A Study of Corporate Sustainability Performance Prioritization Decision-Making based on A Four-Dimensional Evaluation Model

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Abstract. This paper discusses how to evaluate the sustainable development of enterprises and constructs an evaluation model that includes four aspects: environment, society, corporate governance and economy. The model aims to guide enterprises to make correct development decisions under resource constraints, thus deepening the ESG concept. The study identifies key factors through PCA based on 160 relevant indicators of 1032 listed companies in China in 2022. In addition, AHP and CRITIC methods are utilized to determine the weighted composite weights and construct a weighted decision-making model to clarify the direction of corporate sustainable development management.

Keywords: ESG; Sustainable development; AHP; CRITIC

1 Introduction

This paper suggests integrating economic indicators into the ESG framework to create a scoring model that considers economic, social, environmental, and governance aspects, aiding firms in making sustainable decisions and promoting green development practices.

2 Literature Review

Enterprise sustainable development integrates present and future planning amidst challenges like multidimensionality and limited resources. Green talent management aids ecological transformation, digital advances enhance efficiency, and AI innovations boost competitiveness. Systematic sustainability performance evaluation optimizes resource use and economic outcomes in resource-limited settings[1-3].Global push for

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green initiatives elevates ESG as a key investment criterion. Yet, standardized data absence hampers precise sustainability evaluation. Common ESG data providers' use of equal weighting limits comprehensive assessment. Jitmaneeroj and Boonlert from ASSET4 emphasize corporate sustainability's reliance on both ESG and economic factors, introducing an enhanced ESG framework for thorough evaluation[4-6]. Therefore, the research in this paper has certain practical significance for the development of ESG.

3 Construction of Corporate Sustainability Model

The line of research in this paper refers to Figure 1.

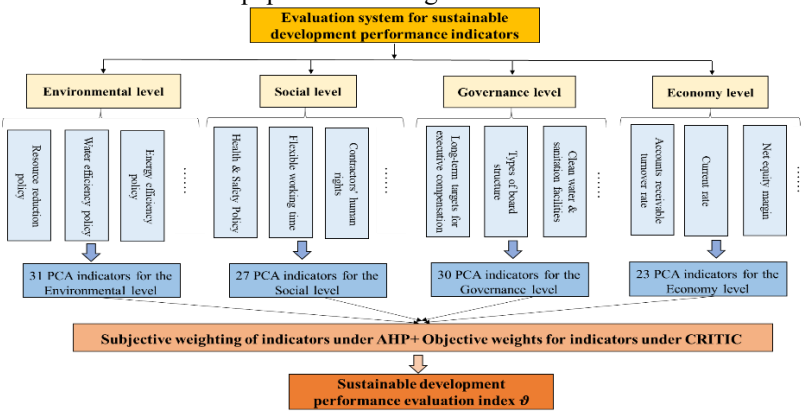
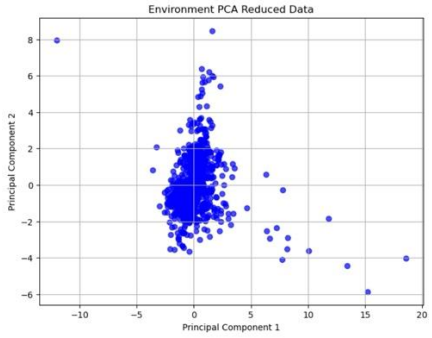
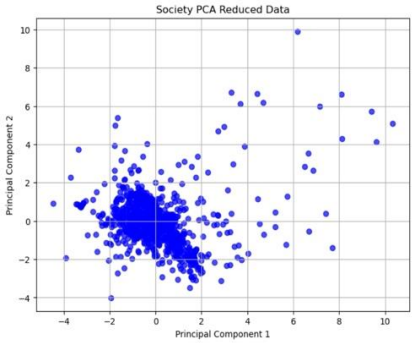


Fig. 1. Construction of a corporate sustainability model.

This study analyzed 160 indicators from the 2022 dataset of 1032 publicly listed Chinese companies in the Reuters ASSET4 database, covering environmental, social, governance, and economic aspects. Using the PCA method, it identified 31 environmental, 27 social, 30 governance, and 23 economic indicators.The classification results are detailed in Figure 2. Weight calculations via Analytic Hierarchy Process (AHP) and CRITIC method facilitated constructing a decision model to assess enterprise sustainability performance.





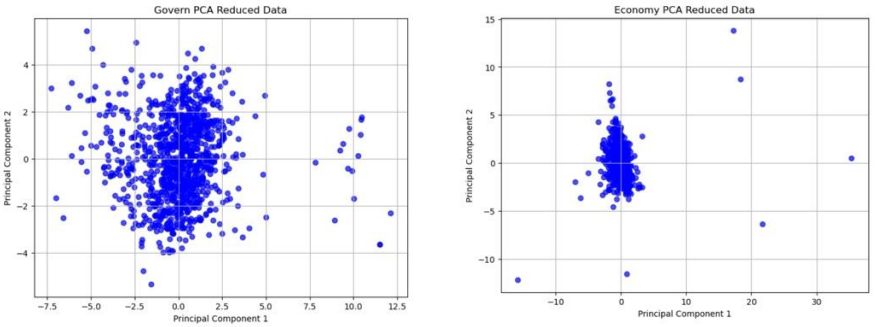


Fig. 2. PCA downscaling diagram

3.1 Finding Data for Indicators

This study initially identifies evaluation indicators from the ASSET4 database. After screening, we found a total of 160 indicators, 40 indicators for each stratum, and some of the indicators are shown in table 1. Then we applied principal component analysis (PCA) methods to downscale the huge dataset, aiming to reduce the number of features while maximizing the preservation of the original data information. In this way, we successfully extracted 31, 27, 30, and 23 principal component indicators for the environmental, social, governance, and economic layers, respectively.

Table 1. Sustainable development performance evaluation system.

Target Layers	Standardized layers	Indicator layers
Sustainable development performance evaluation system	Environment	Resource reduction policy
		Water efficiency policy
		……
	Society	Health and safety policy
		Cyber security policy
		……
	Governance	Long-term goals for executive compensation
		SDG 6 Clean water and sanitation
		……
	Economy	Asset-liability ratio
		Net interest rate on equity
		……

3.2 Combined AHP Subjective Weights and CRITIC Objective Weights

In this paper, we calculate the subjective weights $\omega_j^{(a)}$ of the indicators through the steps of constructing judgment matrix and conducting consistency test by hierarchical analysis method (AHP) [7], see formula 1. In order to reduce the interference of human

factors, we then calculate the objective weights $\omega_j^{(c)}$ of the indicators through the CRITIC method [8], see formula 2. Finally, the weighting model is established by using the formula 3 to get the comprehensive weights of the principal components.

$$CI = \frac{\lambda_{max}-n}{n-1} \tag{1}$$

$$\omega_j^{(c)} = \frac{c_j}{\sum_{j=1}^{m} c_j} \tag{2}$$

$$\omega_i = \frac{\omega_j^{(a)}\omega_j^{(c)}}{\sum_{j=1}^{m} \omega_j^{(a)}\omega_j^{(c)}} \tag{3}$$

This paper introduces a sustainable development performance evaluation index, denoted as ϑ in formula 4 and 5, to better describe a company's sustainable performance.

$$p_{ij} = \frac{x_{ij}}{\sum_{j=1}^{n} x_{ij}} \tag{4}$$

$$\vartheta = \sum_{i=1}^{m} \omega_i \, p_{ij} \tag{5}$$

When ϑ＞0, it signifies favorable development at that level; otherwise, improvement is needed. pij represents the normalized value of xij. Table 2 shows the overall scores of sustainable development performance in various industries.

Table 2. Combined score of sustainable development performance indicators by sector.

Industry categories	Environment	Society	Governance	Economy	Final score
Agriculture, forestry, animal husbandry and fisheries	10.2224	-9.1669	15.1061	2.5344	24.1343
Water, environment and utilities management	8.4712	-6.4608	11.6257	0.2384	18.4369
Electricity, gas and water production and supply industry	11.1542	-5.0379	8.8531	0.8324	10.6869
Scientific research and technical services	-5.3047	-6.8879	-0.5058	-8.5403	10.5506
Real estate industry	2.7008	-0.0283	6.6796	-0.7391	9.9724
Transportation, storage and postal services	2.1218	-5.8907	4.7335	2.2134	9.7302
Financial industry	0.2686	3.2193	5.9375	-2.6331	8.9353
Construction industry	3.7734	-3.3234	4.7519	2.9887	6.6565
Accommodation and catering industry	-4.573	-2.3256	-2.1861	-4.7668	2.7035
Mining industry	2.6026	-1.6967	1.7021	4.5742	0.5166
Information transmission, software and information technology services industry	-3.4216	2.8726	-1.4928	-1.6027	-1.526
Manufacturing industry	-1.0462	-0.5949	-3.6305	-0.2635	-5.0463
Wholesale and retail industry	-5.1335	3.3393	-4.0321	3.8895	-7.1699

Residential services, repairs and other services	0.9101	1.626	-3.5974	1.2948	-8.3757
Rental and business services industry	-0.4037	4.615	-4.9532	-1.0489	-10.8804
Educational industry	-13.405	5.3017	-12.6641	-2.1576	-15.384
Culture, sports and recreation industry	-12.6666	11.7105	-10.083	-1.3169	-15.9837

4 Results

The analysis shows that among the 17 major industry categories, the sustainable development performance indicators of agriculture, forestry, animal husbandry, fishery, water conservancy, environment and public facilities management, and production and supply of electricity, gas and water ranked in the top three of all industries, indicating that the sustainable development capabilities of these three industries are relatively outstanding; on the contrary, the sustainable development capabilities of leasing and commercial services, education, and culture, sports and entertainment are relatively poor.

5 Conclusions

The sustainability performance of different industries varies greatly due to business characteristics, market pressures, and different levels of environmental and social responsibility; therefore, each industry should adopt tailored strategies to address these challenges and contribute to broader social goals.

In order to align enterprises with the national sustainable development strategy, this paper uses an ESG-based evaluation system to analyze industry characteristics and make recommendations.

For industries with poor environmental performance, such as culture, sports, and entertainment, strategies to improve their overall sustainability capabilities include energy conservation and the use of renewable energy.

For industries with poor social responsibility, such as agriculture and forestry sectors, more attention should be paid to labor rights and workplace safety.

For industries with weak governance, such as education, the government should implement stricter professional standards and industry transparency.

For industries with slower economic benefits, such as scientific research, more focus should be placed on market positioning, continuous innovation, and optimized supply chain management to prevent interruptions.

Although this study is insightful, it still has limitations, such as the possible subjectivity of the indicator system and the preliminary stage of its four-dimensional ESG evaluation, which indicates that further research is needed on other evaluation dimensions such as innovation indicators.

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