

Application of Entropy Weight TOPSIS Method in Comprehensive Performance Evaluation of Logistics Industry: Take YTO Express as an Example

Li Liu, Fan He

Department of Management, Sichuan University of Science & Engineering, Zigong, China

Abstract: In recent years, the market pattern of express delivery industry has changed a lot, the competition among leading enterprises has intensified, and the performance of YTO Express has decreased year by year. How to improve its performance level is an urgent problem to be solved. Taking YTO Express as the research object, this paper constructs an enterprise performance evaluation system based on the combination of EVA and BSC with the help of relevant theories of both, and then ranks the comprehensive performance of listed companies of SF Holdings, Sto Express, YTO Express and Yunda Stock Express from 2018 to 2022 by using the method of entropy weight TOPSIS. Finally, the analysis of the evaluation results shows that YTO Express's comprehensive performance is backward and there are some problems, such as unreasonable planning of capital structure, low investment ratio of research and development expenses, weak revenue growth rate and customer satisfaction to be improved, etc. Further more, it puts forward relevant suggestions that YTO Express should grasp the growth opportunities, improve service quality, optimize the operation of express and improve research and development investment, so as to help it continuously improve the performance level and market competitiveness. The research results have certain reference significance for the logistics industry to provide new performance management ideas.

Keywords: YTO Express; EVA; BSC; Enterprise performance

1. Introduction

With the steady recovery of China's economy, the trend of online consumption continues to strengthen and solidify^[1]. The first generation of large-scale comprehensive shopping platforms, such as Taobao and JD.COM, continue to iterate in terms of user traffic, all-category transactions and channel sinking, and the development of the "shopping cart-free" shopping model of the second generation of shopping platforms, such as Pinduoduo, have released a large amount of parcels in the express delivery industry while saving the cost of cultivating consumers' online shopping habits. In 2022, the volume of express delivery business was 110.58 billion pieces, and the business revenue was trillion yuan. The revenue from single ticket increased steadily, and steadily developed towards high quality.

BSC (Balanced Scorecard) analysis method is one of the common performance appraisal methods. This method not only analyzes from financial indicators, but also introduces non-financial indicators of customers, internal processes and learning and growth^[2]. It considers both short-term benefits and long-term development, but the financial indicators do not consider the opportunity cost of capital. EVA (Economic Value Added) takes into account the balance of after-tax profit after deducting the cost of capital, which can truly reflect the value created by business operators for shareholders. The combination of the two will provide a more comprehensive thinking for the enterprise performance evaluation.

YTO Express is the first batch of private express delivery enterprises in China, and is also one of the leading enterprises in the express delivery industry in China. It uses the national procurement and distribution network to provide efficient and fast express delivery logistics services for customers. Since the "backdoor listing", the stock price of YTO Express has been rising all the way, and its market share is almost the highest in the industry. However, in recent years, due to the management's decision-making mistakes and the influence of the spread of negative news, the performance of YTO Express has declined, and Yunda and Sto have successively surpassed each other. How to improve its performance is an urgent problem to be solved. Based on the theory of EVA-BSC, this paper constructs a corresponding index evaluation system, and then gives an objective weight to the index system through the entropy weight TOPSIS method. Finally, it analyzes the performance of YTO Express in the past five years, and finds

out the reasons for its performance decline according to the above analysis results, in order to put forward feasible suggestions for YTO Express to break the current predicament and improve the performance development level.

2. Research and design

2.1. The basic principle of entropy method

The basic idea of entropy weight method is to determine the objective weight according to the variability of indicators, which is an objective assignment method and can reduce the deviation caused by subjective assignment^[3]. TOPSIS evaluation method is a commonly used comprehensive evaluation method, which is used to study the distance between the evaluation object and the ideal solution. Combining the positive and negative ideal solutions, the final approach degree is calculated to reflect the gap between each evaluation scheme. In this paper, the most representative of China's express listed companies, namely S.f. Holding Co., Ltd, Sto Express, YTO Express and Yunda, are selected as the analysis objects. All four companies are listed on Shenzhen Stock Exchange and Shanghai Stock Exchange, and continue to operate healthily with obvious index data characteristics. The entropy weight TOPSIS method is used to analyze the four dimensions of EVA-BSC related index data of these four companies in the past five years and sort the results. The specific operation steps are as follows:

(1) Standardization of indicators:

① Index forward:

$$y_{ij}^+ = \frac{x_{ij} - \min(x_{ij})}{\max(x_{ij}) - \min(x_{ij})}, (1 \leq i \leq m, 1 \leq j \leq n) \tag{1}$$

② Index reversal:

$$y_{ij}^- = \frac{\max(x_{ij}) - x_{ij}}{\max(x_{ij}) - \min(x_{ij})}, (1 \leq i \leq m, 1 \leq j \leq n) \tag{2}$$

③ Normalization:

$$P_{ij} = \frac{y_{ij}}{\sum_{i=1}^m y_{ij}}, (1 \leq i \leq m, 1 \leq j \leq n) \tag{3}$$

(2) Calculate the index entropy and index weight: $E_j W_j$

$$E_j = -\frac{1}{\ln m} \sum_{i=1}^m P_{ij} \ln P_{ij}, (j=1, 2, \dots, n) \tag{4}$$

$$W_{ij} = \frac{1 - E_j}{\sum_{j=1}^n E_j}, (j=1, 2, \dots, n) \tag{5}$$

(3) Establish a standardized weighting matrix:

$$Z_{ij} = W_j \times Y_{ij} \tag{6}$$

(4) Determine the positive and negative ideal values:

$$\begin{cases} S_j^+ = \max_{1 \leq i \leq m} \{Z_{ij}\}, (j = 1, 2, \dots, n) \\ S_j^- = \min_{1 \leq i \leq m} \{Z_{ij}\}, (j = 1, 2, \dots, n) \end{cases} \tag{7}$$

(5) Calculate the distance from each evaluation object to the positive ideal solution and the distance to the negative ideal solution: $D_i^+ D_i^-$

$$D_i^+ = \sqrt{\sum_{j=1}^n (S_j^+ - Z_{ij})^2}, (i=1, 2, \dots, m) \tag{8}$$

$$D_i^+ = \sqrt{\sum_{j=1}^n (S_j^+ - Z_{ij})^2}, (i=1,2,\dots,m) \quad (9)$$

(6) Finally, calculate the closeness between the evaluated object and the ideal solution:

$$C_i = \frac{D_i^-}{D_i^+ + D_i^-}, (i=1,2,\dots,m) \quad (10)$$

2.2. The construction of evaluation system

Combining the basic principles of EVA-BSC with the actual operation of express delivery enterprises, and referring to the index system constructed by other scholars, this paper constructs the evaluation index from the financial level, customer level, internal process level and learning and growth level.

2.2.1. Financial dimension

The selection of financial indicators should be as close as possible to the business philosophy of the enterprise and reflect the profitability of the enterprise. The calculation of EVA takes into account the cost of equity capital, and at the same time makes adjustments to the financial indicators that are not relevant to the operation of the enterprise, so as to show the economic benefits of the enterprise more accurately. $EVA = \text{adjusted net operating profit} - \text{weighted average cost of capital} * \text{total investment capital}$, which can more accurately reflect the value the company creates for shareholders over a period of time. Total assets turnover rate can reflect the level of operation of an enterprise and can be used to measure the enterprise's ability to make profits from assets. The asset-liability ratio is the proportion of corporate liabilities to assets. When evaluating an enterprise, the lower this indicator indicates that the stronger the debt paying ability is, the better the rights and interests of the debtor can be protected. However, the low asset-liability ratio indicates that the enterprise does not make effective use of capital and may lose many opportunities for enterprise development.

2.2.2. Customer dimension

What kind of products and services are provided to customers and how to attract customers are one of the key factors for the company to further expand its market scale. Express delivery business is transparent. The level of customer satisfaction directly reflects the service quality of express delivery. Improving customer satisfaction can improve the customer's loyalty to the brand of the express delivery company. At the same time, to promote the good image of the express delivery company, it can bring more customers to the enterprise and thus increase the sales revenue. Customer satisfaction is also conducive to tap the direction of consumer demand, improve service content and enhance the competitiveness of enterprises. By analyzing the market share of the enterprise, we can get the position of the company in the current industry market. Increasing the market share is more helpful for the enterprise to obtain low cost and high profit.

2.2.3. Internal process dimension

Receiving, delivery and information processing are the main activities of express delivery in direct contact with customers. The effective monthly complaint rate reflects the handling efficiency of express delivery enterprises. The index will decrease with the improvement of express delivery process and delivery efficiency. At the same time, if an enterprise wants to deliver goods to customers on time and meet the needs of present and future customers, it must take the optimization of the internal business process as the premise. The inventory turnover rate can reflect the enterprise's inventory management level and is an important part of enterprise management.

2.2.4. Learning and growth dimensions

Nowadays, under the background of economic globalization, the spatial distribution of stakeholders in the whole logistics chain is increasingly dispersed, and customers are all over the cities and villages. How to reduce the cost and improve the operation efficiency is the top priority to enhance the competitiveness of enterprises. Innovation drives growth, and sufficient capital can support enterprise innovation. Talent is the first capital of an enterprise. Raising the proportion of highly educated employees requires enterprises to learn to include, motivate and retain talents. Management improves efficiency by analyzing how to optimize resources and improve management efficiency and quality through the change of R&D expense input ratio.

Based on the above, the EVA-BSC comprehensive evaluation index system is constructed as shown

in Table 1:

Table 1: EVA-BSC Comprehensive Evaluation Index System

Criterion layer	evaluating indicator	Indicator content
Financial dimension	EVA	Net operating profit after tax-(Weighted average cost of capital * Total investment capital)
	turnover of total assets	Operating income/average total assets
	Asset-liability ratio	Total liabilities/total assets
	Operating income growth rate	(amount of operating income for the current year-amount for the same period of last year)/amount of operating income for the same period of last year
Customer dimension	market share	Proportion of business volume to total business volume in the same industry market
	customer satisfaction	C-CSI index of customer satisfaction in China
Internal process dimensions	Average effective monthly appeal rate	Effective Complaint Volume/Express Volume (Million Pieces)
	Inventory turnover	Operating costs/average inventory balance
Learning and growth dimensions	Proportion of highly educated employees	Number of staff with bachelor degree or above/total staff
	Research and development expense input ratio	Research and development expenses/operating income

3. Data and analysis

3.1. Data selection

This paper takes the relevant financial data and non-financial data of listed companies of SF Holdings, Sto Express, YTO Express and Yunda Stock Express from 2018 to 2022 as the research objects, and the relevant data are derived from the corporate annual report and Guotai 'an Database.

3.2. Weight calculation

Through the application of TOPSIS entropy weight method, the weight of each performance evaluation index can be obtained as shown in table 3. The greater the weight proportion, the greater the impact of this index on the performance evaluation of this enterprise.

Table 2: Weight of each indicator

index	Information entropy value e	Information utility value d	Weight coefficient w	Average weight
EVA	0.9470	0.0530	8.52%	9.68%
turnover of total assets	0.9633	0.0367	5.90%	
Asset-liability ratio	0.9334	0.0666	10.71%	
Operating income growth rate	0.9157	0.0843	13.56%	
market share	0.9272	0.0728	11.71%	12.49%
customer satisfaction	0.9175	0.0825	13.26%	
Inventory turnover	0.9300	0.0700	11.26%	7.20%
Average effective monthly appeal rate	0.9805	0.0195	3.13%	
Proportion of highly educated employees	0.9584	0.0416	6.69%	10.98%
Research and development expense input ratio	0.9051	0.0949	15.26%	

As can be seen from Table 2, in the EVA-BSC evaluation system, the customer dimension with the largest weight in the model has an average weight of 12.49%, followed by the learning growth dimension, with an average weight of 10.98%, indicating that in the logistics industry, enterprises should pay more

attention to the market and learning growth dimension in order to achieve sustainable development.

Judging from the breakdown indicators, the research and development expense input ratio with the largest proportion of weight accounted for 15.26%. For express delivery companies, the use of digital tools to accurately control the express delivery life process can not only improve the operation efficiency, but also achieve fine control of costs, indicating that logistics companies should continue to pay attention to research and development, and increase research and development investment; Immediately after that, the second largest share was the growth rate of operating income, with a weighted share of 13.56%, second only to the growth rate of research and development investment. The growth rate of operating income can reflect the growth status and development ability of the business income of the enterprise. The growth rate of operating income is crucial to the sustainable development of logistics enterprises. In addition, the third and fourth place in proportion are the customer satisfaction index and the market share index, with weighting coefficients of 13.56% and 13.71% respectively. The express delivery industry attaches great importance to the user experience, and the level of customer satisfaction can objectively reflect the service level of the enterprise. Then, the fifth largest proportion is inventories in internal processes, with a weight coefficient of 11.26%. It can measure the company's inventory turnover speed and inventory management efficiency within one year, reflecting the operation quality of some internal processes. Finally, the sixth largest proportion is asset-liability ratio, with a weight of 10.71%. The higher the asset-liability ratio, the stronger the enterprise's ability to use leverage, and a good capital structure can attract investors' attention.

3.3. Calculation of closeness degree C^*

The closeness degree C^* of four express delivery companies calculated by TOPSIS method from 2018 to 2022 is sorted by year, and table 3 is obtained:

Table 3: Closeness C^* and ranking of TOPSIS of each enterprise from 2018 to 2022

Unit	2018		2019		2020		2021		2022	
	Closeness	sort	Closeness	sort	Closeness	sort	Closeness	sort	Closeness	sort
S.f.Holding Co.,Ltd	0.451	1	0.469	2	0.531	1	0.543	1	0.531	1
STO.Express	0.353	5	0.422	3	0.375	3	0.393	4	0.444	3
YTO Express	0.376	2	0.367	4	0.364	4	0.410	3	0.376	4
YUNDA Holding Co.,Ltd	0.365	3	0.612	1	0.433	2	0.500	2	0.466	2

As can be seen from Table 3, S.f.Holding Co., Ltd has performed brilliantly in the past five years, almost taking the leading position in the industry. The performance of YUNDA Holding Co.,Ltd has shown an upward trend year by year. The business volume of YUNDA Holding Co., Ltd exceeded 10 billion in 2019. It actively expanded its fresh food business by carefully controlling the cost of single tickets. In 2022, it was already in the second position in the industry, and Sto Express had a relatively stable development. However, the industry position of YTO Express has declined year by year in recent years, from the second position in 2018 to the last position in the head enterprise.

3.4. Analysis of the reasons for the decline in YTO Express's performance

Through the TOPSIS entropy method, the weight of the evaluation index and the performance of YTO Express in the past five years are obtained. Based on this, the key factors that led to the decline of YTO Express's performance can be obtained. Based on the analysis of the original data of YTO Express, it can be seen that in the past five years, the growth rate of operating income and the investment ratio of research and development expenses in YTO Express have shown a downward trend year by year, and they are at the end value of the industry head enterprises, and the asset-liability ratio is also at the end value of the industry head enterprises, which indicates that it is difficult for enterprises to better use financial leverage to improve their performance level.

Therefore, on the whole, the decline in the performance level of YTO industry in the past five years is mainly due to the weak learning and growth ability, the weaker profitability year by year, and the low utilization efficiency of financial leverage. On the breakdown indicators, it is mainly due to the decline in the growth rate of operating income, the decrease in the investment rate of research and development expenses, and the low asset-liability ratio in the head of the industry. Next, we will describe from these three indicators.

3.4.1. The slowdown in revenue indicates that its performance growth is weak

It is known from Figure 1, the growth rate of operating income is an important indicator to reflect the sustainable development of enterprises. Generally speaking, the larger the operating income scale, the higher the performance level. Over the past five years, the growth rate of operating income in YTO Express has decreased year by year, from 40.94% in 2018 to 18.57% in 2022. The growth rate of receivable has almost halved. Compared with its peers, YTO Express was nearly 15 percentage points lower than SF Holdings in 2022, which was at the end of the industry, indicating that the decline in YTO Express's performance in recent years is closely related to its revenue growth.

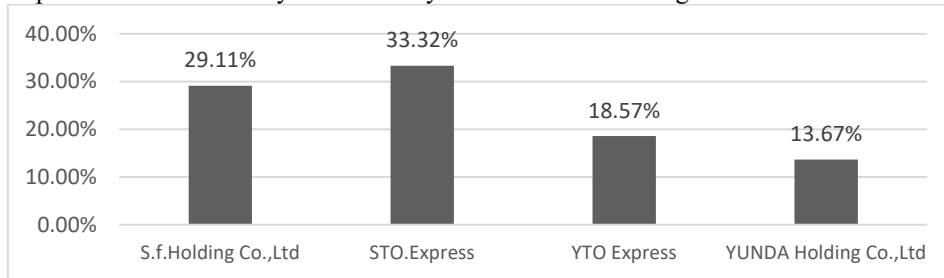


Figure 1: Performance of Growth Rate of Operating Income of Four Major Logistics Companies in 2022

3.4.2. The low investment in research and development reflects the decrease of its innovation ability

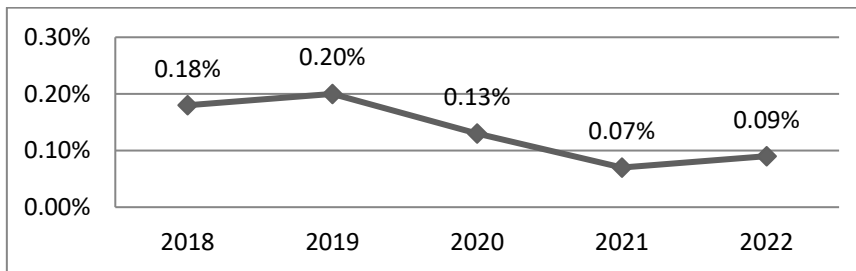


Figure 2: Performance of YTO Express 2018-2022 R&D Expenditure

This is shown in Figure 2, from 2018 to 2022, the investment ratio of research and development expenses in YTO Express did not exceed 0.2%, and the overall trend showed a downward trend. In addition, compared with the same industry, YTO Express's investment in research and development expenses is far less than that of the other three companies, and the ratio of research and development investment in 2022 is the lowest in the industry. "Innovation" is the basis of national strength, is required by national conditions, and is also a roadblock to enterprise development. Report to the 20th CPC National Congress of the Party also pointed out that it is necessary to adhere to the core position of innovation in China's modernization construction, and cannot remain in the face of adversity. In order to achieve sustainable development, express delivery enterprises cannot always rely on price wars, and ultimately need to achieve performance improvement through innovation.

3.4.3. The low asset-liability ratio reflects the lack of investment opportunities

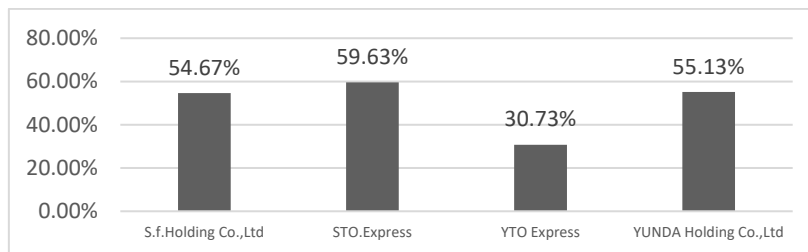


Figure 3: Performance of Asset-Liability Ratio of Four Major Logistics Enterprises in 2022

As can be seen from Figure 3, asset-liability ratio reflects an enterprise's ability to make use of financial leverage. Generally, it can obtain high returns by making rational use of financial leverage. The logistics industry needs to lay out outlets and make a number of operational investments. Generally, the asset-liability ratio is high. However, as soon as YTO Express's asset-liability ratio shows a downward trend year by year, it is also at the end of the industry when compared with the same industry. On the one

hand, it shows that YTO Express's operation is relatively conservative and it is very cautious about investment. On the other hand, it also shows that YTO Express's growth rate is weak and it lacks better growth opportunities.

4. Conclusions and Recommendations

In this paper, a comprehensive performance evaluation system is established through the analysis method of combining EVA with BSC to evaluate the comprehensive performance of express delivery enterprises in a multi-dimensional and more comprehensive way. Using the entropy weight TOPSIS method, the relevant index data of SF Holdings, Sto Express, YTO Express and YUNDA Holding Co.,Ltd from 2018 to 2022 are analyzed, and the weights of each index are determined objectively. It is found that the customer dimension and the learning growth dimension account for the largest proportion of the average weights in the four dimensions; From the breakdown of indicators, the growth rate of operating income, research and development expenses investment ratio, asset-liability ratio and other indicators have a greater impact.

Through the analysis results, we found that the performance of YTO Express has decreased year by year in the past five years. Compared with the same industry, the revenue growth trend is weak, the use of financial leverage is inefficient, and the research and innovation ability is not strong. Based on the above deficiencies, we put forward the following suggestions:

4.1. To seize the growth opportunities to expand the scale of revenue

Find a correct position, make clear one's own competitive advantages, seize opportunities, and explore the enterprise and market potential^[4]. The project of "Express Delivery into Villages" was written into the central document No.1 in 2022. YTO Express should seize the opportunity to push the market down, complete the project of "Express Delivery into Villages" and continue to implement the construction of village post stations. At the same time, it will promote the integration and linkage development of YTO Express International and YTO Airlines, actively develop the products and services of international dedicated lines, enhance the capability of high-quality international logistics full-link services covering Asia and the whole world of Liancheng, and complement the strategic deployment of the short board of the international supply chain with a modern freight aviation network. Flexible use of corporate funds, adjustment of capital structure, refined management of high-quality resources in resource management, avoiding duplication of construction, improving the input-output ratio of core resources, and releasing economies of scale. In order to seek diversified development and enhance the profitability of the enterprise, it is necessary to tap the market's differentiated demand in depth, gradually establish a differentiated and diversified product system, and accurately match the increasingly diversified service demand of customers.

4.2. To improve the quality of service, to stand firm in the mass market

With the improvement of consumers' consumption level and the change of consumption concept, the development of express delivery enterprises is promoted to be more refined. Competition among express delivery enterprises is not limited to price and business volume. Service quality has also become the focus of competition among logistics enterprises. The big data era requires companies to pay more attention to the measurement of online word-of-mouth. The higher the positive word-of-mouth, the higher the satisfaction of the brand in the netizen's speech, the higher the affirmation of the brand in the media report, and the negative word-of-mouth is the opposite. By doing a good job in internet marketing, it can strengthen the image building of the enterprise and continuously bring traffic. At the same time, it can interact with the public on the network platform to create a more friendly network image and maintain the relationship with customers. It can also collect user demand information and feedback, stratify users, carry out product differentiation upgrade, provide diversified products and demands for different types of customers, improve the customer complaint handling mechanism, resolve reasonable demands in a timely manner, and enhance customers' loyalty to the brand.

4.3. To optimize the operation of express delivery, reduce operating costs

In recent years, the express delivery industry has become highly competitive, and price wars have occurred from time to time^[5]. To improve the internal management level is the key point for enterprises to reduce costs and increase efficiency. YTO Express needs to continue to promote the business model of

combining self-operated hub transfer center with flat terminal joining network, increase the investment in automation upgrade and transformation of hub transfer center, strengthen the radiation scope of hub transfer center, make the information smoother, and at the same time strengthen the control of headquarters over affiliates to ensure the service quality of the whole network. Strengthen the information management and control of the whole link, so that the merchants can directly contact the person in charge of any link in the YTO business system, and deal with the relevant problems arising in any link in a timely manner. We will further improve the transportation capacity system, increase the proportion of our own transportation vehicles, increase the comprehensive utilization rate of various vehicles, optimize the existing transportation routes, reduce the transportation costs incurred by vehicles with no load, and try to directly transport to reduce the waste of transportation costs caused by repeated transportation. We will continue to promote refined management of express delivery in terms of timeliness throughout the express delivery process. More often, efficient express delivery is more attractive than low cost, which is beneficial to the Company in optimizing the customer structure, improving the operation efficiency and reducing the operation cost.

4.4. To increase investment in research and development, talent synergy

Enterprises need to strengthen financial support in technology research and development, strengthen internal information technology level construction and informatization level improvement, and improve informatization level. Expand the field of application of science and technology, further promote the construction of smart logistics, innovate the service model, guide the daily business activities of enterprises to gradually develop into digital, and promote the coordinated development of e-commerce and express logistics by means of the internet of things, big data, cloud computing and other technical means. This will not only improve the management efficiency, but also reduce unnecessary costs, thus enhancing the comprehensive competitiveness. Moreover, by reducing the environmental pollution and resource consumption in various links such as receiving, sorting and transportation, the development of "low pollution, low consumption, high efficiency and high benefit" will be realized. Do a good job in personnel training, improve the new staff's familiarity with the corporate culture and work content, encourage the old staff to become mentors, and create a reasonable promotion mechanism. Improve the technical level of talents, actively introduce high-tech talents, prepare manpower for innovative research and development, actively cultivate management talents, and pave the way for efficient operation of enterprises.

References

- [1] Luo Zhengqing, Chen Mengqi. *Research on Enterprise Financial Flexibility Based on Entropy-TOPSIS Method-Taking BOE as an Example [J]. China Market, 2023, (11):131-134.*
- [2] Zhang Jing, Zhao Lizhi. *Application of entropy weight TOPSIS- grey correlation method in indoor environmental quality assessment [J]. Value engineering, 2023, 42(09):113-115.*
- [3] Wu Benjie. *Design of performance evaluation model combining EVA quality evaluation with BSC [J]. Business Accounting, 2022, (24):109-112.*
- [4] He Wenting, Deng Xiaojun. *An Empirical Study on the Performance Appraisal System of Listed Companies in Shaanxi Province Based on EVA—BSC Coupling [J]. China Economic and Trade Journal (2), 2021, (02):104-107.*
- [5] Wang Hong, Guo Heng, Wu Jingyun et al. *Evaluation of low-carbon transformation process of power generation enterprises based on entropy-TOPSIS method [J]. Thermal Power, 2023, 52(07): 26-32.*