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Goal-oriented performance appraisal: An empirical analysis based on an improved fuzzy integrated evaluation method

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Abstract With the deepening development of market economy, enterprise performance assessment has become a key part of enterprise strategic management. This study constructs a corporate performance assessment model that combines economic value added (EVA) and balanced scorecard (BSC), and empirically analyzes it through an improved fuzzy comprehensive evaluation method. The study establishes a performance evaluation index system covering four dimensions: finance, customer, internal process, and learning and growth, based on the financial data and operations of Company T from 2018 to 2022. By applying the expert scoring method and fuzzy evaluation matrix calculation, it is found that the EVA value of Company T improves from -67,212,000 yuan in 2019 to 2018,402,000 yuan in 2021, and the operational performance realizes a significant breakthrough in 2021-2022, with the revenue growth rate increasing from 38.0485% to 96.1922%. Among the customer dimension indicators, the reasonable assessment of customer maintenance rate guides the enterprise to achieve stable market share, while among the internal process dimensions, product quality qualification rate and product shipment timeliness play a key role in the improvement of the enterprise's operational efficiency. The study shows that the fuzzy comprehensive evaluation model based on EVA-BSC can comprehensively reflect the enterprise's strategy implementation effect, effectively integrate financial and non-financial indicators, and provide scientific basis for the enterprise's operation decision-making, so as to realize the steady enhancement of enterprise value and sustainable development.

Index Terms economic value added, balanced scorecard, fuzzy comprehensive evaluation, performance assessment, enterprise value, sustainable development

I. Introduction

As an important means to enhance organizational effectiveness and stimulate the potential of employees, the role of performance appraisal has long surpassed the simple assessment of results, and has become a core tool for enterprises to achieve strategic goals [1]. The traditional performance assessment is too single, often difficult to fully reflect the value of employees in the development of the organization, and may even lead to a disconnect between the goals and the actual needs [2], [3]. In order to crack this problem, goal management has gradually become a more scientific and efficient performance management method [4]. Goal management is a method to improve employee efficiency and management effectiveness by clearly setting specific and quantifiable goals [5]. Through clear goal setting, systematic process management and timely feedback evaluation, it not only allows the strategic direction of the enterprise to be effectively decomposed, but also stimulates the autonomy and creativity of employees, and promotes the two-way empowerment of personal development and organizational growth [6]-[9].

At the same time, through clear goal setting, each employee's personal efforts are aligned with the overall strategic goals of the enterprise, ensuring that all employees work toward a common direction [10]-[12]. Although goal management is an efficient management tool, it still faces many challenges in the implementation process, especially in the goal setting and implementation stages [13]-[15]. Therefore, the introduction of the fuzzy comprehensive judgment method and the design of a new performance evaluation method oriented to the goal management of social enterprises aim to ensure the stable operation and development of enterprises in this way.

Enterprise performance evaluation is an indispensable and important part of enterprise strategic management system, which is not only an important tool to measure the business results of the enterprise, but also a key basis for the enterprise to make decisions and strategic planning. Against the background of increasingly fierce globalization competition and changing market environment, enterprises have higher and higher requirements for performance evaluation. Traditional performance assessment methods mainly rely on single financial indicators,

such as profitability, return on assets, etc. Although these indicators can visually reflect the profitability of enterprises, it is difficult to comprehensively reflect the comprehensive competitiveness and development potential of enterprises. Especially in the era of knowledge economy, the influence of non-financial factors such as intangible assets, innovation ability and customer relationship on the long-term development of enterprises is becoming more and more prominent, and relying solely on financial indicators can no longer meet the needs of modern enterprise performance evaluation. Under such circumstances, it is particularly important to seek a performance evaluation method that can comprehensively consider both financial and non-financial indicators. As a new type of financial performance assessment tool, Economic Value Added (EVA) can more accurately measure the real value created by the enterprise by considering the cost of capital, avoiding the limitations of traditional accounting profit indicators. The Balanced Scorecard (BSC), on the other hand, comprehensively evaluates corporate performance in four dimensions: finance, customers, internal processes, and learning and growth, focusing on short-term financial results as well as the cultivation of long-term development capabilities. Combining EVA with BSC not only makes up for the shortcomings of a single assessment method, but also builds a more scientific and rational performance assessment system. However, in practical application, the issues of how to effectively integrate these two methods, how to determine the weights of each assessment index and how to deal with the ambiguity and uncertainty in the assessment process still need to be studied in depth. The fuzzy comprehensive evaluation method, because of its ability to deal with the combination of qualitative and quantitative issues, has obvious advantages in dealing with assessment problems with ambiguity and uncertainty, and provides an effective way to solve the above problems.

Based on the above analysis, this study proposes an EVA-BSC performance assessment model based on the improved fuzzy comprehensive evaluation method, and takes Company T as an example for empirical analysis. Firstly, the strategic objectives of the enterprise are clarified, a strategy map is drawn, and an EVA-BSC assessment framework containing four dimensions, namely, finance, customers, internal processes, and learning and growth, is constructed; then, representative assessment indicators are selected for the operating characteristics and industry characteristics of Company T and the improved fuzzy comprehensive evaluation method is applied to determine the weights of each indicator; then, based on Company T's 2018-2022 2018-2022 financial data and operating conditions, the value of each assessment index was calculated and a comprehensive evaluation was conducted; finally, based on the evaluation results, the performance status of Company T was analyzed and suggestions for improvement were made. Through this study, it not only provides a scientific performance evaluation method for Company T, but also provides a reference for the performance evaluation practice of other enterprises.

II. EVA-BSC based corporate target performance evaluation

II. A. Relevant Concepts and Connotations

II. A. 1) The concept of EVA and its characteristics

The concept of EVA was put forward by scholars in the United States, EVA refers to the economic value added, which is the net value of the enterprise's after-tax operating profit minus the cost of all the capital used in the enterprise's operation [16]. Compared with the traditional financial indicators of performance evaluation work, EVA is more focused on the real profit of the enterprise, he does not include the profit of investment costs. The formula for calculating EVA is as follows: EVA = net operating profit after tax - cost of capital = net operating profit after tax - weighted average cost of capital rate × total capital. In EVA, through the enterprise's operating profit and investment cost of scientific adjustment calculation, better for the enterprise's performance evaluation to bring scientific indicators. Enterprises can combine their own business types in operation and management, select the main items in EVA to carry out performance evaluation, so as to better improve the rationality of performance evaluation.The application of EVA in performance rating work has the characteristics of accuracy and authenticity. First of all, the accuracy refers to the fact that the application of EVA in performance evaluation can be considered from the perspective of the cost of equity capital invested by shareholders, and scientifically show the real profit situation of the enterprise, better reflecting the actual operating effect of the company, so as to bring more benefits to the shareholders of the company. Secondly, the authenticity refers to the fact that the application of EVA can reduce the phenomenon of manipulation of corporate funds by accountants, better ensure the rationality of the corporate capital structure, and also effectively realize the suppression of short-term behaviors of the operators, and better guarantee the long-term development of the enterprise.

II. A. 2) Balanced scorecard concept and content framework

The balanced scorecard (BSC) is a strategic control system that transforms the strategic objectives of an enterprise into a set of strategic control systems that are easy to operate for performance evaluation [17]. The balanced scorecard is mainly composed of financial and non-financial indicators, which can better promote the successful implementation of scientific and rational performance evaluation. In the balanced scorecard contains

financial, customer, internal processes, and learning and growth content, in the above content, will set the target and indicator values and other content, fully the enterprise's strategic objectives and performance assessment indicators are linked, and then better form a set of scientific performance evaluation system. At present, the Balanced Scorecard has been widely used in the strategic management and control of many enterprises, and has brought scientific guidance to the management decision-making of the enterprises. In the application of the Balanced Scorecard, it is possible to supervise the realization of the strategic objectives of the enterprises and observe the performance of the indicators in the process of achieving the objectives.

II. A. 3) Balanced scorecard performance evaluation based on EVA improvement as a goal

EVA integrated balanced scorecard is to play the carrier function of the balanced scorecard, as well as the orientation of EVA, the guidance function of EVA and balanced scorecard on the long-term development of the enterprise's impact on the organic integration of the company's strategic objectives according to the balanced scorecard indicators for the layer-by-layer decomposition, transformed into a more specific objectives, to the EVA financial indicators as a comprehensive performance evaluation system, to verify the company's EVA financial indicators as a comprehensive performance evaluation system to verify the success or failure of the company's business strategy. In the BSC performance evaluation based on EVA improvement, the ultimate goal is to achieve the strategic objectives of the enterprise, to promote the maximization of the economic benefits of the enterprise, and through the integration of the two, to achieve a comprehensive examination of the financial and non-financial indicators of the enterprise, and to better improve the comprehensiveness and rationality of the performance evaluation. Meanwhile, both EVA and Balanced Scorecard analyze the performance of enterprises from the financial dimension, especially in the Balanced Scorecard, the financial dimension occupies an important proportion in the whole evaluation system, and several other dimensions are born for the realization of finance. The balanced scorecard performance evaluation based on the goal of EVA improvement is characterized by comprehensiveness, participation and synthesis.

II. A. 4) Balanced scorecard performance evaluation methodology based on EVA improvement as a goal

The balanced scorecard performance evaluation method based on EVA improvement as the target fully integrates the performance evaluation dimensions of EVA and balanced scorecard, prompting the combination of EVA value-driven and BSC's five dimensions indicators, thus reflecting the competence quality indicators, driven by the EVA indicators and integrated with the BSC financial indicators, and focusing on the creation of shareholders' value to promote the enterprise's learning progress and innovative development. On this basis, according to the corporate development strategy, the corporate performance evaluation indexes are categorized into five dimensions, namely, social responsibility, internal process, finance, learning and growth, and customer, and their weights are set. That is to say, with EVA as the five-dimensional tailor-made, BSC, and ultimately return to the overall strategy of the enterprise.

II. B.EVA-BSC Corporate Performance Evaluation Design Principles and Basic Framework

II. B. 1) Clarification of strategic objectives

As China's electrical equipment industry begins to transform into high-quality development, T Company realizes the strategic transformation of the enterprise. The company will seize the development opportunity of building new electrical equipment systems, accelerate the implementation of the new energy industry layout, and deeply promote the strategy of strengthening the enterprise with talents to push forward the high-quality development of the enterprise.T Company's strategic plan, which aims to achieve the preservation and enhancement of the value of the state-owned assets, consists of five dimensions, namely, finance, customers, internal processes, learning and growth, and sustainability, which are interconnected and promote each other, and ultimately reflect the organization's strategy.

II. B. 2) Mapping the strategy

Based on the above strategy map drawing logic and the strategic objectives of Company T, each of the five dimensions assumes different strategic sub-objectives, and thus Company T's strategy map is specifically shown in Figure 1:

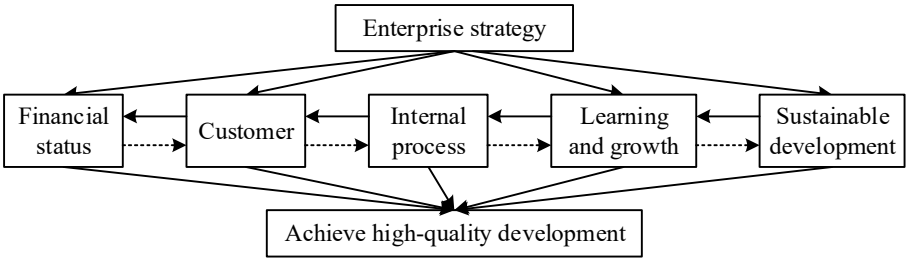

Figure 1: T company Enterprise Strategy

Figure 2 shows the EVA-BSC performance assessment framework of Company T. The overall strategy of Company T is to seek progress while maintaining stability and to realize high-quality development of the enterprise, and the strategic objectives of these five dimensions are interlocked and promote each other to balance each other [18]. Firstly, in the dimension of sustainable development, the production and operation of the enterprise should be based on focusing on environmental protection and energy saving and improving the degree of social responsibility. Secondly, in the learning and growth dimension, through the formation of a long-term mechanism for talent training and incentives, continuously improve the incentive mechanism to strengthen the construction of talent, through the continuous information technology construction and digital transformation to optimize the information system, through the party building, legal construction, etc. to improve the organizational construction. And then promote the internal process dimension procurement, production, warehousing, distribution of high-efficiency production processes, promote the continuous strengthening of internal control methods construction, improve the management of rules and regulations, promote the standardization of production safety management, strengthen the safety management model of the safety production model, promote the design, research and development of scientific and technological innovation. Thus in the customer dimension to consolidate and improve the company's existing products market share, enhance the company's ability to quickly respond to customer demand, improve product quality. Finally, to maximize shareholder value, improve asset utilization, improve cost structure, forming a virtuous cycle to drive the realization of the ultimate strategic objectives.

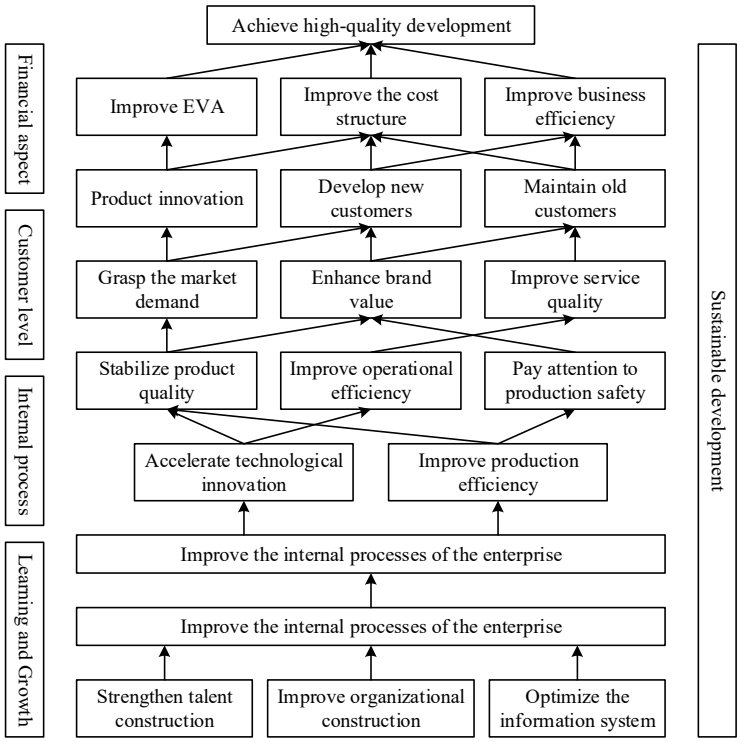

Figure 2: T company EVA-BSC Performance Evaluation Framework

II. C. Selection of indicators related to EVA-BSC performance evaluation

II. C. 1) Financial dimension indicators

The establishment of the EVA-BSC performance evaluation methodology motivates companies to link their financial objectives to the overall strategy of the whole enterprise and to improve their financial level by making the financial objectives the core of the other dimensions, and each of the selected indicators should be a chain of cause and effect.

(1) EVA core indicators

a) EVA

EVA indicator is the core of financial indicators, Stewart proposed the definition and calculation of EVA has been described in Chapter 2. EVA takes into account the opportunity cost of equity funds, better reflecting the business performance of the enterprise than pure accounting profit indicators, and EVA focuses on the sustainable development of the enterprise, and the interests of shareholders are closely linked to the enhancement of fund management and the realization of corporate interests, the interests of operators and employees have a role in promoting the unity of interests. EVA is more focused on the sustainable development of the enterprise and closely related to the interests of shareholders, which is helpful for improving the level of capital management and realizing the unity of the interests of the enterprise, the interests of the operators and the interests of the employees. The formula is:

$$\begin{aligned} \text{EVA} = {} & \text{Net operating profit after tax} \\ & - \text{Weighted average cost of capital ratio} \\ & \times \text{Total capital} \end{aligned} \tag{1}$$

b) EVA return

Capital size affects EVA, the larger the capital size creates more EVA when the capital efficiency is similar. Therefore, in performance evaluation, in addition to the absolute amount, the impact of capital size and the efficiency of the company in creating value should be taken into account. The calculation formula is:

$$\text{EVA Return rate} = \frac{\text{EVA}}{\text{Capital occupation}} \times 100\% \tag{2}$$

(2) Profitability indicators

a) Gross operating margin

Gross operating margin is an important indicator for measuring the profitability of an enterprise, and it is also very helpful for judging the core competitiveness and development of an enterprise. The higher the gross operating margin, the stronger the competitiveness of the enterprise, the better the profitability of the enterprise. Electrical equipment industry has faced the risk of raw material price fluctuations in recent years, should pay special attention to the ability of enterprises to control costs. The calculation formula is:

$$\begin{aligned} & \text{Operating gross profit margin} \\ & = \frac{\text{Operating income - Operating cost}}{\text{Operating income}} \\ & \times 100\% \end{aligned} \tag{3}$$

b) Period expense ratio

The period expense ratio can evaluate the enterprise's ability to manage and control expenses. The lower the period expense ratio is, the better the economic benefits of the period expense inputs are, the stronger the company's ability to control expenses, and the more favorable to the company's profitability. The formula is:

$$\begin{aligned} & \text{Period expense ratio} \\ & = \frac{\text{Sales expenses + administrative expenses + financial expenses}}{\text{Operating income}} \\ & \times 100\% \end{aligned} \tag{4}$$

c) Return on net assets

Return on net assets, as the most comprehensive and integrated indicator for evaluating corporate performance, can effectively measure the efficiency of the use of funds in electrical equipment enterprises and reflect the level of return on shareholders' equity. The calculation formula is:

$$\text{Return on net assets} = \frac{\text{Net profit}}{\text{Average balance of shareholders' equity}} \times 100\% \tag{5}$$

(3) Solvency indicators

a) Current ratio

Current ratio is a measure of the company's short-term debt capacity indicators, the higher the ratio, the greater the cash flow, the stronger its short-term solvency. BL Electric in recent years to develop markets, research and development of new products increased a large number of short-term borrowing needs to focus on the current ratio. The formula is:

$$\text{Current ratio} = \frac{\text{Current assets}}{\text{Current liabilities}} \times 100\% \tag{6}$$

b) Gearing ratio

The gearing ratio can reflect the degree of financial risk of the enterprise and the stability of the share price of the listed company. Since the electrical equipment industry is more obviously affected by domestic and foreign markets and national macro policies and has higher operational risks, Company T needs to adopt a more stable asset-liability structure. The calculation formula is:

$$\text{Asset-liability ratio} = \frac{\text{Total liabilities}}{\text{Total assets}} \times 100\% \tag{7}$$

c) Interest earned multiple

Earned interest multiple is an important indicator to measure the company's ability to repay long-term liabilities with operating income, the higher the earned interest multiple, the higher the long-term solvency of the enterprise. The formula is:

$$\text{The interest multiple obtained} = \frac{\text{Total earnings before interest and taxes}}{\text{Interest expense}} \times 100\% \tag{8}$$

(4) Operating capacity indicators

a) Inventory turnover rate

For electrical equipment companies, the inventory turnover ratio can be used to measure the efficiency of the balance between purchasing, production and sales. A higher ratio indicates that the company's inventory assets have better realizability. The formula for this indicator is:

$$\text{Inventory turnover rate} = \frac{\text{Operating income}}{\text{Average balance of inventory}} \times 100\% \tag{9}$$

b) Accounts receivable turnover ratio

Accounts receivable turnover ratio refers to the time a company is entitled to obtain accounts receivable and spends to collect them into cash. If the company is able to collect accounts receivable in a timely manner, the efficiency of the company's capital utilization will be greatly improved. company T has faced a greater risk of accounts receivable in recent years due to the long payment cycle of its products and other reasons. The calculation formula is:

$$\text{Accounts receivable turnover rate} = \frac{\text{Sales revenue}}{\text{Average occupied amount of accounts receivable}} \times 100\% \tag{10}$$

(5) Development capacity indicators

a) Net profit growth rate

Net profit growth rate is the expansion rate of the enterprise to realize the maximum value, and it is an important index to measure the company's business performance and development potential. The higher the rate, the

stronger the company's market competitiveness and the better the trend of future development prospects. The calculation formula is:

$$\text{Net profit growth rate} = \frac{\text{Net profit for the current period - Net profit for the previous period}}{\text{Net profit in the last period}} \times 100\% \tag{11}$$

b) Capital Preservation and Appreciation Ratio

The capital preservation and appreciation rate reflects the operational efficiency and safety of the enterprise's capital. The higher the index, the better the capital preservation of the enterprise and the stronger the development potential of the enterprise. BL Electric, as a state-owned enterprise, focuses on the preservation and appreciation of state-owned assets in its performance evaluation, so this paper selects the capital preservation and appreciation rate as the assessment index. The calculation formula is:

$$\text{Capital preservation and appreciation rate} = \frac{\text{End-of-period owner's equity}}{\text{Initial owner's equity}} \times 100\% \tag{12}$$

c) Total Assets Growth Rate

Total assets growth rate is an important indicator reflecting the company's capital accumulation and development status in the current year. company T has continued to expand its production capacity in recent years and increased its efforts to acquire enterprises, the overall development speed of the enterprise is relatively fast, and it is necessary to pay attention to the quality of the expansion of the asset scale to avoid blind expansion. The calculation formula is:

$$\text{Growth rate of total assets} = \frac{\text{The increase in total assets this year}}{\text{Total assets at the beginning of the year}} \times 100\% \tag{13}$$

II. C. 2) Customer dimension indicators

Department level customer dimension indicators contain product quality satisfaction, customer maintenance rate, customer satisfaction, customer complaint rate and so on. In this paper, these four indicators are selected, and their specific calculation formulas and the reasons for their selection are as follows:

R & D indicator selection reasons: the indicator is a quantitative study, through the product satisfaction questionnaire, to obtain the consumer's satisfaction with the company's products, the desire to buy again and recommendation rate and other indicators of evaluation. Generally speaking, product quality satisfaction is accomplished by distributing questionnaires, and the survey items of product quality satisfaction of Company T packages taste, packaging and so on.

(1)Satisfaction with product quality

(2)Customer maintenance rate

Reason for selecting the indicator: If an enterprise wants to maintain a stable market share, it is not enough to introduce new customers. Good customer retention rate is the key, you need to keep the old customers on the basis of increasing the competitiveness of the market. Not only does it make the business work more efficiently, but it is also an important way to keep performance stable. The customer retention rate formula is shown in (14):

$$\begin{aligned}&\text{Customer retention rate}\\ &=(\text{Number of customers at the end of the period}\\ &\quad - \text{number of new customers})\\ &\div \text{Number of customers at the beginning of the period}\\ &\times 100\%\end{aligned} \tag{14}$$

II. C. 3) Internal operational dimension indicators

Departmental level internal operation dimension indicators include production plan completion rate, material consumption rate, product return rate, inventory destruction rate, product quality pass rate, product shipment timely rate, safety accident rate and so on. In this paper, we have selected the five indicators of production plan

completion rate, product shipment timeliness rate, product quality qualification rate, inventory destruction rate, and safety accident rate, and the specific formula and the reasons for its selection are as follows:

(1) Production plan completion rate

Indicator selection reasons: the production plan to achieve the rate of the purpose of the overall assessment of the entire production operation of the ability to achieve a low rate shows that there are still many problems within the company, in order to improve the company's operational capacity, we must be determined to take action to solve. The specific formula is shown in (15):

$$\begin{aligned}&\text{Production plan completion rate}\\&=\text{actual production volume}\\&\div\text{Planned production volume}\\&\times 100\%\end{aligned} \tag{15}$$

(2) Timeliness of product shipments

Reason for selecting the indicator: This indicator represents the extent to which the supplier meets the customer's commitment to fulfill the promise and the degree of original demand. For a cold drink food manufacturing enterprise, on-time delivery of products is a more important indicator. The production department's on-time product delivery rate represents whether its collaborative production chain can meet the supply chain demand, or whether the production department's management level is high or low. The formula for product shipment on-time rate is shown in (16):

$$\begin{aligned}&\text{Product on-time delivery rate}\\&=(1-\text{Number of untimely shipments})\\&\div\text{Number of timely product shipments}\\&\times 100\%\end{aligned} \tag{16}$$

(3) Product quality pass rate

Reasons for the selection of the indicator: The product quality pass rate reflects the degree of qualified quality of materials in the production process. It evaluates the degree of performance of the production department, including the relevant quality problems sampled by the enterprise's internal management system and the quality accident problems received from customer complaints. The specific formula is shown in (17):

$$\begin{aligned}&\text{The qualified rate of product quality}\\&=\text{the number of qualified products}\\&\div\text{ the total number of products}\\&\times 100\%\end{aligned} \tag{17}$$

(4) Destruction rate of inventory goods

Reason for indicator selection: SD is a cold drink company, cold drinks are seasonal food, summer sales are in short supply, winter oversupply, i.e., a large amount of inventory will be generated in winter to meet the demand in summer, so the indicator of inventory destruction rate of SD is more emphasized. The formula of inventory destruction rate is shown in (18):

$$\begin{aligned}&\text{The destruction rate of inventory goods}\\&=\text{the number of damaged inventory goods}\\&\div\text{ the total number of inventory goods}\\&\times 100\%\end{aligned} \tag{18}$$

II. C. 4) Learning and Growth Dimension Indicators

The indicators of learning and growth dimensions at the departmental level include employee satisfaction, departmental cooperation satisfaction, employee knowledge level, ratio of highly educated employees, employee training and so on. In this paper, the three indicators of employee training, departmental cooperation satisfaction, and employee satisfaction are selected, and their specific formulas and the reasons for their selection are as follows.

(1) Employee satisfaction

The reason for the selection of the indicator: the indicator refers to the degree of satisfaction formed by an employee through the treatment received in the enterprise compared with his expectations, the enterprise must

pay attention to the inner needs of the staff, to understand the real ideas of the staff, in order to mobilize the enthusiasm of the staff.

(2) Satisfaction with departmental cooperation

Reason for selecting the indicator: This indicator investigates the cooperation between the production department and other departments. Through the survey of departmental cooperation satisfaction to effectively diagnose the potential problems of each department, conduct a comprehensive audit of each department, understand the inter-departmental cooperation program exists in the low efficiency, high loss rate and other issues, improve the level of departmental cooperation, improve the quality of management, and better adapt to the future development of the company.

(3) Employee training rate

Indicator selection reason: the tabulation of the production sector staff training, from the enterprise human resources department report table can be found, the company in the new workers after the entry into the staff for induction training, each department has its own specific training program for employees, the later irregularly experienced veteran employees will be trained on the new employees.

III. Construction of enterprise performance evaluation index system based on fuzzy comprehensive evaluation

III. A. Fuzzy integrated evaluation

III. A. 1) Determination of the set of factors for comprehensive evaluation

The factors affecting the subject of the evaluation are organized into a factor set, i.e., $U=\{U_1,U_2,U_3.....,U_m\}$. Where element U_m represents the m rd factor affecting the subject of the evaluation.

III. A. 2) Determination of evaluation levels for integrated evaluations

The set of various results given by the expert after completing the scoring of the evaluation object based on experience is the evaluation level, which is generally denoted as $V=\{V_1,V_2,V_3.....V_m\}$. In this case, element V_m denotes the m rd evaluation result. Generally speaking, different grades, numbers or rubrics can be used to express this in combination with practical needs. In this paper, the author constructs the evaluation level as V = {excellent, good, fair, poor, very poor}, from which the fuzzy comprehensive judgment matrix can be determined:

$$U_1=\begin{bmatrix} u_{11} & u_{12} & u_{13} & u_{14} \\ u_{21} & u_{22} & u_{23} & u_{24} \\ u_{31} & u_{32} & u_{33} & u_{34} \\ u_{41} & u_{42} & u_{43} & u_{44} \end{bmatrix} \tag{19}$$

Each value in the matrix Ul is divided by the total number of experts Z, from which the fuzzy comprehensive judgment matrix Vl can be obtained:

$$V_1=\begin{bmatrix} v_{11} & v_{12} & v_{13} & v_{14} \\ v_{21} & v_{22} & v_{23} & v_{24} \\ v_{31} & v_{32} & v_{33} & v_{34} \\ v_{41} & v_{42} & v_{43} & v_{44} \end{bmatrix} \tag{20}$$

III. A. 3) Conducting single-factor fuzzy evaluations

Multiply the eigenvector W of the weights of each index with the fuzzy comprehensive judgment matrix V to get the evaluation vector J of the dimension, i.e., $J=W\times V$. Eventually, the evaluation matrix of each dimension can be calculated to get the evaluation matrix J, so as to construct the comprehensive evaluation matrix:

$$J_1=W_1\times V_1=(W_{11},W_{12},W_{13},W_{14})\times\begin{bmatrix} v_{11} & v_{12} & v_{13} & v_{14} \\ v_{21} & v_{22} & v_{23} & v_{24} \\ v_{31} & v_{32} & v_{33} & v_{34} \\ v_{41} & v_{42} & v_{43} & v_{44} \end{bmatrix}=[j_{11},j_{12},j_{13},j_{14}] \tag{21}$$

$$J = \begin{bmatrix} j_{11} & j_{12} & j_{13} & j_{14} \\ j_{21} & j_{22} & j_{23} & j_{24} \\ j_{31} & j_{32} & j_{33} & j_{34} \\ j_{41} & j_{42} & j_{43} & j_{44} \end{bmatrix} \tag{22}$$

III. A. 4) Conducting a fuzzy integrated evaluation

Based on the weight W of each dimension to the total objective and the evaluation matrix J, the two are multiplied to calculate the final business performance matrix of the enterprise, and the evaluation is made according to the principle of maximum affiliation.

III. B. Construction of Enterprise Performance Evaluation Indicators

The integrated performance indicator is a comprehensive score of the performance level of the enterprise, reflecting the combined performance of the enterprise's economic and environmental performance. It is taken by multiplying the comprehensive fuzzy evaluation result B and the transpose of the evaluation level branch line vector C. That is, comprehensive performance indicator = $B*C^T$, as shown in Table 1.

Table 1: Comprehensive performance index system

Target layer	Criterion layer	Primary index	Secondary index
Enterprise performance and business decision	Financial dimension	Profitability	Sales net profit rate
			Net assets yield
			Total assets yield
		Capacity to improve operational capacity	Total asset turnover rate
			Inventory turnover rate
			Receivable turnover rate
		Ability to pay its debts	Asset liability rate
			Flow ratio
			Equity multiplier
		Improve long-term development ability	Total asset growth rate
			Eva growth rate
		Increase the evaand improve enterprise value	Eva
	Customer dimension	Expanded customer base	New customer gain rate
			Customer satisfaction
			The quality customer assurance rate is
		Improve market possession	Market share
	Internal business flow dimensions	Stay ahead	Production plan completion rate
		Optimize operation process	The product is shipped in time to
			Inventory commodity damage rate
		Improve after-sales service ability	Product quality qualification rate
	Learning and growth dimension	Emphasis on employee culture	Staff training rate
			Employee satisfaction
			Department cooperation satisfaction

IV. Application of EVA-BSC Performance Fuzzy Comprehensive Evaluation System of Company T

IV. A. Evaluation of Company T's performance based on fuzzy comprehensive evaluation method and analysis of results

According to the performance evaluation system constructed in the previous section, the expert scoring method is utilized to implement fuzzy comprehensive evaluation, and in the evaluation process, eight authoritative experts with many relevant experiences in the industry are invited (including two members of the certified public accounting firm, two experts from the university, and four managers who are familiar with the situation of the enterprise), and a questionnaire is used to comprehensively rate the selected indicators. Using yaahp software for expert scoring data processing, table 2 shows the weight judgment matrix, there are two more prominent indicators, respectively,

the EVA growth rate and departmental cooperation satisfaction, excellent evaluation grade are 0, corresponding to the weight of the indicator items are 0.0425 and 0.002.

Table 2: Weighting matrix

Index term	Index weight	Evaluation grade			
		Excellence	Good	Passing	Worse
EVA	0.005	0.5	0.375	0.125	0
Net profit	0.1054	0.326	0.5486	0.1254	0
Return on equity	0.0698	0.1148	0.7598	0.1254	0
Total asset yield	0.0634	0.6215	0.3785	0	0
Total asset turnover	0.0248	0.203	0.5485	0.2485	0
Inventory turnover	0.2185	0.073	0.5485	0.3785	0
Receivable turnover	0.0896	0.4946	0.3788	0.1266	0
Asset ratio	0.0425	0.4979	0.3756	0.1265	0
Mobility ratio	0.0898	0.3257	0.5495	0.1248	0
Equity multiplier	0.0086	0.2467	0.6248	0.1285	0
Total asset growth rate	0.0175	0.4514	0.5486	0	0
Eva growth rate	0.0425	0	0.5678	0.3485	0.0837
New customer gain rate	0.0358	0.2504	0.6248	0.1248	0
Customer satisfaction	0.0165	0.1156	0.6248	0.2596	0
Quality customer assurance	0.0269	0.6215	0.3785	0	0
Market share	0.0348	0.0296	0.7856	0.1848	0
R&d cost ratio	0.0152	0.252	0.6232	0.1248	0
The management fee is the ratio of operating income	0.0455	0.4961	0.3785	0.1254	0
Cost margin	0.0015	0.5004	0.3748	0.1248	0
Return rate	0.0013	0.0867	0.5648	0.3485	0
Staff training rate	0.0242	0.001	0.7445	0.2545	0
Employee satisfaction	0.0189	0.529	0.3455	0.1255	0
Departmental satisfaction	0.002	0	0.7486	0.2514	0

IV. B. Processing and calculation of data for indicators of each dimension

IV. B. 1) Economic Value Added (EVA) Indicator Data

Based on the above discussion it can be concluded that CGSW's net operating profit after tax is calculated as:

Net Operating Profit After Tax = Net Profit + (Interest Expense + R&D Expense - Non-recurring Income and Expense + Increase in Allowances) x (1 - Income Tax Rate) - Increase in Deferred Income Tax Assets + Increase in Deferred Income Tax Liabilities.

Based on the above calculation method and the financial statements of Company T for 2019-2021, the process of calculating the net operating profit after tax of Company T is compiled and obtained as shown in Table 3, and the net operating profit after tax for the years 2019-2021 shows a yearly increase, from 243,720,401,311,000 yuan in 2019 to 425,774,865,000 yuan in 2021, with an increase of 74.4953%.

Table 3: The net operating profit calculation after the business tax

/	Project	2019	2020	2021
Plus:	Net profit	18954.3486	26315.8585	35045.8465
	Interest expense	5734.6485	7154.4585	5046.4255
	R&d cost	4936.0488	8265.4812	9456.3452
	The sum of the added amount of the reserves	694.3485	1935.1485	2597.9451
	Outside expenditure	390.4858	1384.4562	730.7562
Minus:	External income	1137.3469	1540.4856	2040.4955
Multiply by::	(1-income tax%)	85%	85%	85%
Plus:	Deferred income tax	891.3485	351.2485	213.2456
Minus:	The added amount of deferred income tax assets	127.0965	-37.2498	847.0965
Is equal to:	Net business profit after tax	24372.40131	37376.17801	42577.44865

Based on the previous analysis of the EVA accounting adjustment items it can be concluded that CGSW's total capital employed is calculated as:

Average total capital employed = average owners' equity + average liabilities + average balance of provisions + credit balance of deferred tax liabilities - debit balance of deferred tax assets - average non-interest-bearing current liabilities - average construction in progress.

Of these, non-interest-bearing current liabilities are the sum of notes payable, accounts payable, receipts in advance, taxes payable, interest payable, dividends payable, employee compensation payable, and other payables.

Based on the above calculation method and the financial statements of Company T for 2019-2021, the process of calculating the average total capital employed by Company T is compiled as shown in Table 4, which shows that the average total capital employed by Company T is 1,912,207.6 thousand yuan in 2019, decreases in 2020, which is 402,241,930 thousand yuan, and slightly increases in 2021, which is 466,529,575 million dollars.

Table 4: T company's average capital account is calculated

/	Project	2019	2020	2021
Plus:	Average ownership	1740654.355	190025.4985	242321.8685
	Mean liability	219146.1645	268048.3585	288654.2485
	The average amount of requirements is the average month	1523.4258	2426.7956	3248.0485
	The average balance of the deferred income tax liabilities	446.2669	1065.0648	1348.1955
Minus:	The average balance of the deferred income tax asset	2283.2658	2348.5998	2749.4988
	Average interest-free current liability	37586.6188	43185.8456	44645.0648
	Average construction	9779.57	13789.34	21648.05
Is equal to:	Total capital amount	1912120.76	402241.93	466529.75

(1) The calculation of WACC can be divided into three parts: determining the firm's capital structure, calculating the pre-tax cost of debt capital, and calculating the cost of equity capital.

Capital structure of Company T: By checking the financial statements of Company T to organize to get its capital structure from 2019 to 2021 as shown in Table 5, the proportion of debt capital of Company T has decreased over the three years, while the equity capital has increased, and the proportion of equity capital in 2021 is 46.9105%.

Table 5: T company 2019-2021 Capital structure

Project	2019	2020	2021
Total assets	450499.2965	455487.9654	596154.5695
Total liability	276654.4869	259487.3485	315487.2657
Debt capital ratio	61.4106%	56.9691%	52.9204%
Total ownership	174126.9485	206487.4969	279659.3156
Equity capital ratio	38.6520%	45.3332%	46.9105%

(2) Estimation of pre-tax cost of debt capital of Company T. Company T has numerous creditors, and since the specific interest rate of each debt is not provided in its annual report, this paper categorizes Company T's debt capital into short-term debt and long-term debt, and estimates its pre-tax cost based on the benchmark interest rate of 1-year and 1-5-year RMB loans issued by the People's Bank of China, respectively, and the specific process is shown in Table 6, which shows that Company T's equity capital cost fluctuates around 4.5%. The three-year average is 4.49%.

Table 6: T's pre-tax cost of debt capital in 2019-2021

Project	2019	2020	2021
Short-term debt ratio	87.93%	54.95%	84.56%
The central bank's one-year interest rate	4.35%	4.37%	4.35%
Long-term debt ratio	12.07%	45.05%	15.44%
The bank's 1-5-year loan rate	12.05%	4.79%	4.75%
Pre-tax debt capital cost	4.46%	4.54%	4.47%

(3) Calculation of Company T's cost of equity capital. The calculation of the cost of equity capital can be divided into three parts: determining the risk-free rate of return, determining the beta coefficient, and calculating the market risk premium. Considering the immature development of China's treasury bond market and the basic national conditions of high savings rate of the population, this paper chooses the 1-year time deposit rate announced by the People's Bank of China as the risk-free rate of return, the beta coefficient is obtained by consulting the database of Cathay Pacific, and the GDP growth rate is used as the market risk premium. Based on the above analysis, the cost of equity capital of Company T for 2019-2021 is calculated as shown in Table 7, and the cost of equity capital of Company T firstly decreases and then increases, from 6.42% to 3.65%, and then increases to 5.85%.

Table 7: T's cost of equity capital in 2019-2021

Project	2019	2020	2021
Risk-free yield	1.55%	1.55%	1.55%
Beta factor	0.8498	0.9485	0.5264
Market risk premium	6.49%	2.25%	8.17%
Equity capital cost	6.42%	3.65%	5.85%

The calculated WACC for 2019-2021 for firm T is shown in Table 8, firm T has financial problems in 2020 and the WACC is reduced to 3.75%, and is at a normal level of 4.79% and 4.8% in 2019 and 2021, respectively.

Table 8: T's weighted average cost of capital in 2019-2021

Project	2019	2020	2021
Equity capital cost	6.49%	3.65%	5.85%
Equity capital ratio	38.50%	44.25%	46.79%
Pre-tax debt capital cost	4.49%	4.57%	4.50%
Debt capital ratio	61.50%	55.75%	53.21%
Income tax	15%	15%	15%
Weighted average capital cost	4.79%	3.75%	4.80%

Substitute the individual parameters calculated above into the following equation:

$$EVA = NOPAT - TC \times WACC \tag{23}$$

The EVA of Company T for the years 2019-2021 can be calculated, as shown in Table 9, the EVA in 2019 is in a negative value of -672,182,000 Yuan, and the EVA in 2020 and 2021 are in a more ideal state, both above 200,000,000 Yuan.

Table 9: T's economic value added in 2019-2021 (Ten thousand yuan)

Project	2019	2020	2021
NOPAT	24372.4	37376.18	42577.45
TC	1912121	402241.9	466529.8
WACC	4.79%	3.75%	4.80%
EVA	-67218.2	22292.11	20184.02

IV. B. 2) Calculation of other indicators of the financial dimension

In this paper, we systematically collect a variety of official sources of information, such as annual financial reports, social responsibility reports, and relevant announcements on the company's official website, issued by Company A from 2018 to 2022. Through this process, not only the core financial data of the company is directly obtained, but also the key financial indicators are further derived through precise calculation and analysis, Table 10 shows the data of other financial dimension indicators, from which it is seen that the operational performance of Company T has a big breakthrough in 2021-2022, which is improved from 38.0485% to 96.1922%.

Table 10: Other financial dimension index data

/	2018	2019	2020	2021	2022
Sales net profit rate(%)	2.7485	1.6486	3.8496	1.8486	4.1486
Speed ratio	0.7483	0.7486	0.7486	0.7486	0.4966
Asset liability rate(%)	68.8196	68.4856	67.9486	64.7648	75.4153
Total asset turnover (times)	0.7495	0.6486	0.7495	0.7886	1.0485
Inventory turnover (times)	4.1648	3.2489	3.6485	4.2485	4.8859
EVA growth rate	-	-31.35%	235.80%	-117.49%	1205.49%
Revenue growth at(%)	22.4869	-1.7486	22.6486	38.0485	96.1922

V. Conclusion

The study obtained several valuable findings by empirically analyzing the EVA-BSC fuzzy comprehensive evaluation system of T Company.

The operating efficiency of Company T shows a clear trend of improvement, with the EVA value changing from a negative value of -67,212,000 yuan in 2019 to a positive value of 222,921,100 yuan and 2018,402,200 yuan in 2020 and 2021, respectively, indicating that the company creates economic value in excess of the cost of capital and realizes value growth in the true sense of the word.

Company T's operating capacity indicators show positive changes, with inventory turnover improving from 4.1648 times in 2018 to 4.8859 times in 2022, and total asset turnover increasing from 0.7495 times to 1.0485 times, reflecting a significant improvement in the efficiency of the company's asset utilization.

By organically integrating EVA and BSC and applying the improved fuzzy comprehensive evaluation method, it is able to overcome the limitations of a single evaluation method and realize a comprehensive and scientific assessment of corporate performance. This evaluation model can not only accurately reflect the current operating conditions of the enterprise, but also predict the future development trend of the enterprise, providing a strategic decision-making basis for enterprise managers.

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