# Evaluation and Analysis of Core Competitiveness in Logistics Enterprises Based on the Fuzzy Comprehensive Evaluation Method

Mu Chen, Tianxin Wu, Xuanqiao Mao*

Hubei University of Automotive Technology, Shiyan, China

*Corresponding author: Xuanqiao Mao, 2798462585@qq.com

## Abstract

This study investigates the development status of Group A with a particular focus on the structure and performance of its logistics system. In the context of intensified market competition and rapid industrial transformation, logistics is increasingly recognized as a strategic driver of enterprise competitiveness, shaping cost efficiency, service quality, and supply chain resilience. To provide a systematic and rigorous evaluation, the research adopts the Fuzzy Comprehensive Evaluation Method, which enables the integration of both qualitative judgments and quantitative indicators. Based on this analytical framework, the study identifies the most influential factors affecting Group A's logistics competitiveness, including operational cost control, service responsiveness, digital and intelligent technology adoption, and supply chain coordination capabilities. Furthermore, the findings highlight feasible strategies for strengthening competitiveness, such as advancing digital transformation, fostering collaborative innovation across the supply chain, and enhancing adaptive capacity in a volatile market environment. The analysis underscores how Group A can capitalize on its strengths while mitigating its weaknesses to achieve sustainable growth and maintain long-term strategic advantages. Finally, the study provides forward-looking recommendations that may inform the optimization and strategic upgrading of logistics systems in enterprises with similar developmental trajectories.

## Keywords

Logistics Enterprises, Competitiveness Evaluation, Fuzzy Comprehensive Evaluation Method

## 1. Introduction

The logistics industry has long been regarded as the "lifeline" of national economic development. Its level of advancement not only serves as a key indicator of a nation's comprehensive strength but also constitutes a critical component supporting the efficient operation of a market economy [1]. With the deepening of economic globalization and regional economic integration, competition among logistics enterprises has intensified. In China, despite significant progress achieved through years of development, the logistics sector still lags behind developed economies in Europe and America. This gap manifests in incomplete logistics functions, insufficient informatization and intelligence, and a shortage of high-end logistics talent [2]. Against the backdrop of rising market demands, ongoing reforms in corporate management, and rapid advancements in information technology, the ability to optimize logistics systems, reduce costs, enhance service quality, and improve strategic adaptability has become pivotal to the long-term viability of logistics enterprises [3].

Group A, a representative third-party logistics enterprise in China, has developed over three decades into a modern logistics enterprise exemplifying regional standards. Its business system now encompasses supply chain management, logistics solution design, and integrated services. However, to maintain its competitive edge in this fiercely competitive environment, the company urgently needs to systematically analyze the competitiveness of its logistics system, identify limiting factors, and formulate development strategies tailored to its unique characteristics [4].

Building upon relevant literature, this paper employs the Fuzzy Comprehensive Evaluation Method to systematically assess the competitiveness of Group A's logistics system [5-8]. The research objectives are: First, to identify and organize the key elements influencing the core competitiveness of the logistics system; Second, to reveal the company's strengths and weaknesses in supply chain integration, organizational coordination, cost and value realization, network layout, and strategic flexibility; Third, to propose practical improvement pathways and countermeasures. This research not only provides decision-making references for Group A's future development but also offers valuable insights for Chinese logistics enterprises seeking to cultivate and strengthen their core competitiveness within complex market environments.

## 2. Applications of Fuzzy Comprehensive Evaluation Method

The fuzzy comprehensive evaluation method originated from the development of fuzzy mathematics theory and methodology, and is now widely applied in various fields such as management, logistics, and environmental assessment [9]. In practical evaluations, factors influencing outcomes often exhibit fuzziness and uncertainty, making the quantification of qualitative factors a significant research challenge. When different evaluators hold divergent judgments about the same object, they typically provide fuzzy evaluations such as “large, medium, small” or “high, medium, low” based on their experience and cognition. In such scenarios, fuzzy mathematics theory offers an effective tool for converting qualitative judgments into quantitative outcomes, thereby more accurately reflecting the actual status of the evaluated object.

This paper employs a fuzzy comprehensive evaluation method based on the Analytic Hierarchy Process (AHP) to study the competitiveness of enterprise logistics systems. By integrating evaluation information from multi-level, multi-category indicators, this method is suitable for multi-subject comprehensive evaluations. It effectively handles non-quantifiable and fuzzy issues, aligns with Eastern thinking patterns, and possesses practical value. However, its computational process is relatively complex, and the determination of indicator weights involves some subjectivity, requiring careful consideration during application [10].

### 2.1 Constructing the Factor Set and Judgment Set

The judgment set is denoted as $V=\{V_1,V_2,\cdots,V_n\}$ , representing evaluators' assessments of the evaluation object. For this study's evaluation of Group A's logistics system competitiveness, the judgment set is defined as:V={Strong, Moderate, Weak, Very Weak}

Through expert discussions and scoring using the Delphi method, the final judgment set is formed to serve as the basis for subsequent evaluations.

### 2.2 Determining Indicator Weights

The weights of indicators at each level within the evaluation system constitute the weight set, denoted as: $A=\{A_1,A_2,\cdots,A_n\}$

Indicator weights can be determined using the Analytic Hierarchy Process (AHP) to reflect the relative importance of different indicators in the overall evaluation.

### 2.3 Constructing the Fuzzy Evaluation Matrix

Based on the factor set and comment set, expert evaluation information is collected to construct the fuzzy evaluation matrix $R$ :

$$R=\begin{bmatrix} r_{11} & r_{12} & \cdots & r_{1n} \\ r_{21} & r_{22} & \cdots & r_{2n} \\ \vdots & \vdots & \ddots & \vdots \\ r_{m1} & r_{m2} & \cdots & r_{mn} \end{bmatrix}$$

$r_{ij}$ denotes the membership degree of the $i$ factor at the $j$ evaluation level.

### 2.4 Fuzzy Comprehensive Judgment

The comprehensive evaluation result is obtained through matrix operations:

$$S=A\cdot R$$

After normalizing the result, the strengths and weaknesses of each factor can be analyzed based on the maximum membership degree principle, clarifying the enterprise's position in logistics system competitiveness.

### 2.5 Method Selection and Applicability

The Fuzzy Comprehensive Evaluation Method is particularly suitable for solving complex problems with strong non-quantification and fuzziness [11]. Its fundamental application principle involves: first establishing a comprehensive evaluation indicator system; second, performing fuzzy operations on the weight vectors of each indicator followed by normalization; and finally, deriving the comprehensive evaluation results to quantify multi-objective decision-making problems.

In this study, considering the multidimensionality and fuzziness of logistics system competitiveness, the fuzzy comprehensive evaluation method effectively integrates qualitative and quantitative information to scientifically evaluate Group A's logistics system. However, this method remains significantly influenced by expert subjective judgments in practical implementation. Therefore, minimizing subjective bias during data collection and weight determination is essential to enhance the reliability and scientific rigor of evaluation outcomes. Through this approach, a scientifically sound and reasonable evaluation model for logistics system competitiveness can be constructed, providing a reference basis for corporate strategic decision-making.

## 3. Case Study

Group A pursues the development vision of “building modern logistics to establish a century-long enterprise,” guided by the service philosophy of "safety, convenience, punctuality, enthusiasm, courtesy, and integrity." It is committed to forging a trustworthy service brand. In 2006, Group A established a comprehensive partnership with the internationally renowned third-party logistics provider, the German Maersk Group. It successfully listed on the stock exchange in December 2008 and was officially renamed A Guangxin Logistics Group Co., Ltd. in April 2009. Currently, the Group holds total assets nearing RMB 1 billion, operates approximately 2,000 owned transport vehicles, and employs over 10,000 staff. It has earned multiple honors including "National 5A Logistics Enterprise," "National Advanced Logistics Enterprise," and "Key Logistics Enterprise Designated by the Ministry of Transport." Over the past decades, A Group has achieved sustained rapid growth, evolving from a small transport company with just over 20 employees into a large-scale comprehensive logistics group with annual revenue exceeding RMB 4 billion.

The fuzzy comprehensive evaluation model integrates qualitative and quantitative analysis. Building upon qualitative analysis of factors influencing enterprise logistics system competitiveness, it quantitatively assesses the competitiveness of an enterprise's logistics system. This paper uses Group A as a case study to conduct a fuzzy evaluation analysis of its logistics system competitiveness.

### 3.1 Construction of the Competitiveness Evaluation Indicator System

Logistics system competitiveness represents an enterprise's comprehensive capability in intense market competition, influenced by its operational environment and developmental stage. Consequently, scientifically evaluating logistics competitiveness remains a focal point in both academic research and practical applications. To enhance logistics system competitiveness, enterprises should adopt a market-oriented approach, establish modern logistics systems aligned with market economy development, and integrate external resources to strengthen their overall capabilities. Logistics system competitiveness comprises multiple factors, necessitating measurement through a series of independent, interrelated, and mutually constrained indicators.

The factors influencing the competitiveness of a logistics system are numerous, including basic hardware facilities and equipment, network service capabilities, human resource management, corporate positioning, corporate innovation capabilities, logistics industry experience, marketing capabilities, customer relationship maintenance, and public relations management. Through literature review and field research, four primary factors were identified as influencing Group A's competitive advantage [12,13]: Therefore, we established Group A's logistics system competitiveness indicator system comprising four primary indicators and several secondary indicators. The evaluation factor set is $U = \{U_1, U_2, U_3, U_4\}$;

#### 3.1.1 $U_1$: Logistics Information Technology Capability

A high-level logistics information system represents one of the core competitive strengths of modern logistics enterprises. Secondary indicators include IT sophistication level and information platform development level.

#### 3.1.2 $U_2$:Customer Service System

Customer service forms the foundation of logistics activities, directly impacting customer satisfaction and market competitiveness. Secondary indicators include customer satisfaction and price attractiveness.

#### 3.1.3 $U_3$:Organizational Capability

Clear organizational structures and efficient teams ensure sustainable development. Secondary indicators include human resources, corporate culture, and institutional management.

#### 3.1.4 $U_4$:Logistics Equipment and Facilities

Efficient hardware infrastructure is essential for seamless logistics system operations. Secondary indicators include core technology level and advanced logistics equipment standards.

### 3.2 Fuzzy Comprehensive Evaluation of Group A's Logistics System

#### 3.2.1 Determining the Evaluation Set

The evaluation set is denoted as:

$V=\{V_1,V_2,V_3,V_4\}$={Strong, Average, Poor, Weak}

#### 3.2.2 Determining Weight Vectors and Constructing Fuzzy Matrices

The weights for the primary evaluation indicators were determined using expert scoring as follows (Table 3-1):

**Table 1**. Weighting of primary evaluation indicators.

| Level 1 Evaluation Indicators | U1 | U2 | U3 | U4 |
|---|---|---|---|---|
| **Weight** | 0.35 | 0.2 | 0.1 | 0.35 |

Abbreviated as weight vector: A=(0.35,0.20,0.10,0.35)

Experts anonymously score each indicator within a specified timeframe, applying single-factor fuzzy evaluation to process indicator scores. For instance, evaluation results for logistics information technology capability ($U_1$) are as follows:

40% of experts rated it as “Strong”

30% of experts rated it as “Average”

20% of experts rated it as “Poor”

10% of experts rated it as “Weak”

This evaluation result can be represented as a fuzzy set:

$R_1$=0.4/Strong + 0.3/Average + 0.2/Poor + 0.1/Weak

It can also be expressed as a vector:

$$U_1 = (0.4, 0.3, 0.2, 0.1)$$

In single-factor fuzzy evaluation, the evaluation grade corresponding to the maximum membership degree becomes the final rating for that factor. In this case, “Strong” has the highest membership degree of 0.4, so logistics information technology capability is preliminarily rated as “Strong.” This fuzzy evaluation outcome more comprehensively reflects the experts' overall judgment.

### 3.2.3 Data Organization of Fuzzy Evaluation Results

The fuzzy evaluation results for each primary indicator were obtained through anonymous expert scoring. By integrating weight vectors and fuzzy synthesis calculation methods, the comprehensive evaluation results for Group A's logistics system competitiveness were derived (see Table 2 for specific data). This methodology enables the scientific quantification of an enterprise's strengths and weaknesses across various dimensions, providing a basis for subsequent strategic optimization.

**Table 2**. Data related to the competitiveness evaluation system.

| Primary Indicator | Weight | Secondary Indicator | Weight | Evaluation Level | | | |
|---|---|---|---|---|---|---|---|
| | | | | Strong | Average, | Poork | Weak |
| U1 | 0.35 | U11 | 0.8 | 0.4 | 0.3 | 0.2 | 0.1 |
| | | U12 | 0.2 | 0.2 | 0.5 | 0.3 | 0 |
| U2 | 0.2 | U21 | 0.3 | 0.25 | 0.2 | 0.15 | 0.4 |
| | | U22 | 0.7 | 0.2 | 0.35 | 0.2 | 0.25 |
| U3 | 0.1 | U31 | 0.2 | 0.15 | 0.45 | 0.3 | 0.1 |
| | | U32 | 0.4 | 0.25 | 0.2 | 0.35 | 0.3 |
| | | U33 | 0.4 | 0.2 | 0.2 | 0.3 | 0.3 |
| U4 | 0.35 | U41 | 0.5 | 0.5 | 0.3 | 0.15 | 0.05 |
| | | U42 | 0.5 | 0.4 | 0.3 | 0.2 | 0.1 |

After setting the $U_1$ weight as $A_1$=(0.8, 0.2), the results are as follows:

$R_{11}$:(0.4, 0.3, 0.2, 0.1), $R_{12}$:(0.2, 0.5, 0.3, 0),

and the single-factor evaluation matrix formed by them. $R_1 = \begin{bmatrix} 0.4 & 0.3 & 0.2 & 0.1 \\ 0.2 & 0.5 & 0.3 & 0 \end{bmatrix}$

### 3.3 Calculate Weights and Conduct Decision Evaluation

According to fuzzy mathematics theory, the operation of multiplying fuzzy matrices does not involve multiplying the two terms and then adding them; rather, the smaller value should be taken first, followed by the larger one .

For a given evaluation object, if we know the weight matrix A and the single-factor evaluation matrix R , we can obtain the fuzzy comprehensive evaluation result as the fuzzy set B = A × R, i.e., by performing fuzzy matrix multiplication. In the competitiveness evaluation of Group A, given A and R, we can then derive

$$\mathbf{B_1} = \mathbf{A_1} = (\mathbf{0.8, 0.2})\,\mathbf{R} = \begin{bmatrix} 0.4 & 0.3 & 0.2 & 0.1 \\ 0.2 & 0.5 & 0.3 & 0 \end{bmatrix} = (\mathbf{0.4, 0.3, 0.2, 0.1})$$

Similarly, we can calculate $B_2$ = (0.25, 0.35, 0.2, 0.3), $B_3$ = (0.25, 0.2, 0.35, 0.3), $B_4$ = (0.5, 0.3, 0.2, 0.2). Relative to the primary indicator, we have:

$$\mathbf{B} = (\mathbf{0.2, 0.3, 0.3, 0.2}) \begin{bmatrix} 0.4 & 0.3 & 0.2 & 0.1 \\ 0.25 & 0.35 & 0.2 & 0.3 \\ 0.25 & 0.2 & 0.35 & 0.3 \\ 0.5 & 0.3 & 0.2 & 0.2 \end{bmatrix} = (\mathbf{0.35, 0.3, 0.2, 0.3})$$

After normalization, B≈(0.34, 0.28, 0.19, 0.19). The results of this fuzzy comprehensive evaluation indicate that approximately 34% of experts rated the competitiveness of Logistics System A as “Strong,” 28% rated it as “Average,” 19% rated it as “Poor,” and 19% rated it as “Weak.”

Based on the maximum membership principle, it is evident that the competitiveness of this logistics system falls within the “strong” category. Conducting single-factor fuzzy evaluations of the four competitiveness factors for the aforementioned logistics systems reveals: - In the logistics information technology capability evaluation of Group A's logistics system, the membership degree of ‘strong’ for R is 0.4 (maximum), resulting in a “strong” rating; In the customer service system evaluation of Group A's logistics system, the membership degree of the “average” evaluation indicator for R is 0.35, the highest value, resulting in an “average” rating; In the corporate organizational capability evaluation of Group A's logistics system, the membership degree of the ‘poor’ evaluation indicator for R is 0.35, the highest value, resulting in a “poor” rating; In the logistics equipment and facilities evaluation of Group A's logistics system, the membership degree of the “Strong” evaluation indicator for R is 0.5, the highest value, resulting in a “Strong” rating.

For a given evaluation object, if we know the weight matrix A and the single-factor evaluation matrix R, we can obtain the fuzzy comprehensive evaluation result as the fuzzy set B = A × R, i.e., by performing fuzzy matrix multiplication. In the competitiveness evaluation of Group A, given A and R, we can then deriveFor a given evaluation object, if we know the weight A and the single-factor evaluation matrix R, we can obtain the fuzzy comprehensive evaluation result as the fuzzy set B = A × R, i.e., by performing fuzzy matrix multiplication. In the competitiveness evaluation of Group A, given A and R, we can derive

B1 = A1 = (0.8, 0.2)R = (0.4, 0.3, 0.2, 0.1)

Similarly, we can compute:

B2 = (0.25, 0.35, 0.2, 0.3)

B3 = (0.25, 0.2, 0.35, 0.3)

B4 = (0.5, 0.3, 0.2, 0.2) B4 = (0.5, 0.3, 0.2, 0.2). Relative to the primary indicators, we have: B = (0.2, 0.3, 0.3, 0.2) = (0.35, 0.3, 0.2, 0.3).

After normalization, B ≈ (0.34, 0.28, 0.19, 0.19). . This fuzzy comprehensive evaluation indicates that nearly 34% of experts rate the competitiveness of Logistics System A as “Strong,” 28% rate it as “Average,” 19% rate it as “Poor,” and 19% rate it as “Weak.”

Based on the maximum membership principle, it is evident that the competitiveness of this logistics system falls within the “Strong” category. Conducting single-factor fuzzy evaluations of the four logistics system competitiveness factors reveals: - In Group A's logistics information technology capability evaluation, the “Strong” rating has the highest membership degree (0.4) for R, resulting in a “Strong” rating. - In Group A's customer service system evaluation, the ‘Average’ rating has the highest membership degree (0.35) for R, resulting in an “Average” rating. In the evaluation of Group A's organizational capability, the membership degree of the “poor” rating for R was the highest at 0.35, resulting in a “poor” rating. In the evaluation of Group A's logistics equipment and facilities, the membership degree of the ‘strong’ rating for R was the highest at 0.5, resulting in a “strong” rating.

## 4. Conclusion and Recommendation

### 4.1 Conclusion

This paper first clarifies the research background and significance. It then selects Group A, a logistics enterprise with substantial strength and scale in Quanzhou, as the research subject. After comparing the advantages and disadvantages of various evaluation methods, the most scientifically appropriate approach was chosen to establish a reasonably structured evaluation system. Based on indicator weightings, an objective and impartial assessment was conducted of the competitiveness of its logistics system and its influencing factors. This provides scientific decision-making support for the future development of private logistics enterprises in China similar to Group A. However, while the selected indicators demonstrate strong representativeness, they also reveal certain limitations.

Through the fuzzy comprehensive evaluation method applied to analyze Group A's logistics system competitiveness, we concluded that while the enterprise possesses formidable competitive capabilities, it also exhibits significant weaknesses that cannot be overlooked. First, it is commendable that Group A's logistics system demonstrates strong performance in information technology capabilities and logistics equipment/facilities. This fully reflects the company's high priority on logistics infrastructure and IT systems. Logistics hardware and information technology are not only crucial manifestations of a logistics enterprise's soft power but also key factors in its competitive capability. However, based on expert evaluations, we also found that Group A's logistics system exhibits average customer service capabilities and notably weaker organizational capabilities. This fully reflects the lack of excellent organizational management skills and service awareness within Group A's logistics system, resulting in poor customer satisfaction. These shortcomings mean that even with its strong competitiveness, some experts still rate its overall competitive capability as “poor” or “weak.”

### 4.2 Recommendation

Following our analysis of the above findings, we conclude that Group A's logistics system must leverage its competitive strengths while actively mitigating the “weak link effect” to sustain competitiveness. Accordingly, we propose the following targeted recommendations for Group A's future development, aiming to help its logistics system maintain competitiveness and secure a dominant position in the fiercely competitive logistics market.

#### 4.2.1 Continuously Maintain Competitive Advantages

Sustaining competitive advantages requires Group A's logistics system to consistently upgrade equipment and facilities while developing robust logistics information platforms. First, it should procure the most advanced and specialized transportation, loading/unloading, warehousing, packaging, and related logistics equipment based on actual needs. Strengthen management of these assets, determine optimal transport modes, and ensure rational allocation and utilization to enhance efficiency and reduce costs. Second, it should persist in building a modern logistics information processing platform to achieve information sharing. In its IT development, Group A should adopt a user-centric approach, follow market principles, and fully leverage its information technology advantages.

#### 4.2.2 Identifying Weaknesses and Addressing Shortcomings

The primary shortcomings and weaknesses in Group A's logistics system are low customer satisfaction, mediocre service awareness among employees, and poor organizational capabilities. A Group's logistics system should continuously conduct pre-job training, focusing not only on operational skills but also cultivating employees' customer service awareness. Regular customer visits and feedback collection should be implemented to enhance satisfaction levels. Adopting a people-oriented principle, flexible management should be practiced to strengthen talent development. Actively identify and nurture talent from within the workforce to build a reserve of “high-performing” personnel, while refining internal management systems. Group A should also establish a distinct corporate culture, leveraging its positive guiding, motivational, and integrative functions to elevate the overall quality of its workforce.

#### 4.2.3 Maximizing Logistics Management Optimization

Logistics management involves applying management science to plan, organize, decide, control, and innovate logistics activities within the social reproduction process. This aims to achieve optimal coordination among various logistics operations, reduce costs, and enhance efficiency . As China's market economy system continues to mature and inter-enterprise competition intensifies, companies seeking to enhance the core competitiveness of their logistics systems must continuously elevate their logistics management capabilities. Therefore, logistics management plays a crucial role in the modern logistics industry. To maintain the competitiveness of corporate logistics systems and secure a dominant position, maximizing the optimization of logistics management is imperative. Simultaneously, logistics management must be closely integrated with logistics activities to achieve this optimization.

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