Research on the Construction of Logistics Informatization Evaluation System for Large State-owned Energy Enterprises

Hui Zhang, Xiaoming Zhang* and Fangmeng Gu

School of Economics and Trade, Jilin Engineering Normal University, Changchun 130052, China

*Corresponding author Email: yaoyue1973@sina.com, *187004499@qq.com, 
b1424295181@qq.com

Abstract. Through the analysis of the status quo of informationization of energy logistics system, this paper builds a logistics information evaluation system for large state-owned energy enterprises. The evaluation system consists of four major criteria: information infrastructure construction status, business operation status, customer service status, cost and profitability. The entropy method and analytic hierarchy process are used to determine the weight of the indicator evaluation system. The qualitative and quantitative analysis methods are used to establish the evaluation system. Comprehensive evaluation model. Finally, it puts forward opinions on improving the informationization of energy enterprise logistics.

1. Introduction

Energy is an important guarantee for economic development. In recent years, with the rapid development of China's economy, the demand for energy in the society has grown rapidly, and the contradiction between energy supply and demand has become increasingly acute. Establishing an energy logistics service system supported by information technology is of great significance for solving the contradiction between energy supply and demand and rational use of energy. However, the energy logistics service system is not a separate system. It is in the energy supply chain system and is closely related to the upstream production links and downstream consumption links of the energy supply chain [1]. Since energy is a bulk item, it is sensitive to logistics costs, and at present, the third-party logistics enterprises engaged in energy product logistics services in China have just begun to develop and do not have sufficient competitive strength. Therefore, China's energy logistics is relatively “self-contained” at this stage. Generally, some large energy resource enterprises are engaged in logistics management activities. The energy logistics system is a typical complex system with a large geographical span and a large time span. It has a wide range, spanning the three areas of production, circulation and consumption. As far as the production field is concerned, the logistics activities of energy companies focus on the storage and distribution of materials and products needed for energy mining; the logistics activities in the circulation field focus on energy storage, transportation, loading and unloading, processing, distribution, etc. Development; logistics activities in the consumer sector are logistics activities carried out by the energy sector for the rational use of energy. Most of the energy used at this stage is non-renewable, and this feature of energy gives the energy supply chain management a higher standard: the entire process must be efficient to supervise
management and save energy, and maintain sustainable energy mining and use. This requires that the consumer link must also strengthen the management awareness of energy logistics and take corresponding actions [2].

2. Establishment of Evaluation Index System for Logistics Informationization of State-owned Energy Enterprises

In the selection and determination of the indicator system, the author integrates some representative logistics informatization evaluation indicators by establishing an information evaluation system of information infrastructure status, business operation status, customer service status, and cost and profitability status. The scope of logistics information evaluation. The specific indicator system is shown in the table below.

Table 1. State-owned Energy Enterprises Logistics Informatization Evaluation Index System.

| Target layer | State-owned energy enterprise logistics information evaluation index system (A) |
|--------------|--------------------------------------------------------------------------------|
| Criteria layer | Information Infrastructure Status (B1) | Business Operation Status (B2) | Customer Service Status (B3) | Cost and profitability (B4) |
| Indicator layer | Informatization investment accounts for the proportion of fixed assets investment (C11) | Order Processing Accuracy (C21) | Timely delivery rate (C31) | The proportion of logistics costs (C41) |
| | Computer networking rate (C12) | On-time delivery rate (C22) | Delivery accuracy rate (C32) | Unit logistics cost (C42) |
| | GPS configuration rate (C13) | Contract performance rate (C23) | Timeliness of service (C33) | Logistics cost control level (C43) |
| | Computer ownership rate (C14) | Inventory turnover rate (C24) | Customer retention rate (C34) | IT contribution rate (C44) |
| | Advanced software configuration rate (C15) | Website click rate (C25) | Loss rate (C35) | Capital turnover rate (C45) |
| | Information utilization (C16) | Online business turnover rate (C26) | Cargo tracking rate (C36) | Inventory unit cost (C46) |
| | Information sharing rate (C17) | Decision Informatization Level (C27) | Customer accurate query rate (C37) | |

3. Application of Analytic Hierarchy Process and Entropy Method in Evaluation Index System

The analytic hierarchy process is a widely used and recognized method for the evaluation of logistics information. This paper will also use the analytic hierarchy process as the core calculation method. However, the analytic hierarchy process is not perfect. The biggest shortcoming is that the weight of the index is lacking. It is often obtained through subjective methods such as expert scoring. Due to the subjectivity of the weight, the final result will be inaccurate. In order to make up for this deficiency, this paper first uses the analytic hierarchy process to determine the weight of each evaluation index, and then supplements the entropy method to improve the index weight.
3.1. Analytic hierarchy process to determine indicator weights
Assuming that the element \( B \) of the previous layer is used as a criterion, it has a dominant relationship with the elements \( C_1, C_2, ..., C_n \) of the next level. The establishment of the judgment matrix is to assign the corresponding weights of \( C_1, C_2, ..., C_n \) according to their relative importance under criterion \( C \), that is, to repeatedly weigh the importance of criterion \( C \), the two elements \( C_1 \) and \( C_2 \), and here we need to use the 9-point ratio [5]. The scale assigns importance to importance. If the factor \( i \) is compared with \( j \) by \( a_{ij} \), the factor \( j \) is compared with \( i \) and judged as \( 1/a_{ij} \). The consistency test is performed on the evaluation results using the formula (1), and the formula is as follows.

\[
CI = \frac{\lambda_{\text{max}} - n}{n - 1}
\] (1)

Then determine the indicator weights, there are formulas as follows.

\[
\overline{w}_i = n \sqrt[n]{\prod_{j=1}^{n} a_{ij}} \quad (i = 1, 2, 3, ..., n)
\] (2)

Then, the normalized judgment matrices are added by columns according to formula (3), and then the entire column vector is normalized to obtain the normalized relative importance of the elements relative to the upper layer criterion.

\[
w_i = \frac{\overline{w}_i}{\sum_{i=1}^{n} \overline{w}_i} \quad (i = 1, 2, 3, ..., n)
\] (3)

3.2. Entropy method to determine the index weight
(1) Raw data standardization processing. Converted as follows:

\[
x_{ij} = \frac{\max_i \{a_{ij}\} - a_{ij}}{\max_i \{a_{ij}\} - \min_i \{a_{ij}\}} \quad (i = 1, 2, 3, ..., n)
\] (4)

In the formula, \( \max_i \{a_{ij}\} \) and \( \min_i \{a_{ij}\} \) respectively represent the maximum value and the minimum value among all the evaluation objects under the same indicator.

(2) Calculate the characteristic weight of the i-th evaluated object under the j-th index.

\[
P_{ij} = \frac{x_{ij}}{\sum_{i=1}^{n} x_{ij}} \quad (i = 1, 2, 3, ..., n)
\] (5)

(3) Calculate the entropy value \( A \) of the j-th index, with the expression:

\[
e_j = -(\ln n)^j \sum_{i=1}^{n} p_{ij} \ln p_{ij}
\] (6)
If \( p_{ij} = 0 \), define \( \lim_{p \to 0} \ln p_{ij} = 0 \). If \( x_{ij} \) is equal for a given \( j \), then \( p_{ij} = 1/n \), then \( e_j = 1 \). Where \( n \) is the number of objects to be evaluated and \( m \) is the number of indicators.

(4) Calculate the difference coefficient of index \( x_j \). The greater the difference coefficient \( q_j = 1 - e_j \), \( q_j \) more attention should be paid to the role of this indicator.

(5) Determine the weight. Using the entropy value to calculate the objective weighting expression of each indicator is:

\[
W_j = q_j / \sum_{j=0}^{m} q_j \quad (j=0,1,2...,m)
\]

3.3. Comprehensive weight determination

The weights obtained by the analytic hierarchy process belong to subjective weights, and the weights obtained by the entropy method belong to objective weights. In order to make the weight of each indicator more scientific and reasonable, this paper will combine the above two methods to determine the weight of indicators in each dimension and each dimension layer.

4. Example analysis

In the actual evaluation operation, the energy companies under test can compare their scores with the scores of excellent energy companies in the industry. While determining the information performance of the energy companies, they can further observe the informationization process of energy enterprises from four levels. And the gap with the industry's outstanding energy companies. Referring to this result, it can be seen that the energy enterprises have some shortcomings in the development of informationization, and provide a basis for formulating the key strategies for the next stage of informationization [3].

Calculate the weights of each dimension of the evaluation criteria layer relative to the indicators of energy enterprise logistics informatization evaluation, and obtain Table 2.

|     | B1  | B2   | B3   | B4   | W     |
|-----|-----|------|------|------|-------|
| B1  | 1   | 1/2  | 1/2  | 4    | 0.27  |
| B2  | 2   | 1    | 3    | 1/2  | 0.35  |
| B3  | 2   | 1/3  | 1    | 4    | 0.21  |
| B4  | 4   | 2    | 1/4  | 1    | 0.17  |

Consistency test results: \( \lambda_{\max} = 6.329; CI = 0.0658; RI = 1.24; CR = 0.0531 < 0.1 \).

By analogy, the secondary indicators can be used to derive the weight of each level of indicators relative to the upper level indicators. According to the above steps, the weights of each index under the various dimensions of energy enterprise logistics informationization are obtained, and combined with the entropy weight method, the selection coefficient is 0.5, and the comprehensive indicators are shown in Table 3.
Table 3. Energy weight of each index of energy enterprise logistics information evaluation system.

| Criteria layer | B1 Weights | B2 Weights | B3 Weights | B4 Weights |
|----------------|------------|------------|------------|------------|
| Indicator layer | 0.27       | 0.35       | 0.21       | 0.17       |
| C11            | 0.02       | C21        | 0.26       | C31        | 0.16       | C41        | 0.10       |
| C12            | 0.10       | C22        | 0.15       | C32        | 0.03       | C42        | 0.27       |
| C13            | 0.24       | C23        | 0.08       | C33        | 0.10       | C43        | 0.19       |
| C14            | 0.30       | C24        | 0.26       | C34        | 0.14       | C44        | 0.14       |
| C15            | 0.06       | C25        | 0.06       | C35        | 0.27       | C45        | 0.25       |
| C16            | 0.05       | C26        | 0.11       | C36        | 0.04       | C46        | 0.05       |
| C17            | 0.23       | C27        | 0.07       | C37        | 0.26       |

5. Ideas and promotion opinions of energy enterprise logistics informationization

Logistics management information system is the core of logistics management informationization. This system utilizes information technology, combines the successful experience of enterprises in logistics management, relies on information technology to standardize processes, clarifies responsibilities, standardizes management, integrates information, and makes the logistics management of enterprises efficient, reasonable, detectable and controllable. Enhance the competitiveness of enterprises. This system should include the following main modules: supplier management, bidding management, warehousing management, outbound management, inventory management, program management, contract management, comprehensive query, system maintenance [4].

5.1. Strengthening the construction and management of energy enterprise information systems

With the development and application of Internet of things technology, the application of RFID technology and wireless sensing technology in energy mining and transportation enterprises has gradually deepened [5]. In terms of the hardware of enterprise information system construction, energy resource enterprises should focus on the application of various advanced sensing and recognition technologies on the basis of the Internet, in order to accurately track and locate the position and quantity changes of products [6]; in terms of software, energy companies In addition to paying attention to the traditional material management system for the enterprise's own production management services, it should also attach great importance to the changes in the data of energy resources information from the production management system to the sales system. The awareness of energy companies should be extended from the management of production materials. The management of sales logistics, and then to the attention of the entire process of the energy logistics supply chain and its own information behavior in the energy logistics supply chain, improve and improve its information system in the development, for the other in the energy logistics supply chain Businesses provide clear, shared information that meets their needs.
5.2. Strengthening the awareness of internal energy logistics management in energy-using units

An energy management information system is a communication system that includes software, data acquisition and storage, and energy information for storing, analyzing, and displaying various organizations. The types of data that energy information systems typically process include energy consumption data, energy price signals, and demand response information. These data are used for operations such as energy forecasting, energy load information, and historical analysis of energy use. Standardized management of energy information of energy-using units can not only save costs and create benefits for energy-using units, but also effectively implement national energy-saving and emission-reduction policies and promote rational use of energy [6].

5.3. Strengthening the construction and management of the public information platform for energy logistics

Establish a public logistics information platform to achieve the goal of information sharing, coordination and cooperation among various departments and enterprises, and a consensus has been formed in the development of the logistics industry. The energy logistics public information platform led by large energy production enterprises or energy logistics service enterprises has the foundation of construction and operation. The key to its function lies in the ease of use of the platform and the necessary business with transportation, industry and commerce, banking and other departments connection. Since energy transportation generally has the characteristics of long-distance and multimodal transportation, in the energy logistics information platform, the energy storage and transportation conversion status of each land and water port in the energy supply range and the transportation capacity of each line transportation equipment should be strengthened. The reflection and processing of transportation status information. The energy logistics public information platform plays a role in the logistics management of energy supply chain. The previous energy logistics system should be kept from the relatively closed traditional logistics system consisting of energy production enterprises and energy-using units. The core competitiveness, the division of labor in the value chain, and the transformation of the open modern logistics system with strong information processing capabilities.

6. Summary

This paper constructs the corresponding evaluation index system, and uses the analytic hierarchy process and the entropy weight legal analysis and quantitative research to provide a new idea for the energy enterprise logistics information evaluation. The evaluation model can provide an operational method to help energy enterprise logistics managers to accurately understand the current informationization of the enterprise, eliminate the bottlenecks in the process of energy enterprise logistics information construction, and provide decision support for enterprise decision makers in information construction. At the same time, the evaluation process is standardized, and it is easy to program and promote the application, which improves the efficiency and scientific of the energy information evaluation of energy enterprises.

Acknowledgments
This work was financially funded by science research project of education department of jilin province, Project number: JJKH20190785SK.

References
[1] Wang Xiaojian, Wang Jianwei. Research on Evaluation Index System and Evaluation Method of Logistics Informatization. Railway traffic and economy, Vol. 10 (2009) No.31, p. 14-19.
[2] Jiang Changbin, Wang Hu, Chen Li. Research on the Evaluation of Automotive Industry Logistics Information Based on AHP. Journal of Wuhan University of Technology: Information and Management Engineering Edition, Vol. 5 (2009) No.1, p.792-795.
[3] GONG Sixing, LIU Weifeng. Urban Port Logistics Informatization Evaluation Model and
Empirical Study Based on Entropy Weight Method. Logistics Engineering and Management, Vol. 12 (2015) No.37, p. 27-29.

[4] Zhao Guanghui. Economic Benefit Evaluation of Logistics Information Service in China. Statistics and Decision, Vol. 4 (2016) No.11, p. 37-42.

[5] Tian Qing, Bai Weidong. Research on the Construction of Informatization Evaluation Index System of Logistics Enterprises. Journal of Logistics Science and Technology, Vol. 1 (2010) No.33, p. 96-98.

[6] Zheng Tianchi, Chu Lisong. Research on the Formation Mechanism of Logistics Informationization and the Construction of Fuzzy Evaluation Model. Logistics Technology, Vol. 8 (2008) No.14, p. 188-191.