$$

$$d_{33}^{'}=\min(V(S_{33} \geq S_{31}, S_{32})=\min(1,1)=1$$

Therefore, the un-normalized weighting coefficients

$$W^{'}=(0.979, 0.529, 1)$$

(5)After normalized calculation, the weight of the criterion layer relative to the target layer is obtained as

$$W=(0.390, 0.211, 0.399)$$

4.3.4. Derive the Weight of Each Indicator to the Total Target

The weight of each indicator to the total target is known from the above calculation, as shown in Table 11.

Table 11: Weights of each indicator for inventory management objectives

Target layer	Weights	Guideline layer	Weights	Indicator layer	Weights
Inventory Management Objective S	0.389	Customer Service Level S_1	0.335	Order completion rate S_{11}	0.130
			0.393	On-time delivery rate S_{12}	0.153
			0.272	Order return rate S_{13}	0.106
	0.309	Inventory control cost S_2	0.198	Storage cost S_{21}	0.061
			0.320	Order cost S_{22}	0.099
			0.481	Out-of-stock cost S_{23}	0.149
	0.302	Inventory Control Quality S_3	0.390	Inventory turnover rate S_{31}	0.118
			0.211	Inventory control level S_{32}	0.064
			0.399	Inventory material availability rate S_{33}	0.120

According to the results of the above table, it can be seen that the on-time delivery rate accounts for the greatest weight and influence on the total inventory management objectives. Therefore, the company can only better achieve the total inventory management objectives of customer service level. Inventory cost reduction and inventory turnover improvement by ensuring the good delivery time of goods and improving its on-time delivery rate.

FAHP can scientifically and reasonably determine the weights of performance evaluation indicators in inventory management, avoiding the subjective arbitrariness of the human brain and also taking into account the fuzziness of thinking and judgment. [9-10] FAHP can be utilized not only for determining the weights of inventory management performance evaluation indicators, but also for determining the weights of other indicators in enterprises, which can also objectively and scientifically express the weights of indicators in a fuzzy environment.

5. Conclusion

5.1. Summary

With the increasing development of economic globalization, the market competition is becoming more and more fierce, which brings new opportunities and challenges to enterprises. In order to seize the opportunity to stand out in this competition, the change of its existing operation mode is undoubtedly a major breakthrough in the transformation of enterprises. Company A, as a manufacturing enterprise with R&D and production, should give full play to its core competitiveness, actively manage its inventory, receive innovative ideas and methods, and improve its inventory management mechanism.

This paper firstly introduces the background of the study and the research idea, and then provides a comprehensive and detailed explanation and analysis of some theoretical knowledge related to inventory management that will be used in the following, then gives a detailed introduction to the current situation of inventory management in the Black Forest department of Company A, and then uses qualitative and quantitative analysis methods to analyze the causes of the problems. This paper uses FAHP theory to construct a scientific inventory management performance evaluation system for the Black Forest department of Company A, so that managers can adopt focused and planned management of inventory based on the comprehensive weight scores of the indicators in the system.

5.2. Outlook

As more and more experts and scholars have studied inventory management in recent years, often in the context of real-life cases, it is clear that inventory management is a very important aspect of research and that it plays an important role in the development of enterprises. In today's modern society, there are more and more specialized inventory issues, so companies need to pay more attention to inventory management. When making management decisions, it is important to analyze the actual operation of the company and to pursue the principle of seeking truth from facts, rather than blindly applying theoretical knowledge to it, in order to find a mode of operation that meets their own development requirements.

In this paper, we study and analyze the inventory management aspects of the Black Forest department of Company A. We can make corresponding optimization decisions and hope that inventory management can be paid more attention to in the future. A scientific and reasonable inventory management system can greatly enhance the overall competitiveness of an enterprise, so a reasonable improvement of inventory management is a direction that Company A can work on in the future.

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