Optimization of Performance Evaluation System based on Economic Value Added and Balanced Scorecard

-An Example of SS Company

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Abstract. A performance evaluation system is an important guarantee for a company to realize its strategic objectives. SS Company is specialized in lithium battery anode material, whose performance evaluation indexes cannot well reflect the company's strategic objects. Based on strategic objects, and industry characteristics, and using the AHP method to determine the weights of each index，this paper builds an EVA-BSC performance evaluation model finally, which greatly improved the previous performance evaluation indexes.

Keywords: Performance Evaluation, EVA, BSC, AHP Method

1 Introduction

In recent years, the new energy vehicle market has shown explosive growth, and the supporting energy storage battery industry has also boomed. However, the expansion of industrial scale and the rapid rise of enterprises, also bring problems that cannot be ignored. To maintain robust adaptability and comprehensive strength for sustainable development after the subsidy policy disappears, lithium battery material companies should optimize their performance evaluation system. In this paper, we adopt the mode of combining EVA and BSC, fully consider the characteristics of the lithium battery material industry, combine the company's strategic goals, dissolve the key issues that restrict the development of enterprises, and optimize the performance evaluation system of the case company.

2 Literature Review

2.1 The Concept and Features of EVA

EVA (Economic Value Added) is a financial measure created by Stern Stewart Corporation in the United States, which is the balance of the company's adjusted net operating profit after tax (NOPAT) minus the opportunity cost of the economic value of the

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company's existing assets. The research achievements of EVA are mainly divided into two stages.

On the relationship between EVA and enterprise value, O'Byrne S F (1996) proved that the change of EVA explains more in market value than NOPAT (net operating profit after-tax) [1].On the application and improvement of EVA, Sun (2020) conducted a comprehensive evaluation of the project using EVA and believed that even if the company's resources are limited, the optimal allocation management project can help the company obtain maximum benefits to a certain extent[2].

2.2 The Concept and Features of BSC

BSC (balanced scorecard) was first proposed by Robert S. Kaplan and David P. Norton, they creatively provided a performance evaluation guidance framework, explaining it from the four dimensions: financial, customer, internal business, innovation, and learning (Kaplan& Norton,1992[3]). Regarding the application of BSC, it was mainly concentrated in the commercial field at the beginning, with the development of the theory, it was gradually applied to other fields, and the BSC is useful in industries such as hospitality and tourism(Fatima& Elbanna,2020[4]), health(Amer, et al.,2022[5]), and new energy vehicle(Peng&Gan,2023[6]).

2.3 EVA-BSC Performance Evaluation

Regarding the research on EVA-BSC performance evaluation, scholars mainly focus on practical application. Zhang (2020) took IFlytek, a software company, as an example, built the BSC-EVA performance evaluation based on its industry characteristics, and applied the constructed system to the performance evaluation from 2014 to 2018, the results showed that the system had obvious operability and superiority[7].

3 Building the Comprehensive Performance Evaluation System

The SS company is a high-tech company, which specializes in lithium battery anode material. Through preliminary research, we found that the company's performance evaluation indexes are all traditional financial indexes, which cannot well reflect the company's strategic objectives. To better match the strategic objectives, this paper builds an EVA-BSC performance evaluation that combines industry characteristics. The typical indexes for SS Company in Table 1.

Table 1. Typical Indexes for SS Company

Dimension	Typical Indexes
Financial	EVA, Net Profit Ratio, Asset Liability Ratio, Inventory Turnover, R&D Investment Ratio
Customer	Customer satisfaction, Customer retention rate, Market Share

Internal Business	Product Qualified Rate, Safe Productivity, On-time Delivery
Learning & Growth	Employee Turnover rate, Training Hours, Technical Personnel Ratio

4 Weight Determination Method

Once the performance evaluation system indexes are determined, the assessment weight needs to be determined for each index. In this paper, we use the analytic hierarchy process (AHP) to weigh the index through questionnaires.

4.1 Construct Judgment Matrix

By comparing the indexes in pairs, the scoring value ranges from 1 to 9, which corresponds to the degree of importance. 1 represents that the two are equally important, and 9 represents that the former is extremely important to the latter. According to the scoring results, the judgment matrix K is obtained. Table 2 follows. The same for the second level.

Table 2. Forms of Judgment Matrix

Dimension	Financial	Customer	Internal Business	Learning& Growth
Financial	1	*	*	*
Customer		1	*	*
Internal Business			1	*
Learning& Growth				1

4.2 Determine Index Weight

As mentioned in 4.2, we can obtain the judgment matrix K of n order, and the normalized matrix is as follows:

$$\mathbf{N}=K/\Sigma K \tag{1}$$

In formula (1), ΣK represents the sum of the elements in each column of matrix K. Next, we average the elements of each row of the normalized matrix, and get the following results:

$$w_1=\Sigma K(1,j)/n,\ w_2=\Sigma K(2,j)/n,\ w_3=\Sigma K(3,j)/n,\ .....,\ w_n=\Sigma K(n,j)/n \tag{2}$$

Then we divide the result in formula (2) by their sum, can get the index weight.

$$w_1/(w_{1+}\ w_{2+...+}\ w_n),\quad w_2/(\ w_{1+}\ w_{2+...+}\ w_n),\ .....,\ w_n\ /(\ w_{1+}\ w_{2+...+}\ w_n) \tag{3}$$

4.3 Calculate Eigenvector

Using the judgment matrices, we can calculate the eigenvalues and eigenvectors of each matrix.

$$KA=\lambda_{max}A \tag{4}$$

In formula (4), λmax is the maximum eigenvalue, and A is the eigenvector.

4.4 Check Consistency

The index weight obtained by rooting out the feature vectors corresponding to the maximum feature values needs to be checked for consistency.

$$CI=(\lambda_{max}-N)/(N-1) \tag{5}$$

In formula (5), CI is the consistency index, and N is the number of indexes
The consistency test discriminant CR is calculated as follows:

$$CR=CI/RI \tag{6}$$

In formula (6), RI is the average random consistency index, and CR is the consistency test discriminant. When CR＜0.1, the judgment matrix passes the consistency test, otherwise it fails.

5 Data Collection and Weight Determination

5.1 Data Collection

The questionnaire survey lasted for 3 weeks. The target audiences were the company's middle and senior managers experts and scholars in related fields. A total of 29 questionnaires were issued and 27 questionnaires were collected, the questionnaire recovery rate is 96. 55%.

5.2 Weight Determination

We imported the collected data into SPSSAU, the results are as Table 3.

Table 3. Relative Weights of Four Dimensions

Dimension	Financial	Customer	Internal Business	Learning& Growth	Weight
Financial	1	*	*	*	42.62%
Customer	1/2	1	*	*	25.31%
Internal Business	2/5	1/2	1		17.17%
Learning& Growth	2/5	2/3	2/3	1	14.90%

Consistency test	The maximum characteristic root=4.057, the RI=0.89, and the CI=0.019 Therefore, CR = CI / RI = 0.021 < 0.1, which passed the consistency test.

Similarly, using the same method, the second-level judgment results can be obtained. By organizing the weights of the indexes in each dimension above, we can get the table 4.

Table 4. Performance Evaluation Index Weight

Dimension	Dimension weight(A)	Code	Index	Relative Weight(B)	Index Weight(C=A*B)
Financial	42.46%	1-1	EVA	31.55%	13.40%
		1-2	Net Profit Ratio	13.23%	5.62%
		1-3	Asset Liability Ratio	14.24%	6.05%
		1-4	Inventory Turnover	18.90%	8.02%
		1-5	R&D Investment Ratio	22.08%	9.38%
Customer	25.31%	2-1	Customer satisfaction	53.17%	13.46%
		2-2	Customer retention rate	15.11%	3.82%
		2-3	Market Share	31.27%	7.91%
Internal Business	17.17%	3-1	Product Qualified Rate	59.23%	10.17%
		3-2	Safe Productivity	10.78%	1.85%
		3-3	On-time Delivery	29.99%	5.15%
Learning& Growth	14.90%	4-1	Employee Turnover rate	26.95%	4.02%
		4-2	Training Hours	54.00%	8.05%
		4-3	Technical Personnel Ratio	19.05%	2.84%

5.3 Standard Values

After determining the weight of each index in the EVA-BSC performance evaluation system, each index in the performance appraisal system should be quantified. This paper intends to adopt a hundred-point quantitative standard, that is, each index is scored out of 100 points, and the minimum is 0 points. The results are as Table 5.

Table 5. The Grading Standards of Performance Evaluation Index

Dimension	Index	Base Value	Grading Standards
Financial	EVA	7,486.32	=7,486.32，60 poin; ≥12,964.94，100 point EVA≤5,607.21，0 point
	Net Profit %	5.70%	=5.70%, 60 point; ≥9.20%, 100 point; ≤-2.20%,0 point
	Asset Liability%	58.30%	=58.30%, 60 point; ≥83.3%, 0 point; ≤48.3%, 100
	Inventory Turnover	4.2	=4.2, 60 point; ≥10.3, 100 point; ≤1.7, 0 point
	R&D Investment	3.40%	o=3.4%, 60 point; ≥5.0%, 100 point; ≤2.0%, 0 point
Customer	Customer Satisfaction	/	Complaints 5 times or less, 100 points. More than 5 times, 5 points will be deducted each time.
	Customer Retention	80%	=80%, 80 point; Add 1 point for every 1% increase; deduct 2 points for every 1% decrease
	Market Share	16%	Score = market share / 16%* 100
Internal Business	Product Qualified%	90%	=90%, 90 point; Add 1 point for every 1% increase; deduct 5 points for every 1% decrease
	Safe Productivity	/	serious accidents, 0 point; general accidents, 50 point; no production accidents, 100 point
	On-time Delivery	95%	=95%, 95 point; Add 1 point for every 1% increase; deduct 5 points for every 1% decrease
Learning& Growth	Employee Turnover%	5%	≤5%, 100 points. deduct 3 points for every 1% decrease
	Training Hours	120 h	≥120h, 100 point; deduct 1 point for 1 hour decreased
	Technical Personnel %	70%	≥70%, 100 points; deduct 3 points for every 1% decrease

6 Conclusions and Limitations

This paper builds the EVA-BSC performance evaluation system that can be used in practice, which plays a great role in the future development of SS company, and also provides a reference for similar companies to apply this system.

But as we know, The lithium battery anode material industry is developing rapidly, to ensure the timeliness of the performance evaluation system, SS Company can establish a dynamic adjustment mechanism. For example, periodically re-evaluate the characteristics of the industry, and adjust the performance evaluation indicators and weights according to the evaluation results. Otherwise, the AHP method still has certain subjectivity when determining index weights. This may affect the accuracy of weight determination.

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