Research on Evaluation Indexes of Low-Carbon Environmental Protection Living Supply Chain

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Abstract. In the process of implementing a low-carbon living supply chain, the results we seek also need to be evaluated. This is a very critical step. Correct and reasonable evaluation can help us find problems and find solutions to problems. This will improve the operation of our green supply chain. Practice a low-carbon lifestyle and create a happy life.

1. Introduction
The rapid development of science and technology and the continuous progress of society have brought convenience to our lives, and at the same time, ecological problems have become increasingly prominent. Advocating low-carbon life will become our focus today. Good ecological and environmental protection measures will be beneficial to a country or a country. Enterprises gain a favorable position in competition in the world market. Practice the concept of low-carbon life, and apply this concept throughout the entire process of supply chain management to maximize the use of limited resources and minimize pollution and achieve a virtuous circle. Whether a green supply chain meets the expected demand, a complete and comprehensive green supply chain management system is required to control the entire process from product design, production, sales, and after-sales. The results of each stage of the control data show that each The performance of the green supply chain is evaluated to provide a stable development road standard and theoretical basis for the green supply chain, so that each green supply chain can develop healthily and steadily, and it can effectively control the green supply chain from production orders to after-sales work. So as to realize the economic benefits of the enterprise.

2. Product Production Quality Supply Chain
Product production quality refers to the quality of parts or components used in each node in the green supply chain. It is mainly examined from the product qualification rate, scrap rate, breakage rate and other indicators. Because there are many types of output products in the green supply chain, each of the above assessment indicators can be called comprehensive indicators.

(A). Rate of qualified products
The qualification rate of a product is the ratio of the qualified quantity of the product to the quantity of the finished product. The level of a product's qualification rate directly affects the product quality level of the entire green supply chain.

(B). Product scrap rate
The ratio of product waste units to total product units. Literally, some of the products are qualified products, and the rest are scrap products. If you need to evaluate the green supply chain, you only need to add one of the product qualification rate and scrap rate factor.
(C). Product return rate

The product return rate is the ratio of product sales to returns. Due to factors such as transportation conditions, after receiving the product, the customer feels that it is not suitable. Customer satisfaction. 

Product return rate = \text{product value for which a return occurs or product return rate} = \text{total value of product order for product units for product return for product order unit.}

(D). Product breakage rate

Product damage rate refers to the ratio of the amount of damage caused by non-production of the product to the output of the finished product. Generally measure product quality problems caused by non-production reasons. In order to obtain the damage rate, a calculation formula is established, such as the product damage rate = the value of the broken product divided by the total value of the product. It should be noted in the calculation that the value of the damaged product should be equal to the value of non-production factors before the damage was completed. The total damage value can be calculated by recording the sales damage amount of each node in the green supply chain. In the actual product transportation process, you should choose a suitable transportation method according to the characteristics of the product to avoid damage that will cause the product to lose its original actual value.

3. Comprehensive performance evaluation of green supply chain follows principles

The creation of a good indicator system needs to start from the overall strategy of the green supply chain, guarantee the balanced development between short-term and long-term goals, financial performance and other performance, and internal and external performance of the enterprise. This indicator system can be comprehensive. Reflecting the overall performance of the green supply chain, it can also meet the needs of stakeholders in each process of the supply chain and the need to understand the development of the green supply chain. In addition, the indicator system should be comparable and comprehensive. The following principles should be followed:

First, the indicator system should perform multi-level analysis, which can clear the focus of each level in the green supply chain, and also facilitate the analysis of key information in key performance evaluation. Second, the dynamic evaluation system can be used to consider the changes caused by changes in multiple factors. Dynamic effects are not limited to indicators under a single factor. Third, the indicator system should be based on the whole, not only reflect the operating status of a single level, need to control the overall situation of the enterprise, and also facilitate the management of the enterprise to develop operational issues as soon as possible; Fourth, the indicator system should be time-effective, and should have some control over the expected changes in the future, to avoid unexpected situations that cause problems throughout the supply chain. Fifth, the indicator system should use the Internet's multi-end functions, which can clearly reflect the supply chain through charts. The relationship between the relevant parties (suppliers, manufacturers, distributors and users); sixth, the indicator system should be far-sighted, considering long-term interests and development prospects.

4. Comprehensive Performance Evaluation of Green Supply Chain Based on AHP

Regarding the comprehensive performance evaluation of green supply chains, a well-known American researcher has created a method with obvious effects. This method can transform some tedious and ambiguous relationships into a form of quantitative analysis. This method is named AHP. It is currently the most widely used evaluation method. AHP can simplify a very complex problem, arrange and combine the elements according to a certain rule, and then the researcher can use this arrangement to analyze the relationship between the elements, compare the importance and influence of each factor, and so on. Can make effective decisions through the results of AHP, reducing decision bias. It is roughly divided into the following steps:

a). Establish a hierarchical structure of the system. The so-called hierarchical structure of the system refers to the elaboration and analysis of the evaluation objects, simplifying tedious problems, comprehensively, systematically, and objectively analyzing the problem. The degree of perfection of the establishment of the hierarchical structure will affect the correctness of decisions. The hierarchical structure is generally divided into three levels, that is, the highest level, the middle level, and the bottom
The highest level is the predetermined goal of analysing the problem; the middle level is the intermediate process to obtain the final result; the bottom level is obtained through analysis. The final solution is different from the highest and lowest layers. The middle layer can consist of multiple layers. At the same time, it also corresponds to three structures, namely: a mixed structure, a completely related structure, and a completely independent structure. The three structures can make the problem analysis more comprehensive, so as to formulate a perfect solution strategy. According to research, the maximum value that humans can make subjective judgments is nine, so the factors of all levels should be ≤9.

b). After establishing the hierarchical structure of the system, we can determine the final judgment matrix through the membership relationship between the upper and lower layers. Taking an upper-level factor as a standard, and then comparing the lower-level factors according to certain requirements, in order to determine the more important lower-level factors, the well-known scholar TLSaayt has created an effective method to score each factor. Compared.

**Table 1. Definition of judgment matrix scale**

| Scale meaning | Scale meaning          |
|---------------|------------------------|
| 1             | Compared with the two elements, they are equally important |
| 3             | Compared with the two elements, the former is slightly more important than the latter |
| 5             | Compared with the two factors, the former is obviously more important than the latter |
| 7             | Compared with the two elements, the former is more important than the latter |
| 9             | Compared with the two factors, the former is more important than the latter |
| 2, 4, 6, 8    | Median                 |
| reciprocal    | A scale of importance compared to the two factors, the latter over the former |

In the comprehensive performance evaluation of the AHP green supply chain, H represents the upper-level assessment factors, A represents the lower-level factors of Hs, \( A = a_{ij} (i, j = 1 \sim n) \) is the judgment matrix, and \( a_{ij} = 1; \ a_{ji} = 1 / a_{ij} \) for \( a_{ij} \).

For the items displayed in the judgment matrix, we can use the power method to obtain the feature vector and maximum feature root of each precision. The feature vector can reflect the influence of a certain level on the previous level. But generally speaking, when we apply this method to life, because there are many factors that cause errors in judgment, the accuracy is not particularly high. On the other hand, the fundamental purpose of this analysis method is to express a qualitative concept. Therefore, we can use relatively simple methods, such as: common root finding method and approximate solution. The specific process is as follows:

(a). Find the component of the feature vector \( W \): \( W_i = (\prod_{j=1}^{n} a_{ij})^{1/m} \)

\[
W_i^0 = \frac{W_i}{\sum_{i=1}^{n} W_i}
\]

(b). Normalize:

5. **Consistency check**

The assignment of each element of the matrix is determined by the decision maker, and it is subjective. Sometimes serious logical errors occur. The conclusions drawn by them are immediately overturned by the conclusions. In the face of such errors, the matrix is correct. The inspection is very necessary. The inspection steps are as follows:
(a). Calculate the maximum eigenvector of a matrix:
\[ \lambda_{\text{max}} \approx \frac{1}{n} \sum_{i=1}^{n} (AW)_{ij} \]
\[ = \frac{1}{n} \sum_{i=1}^{n} \frac{\sum_{j=1}^{n} a_{ij}W_j}{W_i} \]

(b). Calculate the random consistency index:
\[ C.I. = \frac{\lambda_{\text{max}} - n}{n - 1} \]

(c). Calculate the stochastic consistency ratio index, and its value can be found in the following table:
\[ C.R.: C.R. = \frac{C.I.}{R.I.} \]

R. I. in the formula is the average random consistency index, and its value can be found from the following table:

| Order | 3   | 4   | 5   | 6   | 7   | 8   | 9   | 10  | 11  | 12  |
|-------|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| R.I.  | 0.51| 0.88| 1.11| 1.25| 1.35| 1.40| 1.45| 1.48| 1.52| 1.53|

When C.R. <0.1, the consistency of the judgment matrix is considered to be acceptable; otherwise, the judgment matrix should be appropriately corrected.

The total operating cost of the green supply chain is mainly composed of four parts: core product cost, inventory cost, labor cost, total external transportation cost of each node enterprise, and environmental protection cost. The core enterprise product cost is represented by A, the inventory cost is represented by C1, the labor cost is represented by C2, the transportation cost of each node is represented by C3, and the environmental protection cost input is represented by C4.

The specific calculation process is as follows:

The following data are all scored by experts. Finally, the weighted average is calculated. Taking the index under A as an example, the calculation is as follows:

| A | C1 | C2 | C3 | C4 | W | W0 |
|---|----|----|----|----|---|----|
| C1 | 1  | 1  | 3  | 2  | 1.565 | 0.351 |
| C2 | 1  | 1  | 3  | 2  | 1.565 | 0.351 |
| C3 | 1/3| 1/3| 1  | 1/2| 0.486 | 0.109 |
| C4 | 1/2| 1/2| 2  | 1  | 0.841 | 0.189 |

From this, the weight of each indicator under the A indicator is:
\[ W_c = (W_{c1}, W_{c2}, W_{c3}, W_{c4}) = (0.351, 0.351, 0.109, 0.189) \]
In the same way, the weight of each indicator under the A indicator is:
\[ W_b = (W_{b1}, W_{b2}, W_{b3}) = (0.418, 0.298, 0.284) \]
Calculated according to the above formula:
\[ u_n = (u_1, u_2, u_3, u_4, u_5, u_6) = (0.384, 0.226, 0.262, 0.557, 0.736, 0.733) \]

6. Conclusion
Through a detailed analysis of the green supply chain, a set of models suitable for the healthy development of the green supply chain was designed to provide an effective basis for the development of the green supply chain. Focus on the entire system of green supply chain analysis and research to find the main factors affecting the development of green supply chain. The rationality of the indicators involved in the evaluation needs to be proved by practice. At the same time, this design scheme is completed in practice to a certain extent achieve.
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