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Retraction

Retracted: Evaluation Method of Enterprise Management Effectiveness Based on Improved Analytic Hierarchy Process

Security and Communication Networks

This article has been retracted by Hindawi following an investigation undertaken by the publisher [1]. This investigation has uncovered evidence of one or more of the following indicators of systematic manipulation of the publication process:

(1) Discrepancies in scope

(2) Discrepancies in the description of the research reported

(3) Discrepancies between the availability of data and the research described

(4) Inappropriate citations

(5) Incoherent, meaningless and/or irrelevant content included in the article

(6) Manipulated or compromised peer review

The presence of these indicators undermines our confidence in the integrity of the article's content and we cannot, therefore, vouch for its reliability. Please note that this notice is intended solely to alert readers that the content of this article is unreliable. We have not investigated whether authors were aware of or involved in the systematic manipulation of the publication process.

Wiley and Hindawi regrets that the usual quality checks did not identify these issues before publication and have since put additional measures in place to safeguard research integrity.

We wish to credit our own Research Integrity and Research Publishing teams and anonymous and named external researchers and research integrity experts for contributing to this investigation.

The corresponding author, as the representative of all authors, has been given the opportunity to register their agreement or disagreement to this retraction. We have kept a record of any response received.

References

[1] L. Cheng, "Evaluation Method of Enterprise Management Effectiveness Based on Improved Analytic Hierarchy Process," *Security and Communication Networks*, vol. 2022, Article ID 2409614, 12 pages, 2022.

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Research Article

Evaluation Method of Enterprise Management Effectiveness Based on Improved Analytic Hierarchy Process

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To describe the effectiveness of enterprise management through quantitative methods, this paper established an evaluation index system through five levels: profitability, solvency, operation ability, development ability, marketization ability. The data of enterprise performance evaluation indicators were dimensionless processed to remove the influence of dimensionality of evaluation indicators and finally synthesized into a relative quantitative value. The study used hierarchical analysis on determining indicator weights. Through the construction of management possible set and management front surface, the general form of management effectiveness was put forward. By using this method, the influence of the difference of objective basic conditions between the evaluation units can be completely eliminated. There were several enterprises selected as samples to conduct an empirical study, and the results showed that the evaluation method of enterprise management effectiveness can completely eliminate the impact of differences in objective basic conditions between enterprises on the evaluation of management effect. This study shows that the evaluation method of management effectiveness can fairly describe the pros and cons of the degree of enterprise management.

1. Introduction

The evaluation of enterprise management is the premise of improving the level of enterprise management. The establishment of an accurate and effective evaluation method for the effectiveness of enterprise management can promote the analysis of gaps between enterprises [1], find the reasons for low operating efficiency, fully improve the enthusiasm of employees' enthusiasm, and extremely improve the of enterprise management's efficiency and management level goals [2].

The current literature research on enterprise management evaluation is inconsistent with their actual development, and its limitations are reflected in two aspects. One is that the evaluation methods and indicators are traditional and single, and the other is that there are differences between the evaluation units. Due to the impact of differences in objective basic conditions, it is difficult for the evaluation results to truly reflect the management efficiency of the enterprise [3]. Therefore, if such an evaluation method is

used as the basis for incentives, in view of the differences in the objective basic conditions between enterprises, the evaluation results are often unfair. At the same time, this evaluation method will make the management of enterprises find the reasons from the objective conditions, resulting in insufficient analysis of their own subjective efforts, making it difficult to expect the effect of incentives.

However, the insufficiency of the above evaluation methods happens to be filled by the theory of management effectiveness. The evaluation of enterprise management effectiveness is to evaluate whether the efficiency of enterprise management, capital flow efficiency and operation efficiency of enterprise high-level structure can play an effective role. Management effectiveness eliminates differences in objective underlying conditions between assessment units in the analysis. Therefore, this method can truly evaluate the production performance of the evaluation unit due to subjective efforts. With the help of the idea of management effectiveness, by constructing an accurate and effective evaluation method to analyze and evaluate the effectiveness

of enterprise management, the management efficiency of the enterprise can be obtained. This method helps to analyze the gap between enterprises, find the reasons for the inefficiency of enterprises, fully improve the enthusiasm of employees, and approach the target of improving the management level of enterprises [4].

2. Literature Review

2.1. Analytic Hierarchy Process (AHP). Analytic hierarchy process (AHP) belongs to a branch of systems engineering. It was proposed by Darko et al. in the 1980s [5]. The AHP method is an effective way to deal with people's subjective judgments and combine quantitative and qualitative methods [6]. AHP is not only suitable for situations where there is uncertainty and subjective information, but also allows experience, insight, and intuition to be applied in a logical manner, enabling the evaluator to seriously consider and measure the relative importance of indicators. This paper uses AHP to determine the weight of enterprise management efficiency evaluation index system, which makes the evaluation system more scientific and reasonable.

AHP consists of four steps [7, 8]: the first is to establish a hierarchical structure model; the second is to construct a pairwise comparison judgment matrix; the third is to determine the relative weight of each element by the judgment matrix; the fourth is to sort the weights.

2.1.1. Establishing a Hierarchical Structure Model. The AHP decomposes different factors into multiple levels from top to bottom according to different attributes. The AHP is to decompose the decision-making problem into different hierarchies according to the order of general objective, subobjective of each level, evaluation criterion, and even specific alternative scheme, the elements in the lower level have an impact on the upper elements and dominate the next level at the same time. The top layer is called the target layer, which generally contains only one factor. There can be one or more layers in the middle, which become the criterion layer or index layer, and the bottom layer is called the scheme layer. The criteria layer can continue to be divided into multiple levels.

2.1.2. Constructing a Pairwise Comparison Judgment Matrix. The judgment matrix is generally written in the form of formula (1), which represents the result of pairwise comparison of the importance of various factors at the same level:

$$A = \left(a_{ij}\right)_{n \times n}, \tag{1}$$

where A is the judgment matrix; n is the number of factors to be compared in pairs; a_{ij} is the ratio of factor U_i to U_j relative to the importance of a criterion, and the importance can be assigned on a scale of 1–9 [9] as shown in Table 1. In addition, this formula also needs to satisfy the conditions of $a_{ij} = 1/a_{ji}$, $i \neq j$; $i,j = 1,2,3, \ldots, n$; $a_{ij} \geq 0$; $a_{ii} = 1$.

2.1.3. Determining the Relative Weight of Each Element by the Judgment Matrix

(1) Calculate the eigenvector W of the judgment matrix, and then the normalized eigenvector is the relative weight vector.

$$b_{ij} = \frac{a_{ij}}{\sum_{i=1}^{n} a_{ij}}, (i, j = 1, 2, \ldots, n),$$

$$W_i = \frac{1}{n} \sum_{j=1}^{n} b_{ij}. \tag{2}$$

a_{ij} is the ratio of factors relative to the importance of a criterion, b_{ij} is the weight of one factor among all the factors, n indicates the number of evaluation factors in the AHP, and W_i is the eigenvector of the judgment matrix.

(2) *Consistency Test.* The consistency check index CI is defined as follows:

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

$$\lambda_{\max} = \sum_{i=1}^{n} \frac{(AW)_i}{nW_i}, \tag{3}$$

$(AW)_i$ is the i-th component of AW, $W = (w_1, w_2, \ldots, w_n)$; $\lambda_{\max}$ is the largest eigenroot of the judgment matrix; N is the order of the judgment matrix; and W_i is the eigenvector of the factor i, that is, relative weight. The randomness index RI can be obtained from Table 2 [10].

$$CR = \frac{CI}{RI}. \tag{4}$$

When the order is less than or equal to 2, the matrix is always completely consistent and when the order is greater than 2 and $CR < 0.1$, it can be considered that the consistency of the judgment matrix meets the requirements.

2.1.4. Performing Weight Total Sorting. Calculating the composite weight of each layer of factors to the system goal, and at the same time, the effect (relative weight) of each factor or criterion on the realization of the system goal can be sorted.

2.2. Basic Theoretical Analysis of Management Effectiveness

2.2.1. The Connotation of Management Effectiveness. The theory of management effectiveness is derived from the theory of business management [11]. Enterprise management refers to the behavior of enterprise owners or business operators to plan, make decisions, organize, lead, and coordinate all economic activities of the enterprise in order to achieve the business goal of maximizing profits [12].

TABLE 1: The scale of absolute numbers.

Importance intensity	Definition	Explanation
1	Equal	Two activities have equal contribution to the objective
2	Weak/slight	
3	Moderate	One activity is faintly preferred over another, established on judgment and experience
4	Moderate + plus	
5	Strong	One activity is strongly preferred over another, established on judgment, experience
6	Strong + plus	
7	Very strong (proved importance)	One activity is very strongly preferred over another, established on judgment, experience; its dominance is proved by practice
8	Very–very strong	
9	Extreme	The substantiation when one activity is preferred over another is at the topmost possible order of affirmation
Reciprocals of abovementioned	If activity i is attributed one of the abovementioned non–zero values when compared to activity j, then activity j when compared to activity i has the reciprocal value	A reasonable statement

TABLE 2: The value of the random consistency indicator (RI).

n	1	2	3	4	5	6	7	8	9	10	11
RI	0	0	0.58	0.90	1.12	1.24	1.32	1.41	1.45	1.49	1.51

2.2.2. General Forms of Management Effectiveness.
Management effectiveness evaluation reflects the management level of the evaluation unit, and this evaluation method takes dynamic performance changes as the basic premise [13]. Therefore, a method to reflect the effective effort level of each evaluation unit can be proposed first by describing the performance of the evaluation unit. Discovering and finding the frontiers of the effort level of the assessment unit is the basic premise of evaluating the assessment unit. This frontier is generally referred to as the "management frontier," which can be interpreted as the optimal management level among the levels (or possible sets of management) that all management activities can be achieved [14].

There are assessment units, the performance value of the assessment unit in period $t-1$ is A, and the performance value of the assessment unit in period t is B. Hence, both A and B show the performance level of the assessment unit in these two periods. Here, we define A and B as the reference index and the current index, the former showing the objective underlying conditions of the assessment unit. (A, B) are the index status of the assessment unit, reflecting the status of the management activities of the assessment unit [15, 16].

Definition 1. The set of management possibilities V represents the set of all possible management activities: $V = \{(A, B)\}$. A possible management set is located in the first quadrant area of the coordinate axis and is formed by the combination of the reference index and the current index. The positive direction of the X-axis is the reference index axis; the upper bound of this area is a curve: $B = f(A)$, which is the A curve changes as the industry changes. The management possible set V must meet the following requirements:

F1: $(A,0) \in V$, that is, no matter what the reference index changes, the current index may be zero; $(0,B_0) \in A$ when $B > B_0$, $(0,B_0) \in V$, that is, the starting point of the curve is a certain point on the current index B, that is to say, when the reference index of period $t-1$ is zero, the current index of period t cannot be infinite.

F2: For any given A, V has an upper bound, that is, when the reference index of period $t-1$ is determined, the current index of period t cannot be infinite. This is the bound of managing the possible set.

F3: $(A,B) \in V \Rightarrow (\lambda A,B) \in V$, where $\lambda \geq 1$, that is, for any given current index of period t, it can be obtained under the reference index of period $t-1$. This is the ineffectiveness of managing possible sets.

F4: $(A,B) \in V \Rightarrow (A,\lambda B) \in V$ where $0 \leq \lambda \leq 1$, that is, for any given reference index in period $t-1$, there may be a lower current index; this is also Manage the invalidity of possible sets.

F5: $(A_1,B_1) \in V$, $(A_2,B_2) \in V \Rightarrow (\lambda A_1 + (1-\lambda)B_2, \lambda B_1 + (1-\lambda)B_2) \in V$, where $0 \leq \lambda \leq 1$ means that V is Convex set. This is the convexity that governs possible sets.

F6: V is the smallest set that meets the above conditions. This is the minimum that manages the possible set.

Definition 2. If the management index status of an evaluation unit is (A,B) and it is on the upper bound curve of the management possible set V, then this unit is effectively effective. If the management index status (A,B) is in the internal area of the management possible set V, then this unit is invalid.

The evaluation unit (A_1,B_1) is effectively managed. Compared with other evaluation units, such as the evaluation unit (A_2,B_2), under the same reference index, the current index of the evaluation unit (A_1,B_1) is the highest. Therefore, the evaluation unit (A_1,B_1) belongs to the management and is effective. Compared with the evaluation unit

(A_1, B_1), the management levels of the evaluation units (A_2, B_2) and (A_3, B_3) are in an invalid state. When the reference index is fixed, the target current index of the evaluation unit (A_2, B_2) is the current index of the evaluation unit (A_1, B_1). Therefore, the difference between the current management indices of these two units, that is, the ratio of the current indices of the two, can reflect the effective effort of the evaluation unit (A_2, B_2). This ratio is between 0 and 1. The closer the current index is to 1, the better the management effectiveness of this evaluation unit, and vice versa. Obviously, the management effectiveness value of the assessment unit (A_1, B_1) is 1, while the management effectiveness value of the assessment unit (A_2, B_2) is less than 1.

Definition 3. The management frontier represents the upper bound curve of the management possible set, that is, the curve of $B = f(A)$. It represents the entire set of the maximum current index that the evaluation unit can achieve under any given reference index.

The management frontier enables the measurement of management effectiveness. For example, the reference index of the assessment unit (A_3, B_3) is A_3, and the other maximum possible current index is $B = f(A_3)$. By definition, the management effectiveness of the assessment unit (A_3, B_3) is $B_3/f(A_3)$.

Definition 4. The management effectiveness ME (Managerial Effectiveness) of the evaluation unit (A, B) represents the ratio of the actual current index of the evaluation unit to the projected value of the management frontier under the same reference index, that is, $ME = B/f(A)$.

The size of ME shows the effective effort of the evaluation unit to change the value of time and objectively measures the effective degree of the management of the evaluation unit. The evaluation method of management effectiveness regards the evaluation unit as a complete individual. Under the influence of the difference in objective basic conditions, the dynamic change of the performance of the evaluation unit shows the effective effort level of people. This is a fair and reasonable way to evaluate the subjective effort level of the assessment unit. According to the basic idea of management effectiveness evaluation, construct the possible set of enterprise management and get the management frontier, and then construct the enterprise management effectiveness evaluation model.

3. Method

3.1. The Construction of the Evaluation Index System of Enterprise Management Effectiveness.
The construction of the performance evaluation index system is based on the principles of scientificity, comprehensiveness, comparability, measurability, and operability. In this paper, through expert interviews and literature research, and by integrating the characteristics and actual situation of current enterprises, five aspects of enterprise management are used as indicators for enterprise performance evaluation, namely, profitability (B1), solvency (B2), operation (B3),

development (B4), and marketability (B5) [17], forming a hierarchical structure model, as shown in Figure 1.

The work proposes a comprehensive evaluation method of enterprise management effectiveness which integrates nonlinear fuzzy dimensionless processing method and AHP.

3.2. Dimensionless Treatment of Performance Evaluation Indicators.
Dimensionless processing is a method that uses certain mathematical formulas and other methods to convert to remove the dimensional influence of evaluation indicators. This paper used nonlinear fuzzy dimensionless processing model to conduct dimensionless processing for enterprise performance evaluation index. Dimensionless was used to deal with each evaluation index, and AHP was used to get the weight coefficient of criterion layer and index layer.

The nonlinear fuzzy dimensionless processing model represents the superposition of two functions, the exponential function and the fuzzy membership function [18]. It should be pointed out that the fuzzy membership function is the independent variable of the exponential function [19]. According to the characteristics of evaluation indicators and different expressions, they can be mainly divided into three types, and the models are as follows [20]:

(1) Positive indicator model: It represents that the larger the value, the better the performance of the index, such as the rate of return on net assets and so on. The demand is greater on the basis of a larger number, and the effort required is increasing. Therefore, the quantitative value of the positive index will increase with the increase of the index value. Its model is

$$F(X_i) = \begin{cases} \dfrac{X_i - X_{i0}}{Ae^{X_{max} - X_{i0}}}, & X_i > X_{min}, \\ \\ 0, & X_i \leq X_{min}, \end{cases} \quad (5)$$

X_{max} is the maximum value of the i-th indicator value, X_{min} is the minimum value of the i-th indicator value, and X_{i0} is the average value of the i-th indicator value.

(2) The reverse index model represents that the smaller the index value is, the better the performance of the index is. On the basis of the smaller value, the requirement is smaller, and the required effort is increasing. Therefore, the quantitative value of the reverse index will increase as the indicator value decreases. Its model is

$$F(X_i) = \begin{cases} \dfrac{X_{max} - X_i}{Ae^{X_{max} - X_{min}}}, & X_i > X_{max}, \\ \\ 0, & X_i \geq X_{max}. \end{cases} \quad (6)$$

(3) Moderate index model: it represents that the index value should be moderate. When the index value is less than the moderate value, it is attributed to the nature of the positive index; when the index value is
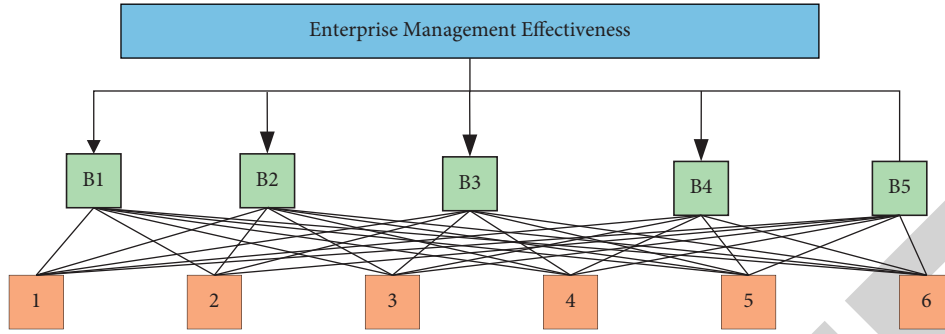
Figure 1: Decomposition of the decision-making problem into a hierarchy.

greater than the moderate value, it is attributed to the nature of the reverse index.

Appropriate indicators include the current ratio and the production–liability ratio in the enterprise management evaluation indicator system. Its model is:

$$F(X_i) = \begin{cases} \dfrac{2(X_i - X_{\min})}{Ae^{X_{\max}-X_{\min}}}, & X_{\min} < X_i < X_{i0}, \\[3mm] \dfrac{2(X_{\max} - X_i)}{Ae^{X_{\max}-X_{\min}}}, & X_{i0} < X_i < X_{\max}, \\[3mm] 0, & X_i \leq X_{\min} \, \text{or} \, X_i \geq X_{\max}, \end{cases} \qquad (7)$$

X_{i0} is the optimal value of the i-th index. Here, we use the traditional percentage system for calculation, and the quantitative value of the indicator is in the $[0, 100]$ interval. The 100-point system divides the score into 100 intervals, which has a high degree of differentiation in evaluation, and the corresponding position of the score of each case can be found on the interval. The 100-point system has hundreds of grade differentials that accurately describe the level of the subject being assessed, reflecting nuances. Percentage system is also easy to statistical analysis, variable analysis judgment. At the same time, it is stipulated that when $F(X_i) = 100$, it means that the index i is in the optimal state. When the indicator is in its worst state, $F(X_i) = 0$. Therefore, for a positive indicator, if and only if $X_i = X_{\max}$, $F(X_i) = 100$; and when $X_i \leq X_{\min}$, $F(X_i) = 0$. For a contrarian indicator, it is the opposite of a positive indicator. For moderate indicators, $F(X_i) = 100$ only when $X_i = X_{i0}$.

3.3. Determination of Index Weights Based on AHP

Step 1. Determine the analysis problem and build a hierarchical analysis diagram. Determining the analysis problem is the basis of AHP. Therefore, when analyzing complex problems, on the one hand, the goal of the research problem should be clear, and on the other hand, the scope of the analysis problem should be clear. On this basis, a hierarchical structure analysis diagram is constructed.

Step 2. Establish a judgment matrix. It assigns the degree of correlation to the relevant elements of each level in the hierarchical structure analysis diagram, quantifies the

qualitative problems, and shows the proportion of each element in the next level to an element in the previous level. Calculate the relative weight (or called weight vector) w of each indicator in the next layer to the indicator in the previous layer. Only when the judgment matrix is not a consistent matrix, its maximum eigenroot λmax and the corresponding normalized eigenvector are the weight vector w, that is, it satisfies

$$AW = \lambda_{\max} W. \qquad (8)$$

The normalized w is the sorting weight for the importance of the corresponding elements in the same layer relative to an element in the previous layer. It should be pointed out that in actual operation, the consistency of the judgment matrix needs to be checked, and the judgment matrix that cannot pass the consistency check is logically unreasonable. Only passing the weight of the test can continue to analyze the results.

$$CI = \frac{(\lambda_{\max} - n)}{(n - 1)},$$
$$CR = \frac{CI}{RI}. \qquad (9)$$

Step 3. Perform a hierarchical total sorting. Through the total ranking of the hierarchy, the weight of each indicator at the bottom level of the hierarchical structure analysis diagram in the overall goal can be obtained. The total ranking of layers is to calculate the ranking weight of the relative importance of all indicators at the same layer to the target layer. This process needs to synthesize the weights of each level from top to bottom. Assuming that the order of n elements $(B_1, B_2, \ldots, B_n)$ in level B to the total target A is b_1, $b_2, \ldots,$ bn; the single-level order of m elements in level C to the element B_j in the previous level B is $c_{1j}, c_{2j}, \ldots, c_{mj} (j = 1, 2, \ldots, n)$. Then the total sorting weight of the i-th element in the C level to the total target is $w_i = b_j c_{ij}$. The obtained single-level weight results are sorted and the combined weight is calculated, and finally the total weight of each indicator can be calculated. In enterprise management effectiveness measurement method, after standardizing the data of the indicators and determining the weights, the management effectiveness score of the j-th enterprise can be obtained.

The formula is as follows:

$$P_j = \sum_{i=1}^{m} w_i F(X_{ij}), \tag{10}$$

W_i is the weight of the i-th indicator, X_{ij} is the value of the i-th evaluation index of the j-th enterprise, and $F(X_{ij})$ is the normalized value of the i-th index of the j-th listed logistics company. P_j denotes the business performance score of the jth company, and the higher the calculated evaluation score P_j, the better the business performance of the company is shown.

And $F(X_{ij})$ is the normalized value of the i-th indicator of j companies. Therefore, the higher the calculated evaluation score P_j, the better the management of the enterprise. Therefore, according to the above theory, we can easily measure the management effectiveness of the enterprise during this period through the collection of data and the evaluation method of enterprise management.

3.4. Setting of Relevant Parameters of Management Effectiveness Evaluation Model. The relevant parameters of the enterprise management effective evaluation model are mainly composed of three components: the reference index, the current index and the management possible set [21]. The evaluation of enterprise management effectiveness is a dynamic process. We generally divide the evaluation time interval into two time periods: $t-1$ period and t period. We refer to the enterprise as the price measurement unit. Let A_j be the reference index of the j-th price measurement unit (or the business performance level in the $t-1$ period), and B_j be the current index of the price measurement unit (or the business performance level in the t period), (A_j, B_j) is called The index status of the j-th price measurement unit. According to the index status of the evaluation unit, the management of the evaluation unit can be simply compared. There are two price measurement units (A_1, B_1) and (A_2, B_2). If the reference index of the former is lower than the reference index of the latter and the current index of the former is greater than the current index of the latter, it is indicated by letters as when $A_1 \leq A_2$ and $B_1 > B_2$, it is obvious that the management level of the former is obviously better than that of the latter. If the former's reference index is higher than the latter's reference index and the former's current index is lower than the latter's current thinking index, the letter is when $A_1 \geq A_2$ and $B_1 < B_2$, then the management level of the former is worse than that of the latter. Assuming that the relationship between the two evaluation units (A_1, B_1) and (A_2, B_2) is not as described above, then when $A_1 \leq A_2$, $B_1 \leq B_2$ and $A_1 \geq B_2$, $B_1 \geq B_2$ occur, the There is no way to directly analyze which assessment unit management level is more effective.

Although it is possible to evaluate the management quality of the two evaluation units through a comparative

approach. However, how to quantitatively analyze the effectiveness of management is still unresolved. Therefore, on the basis of the above problems, we should further study and discuss the management effectiveness of the evaluation unit with the theoretical support of management possibility sets and management frontiers. Taking the abscissa X as the reference index and the ordinate Y as the current index, the index status of all price measurement units can be displayed in a plane coordinate system, as shown in Figure 2. Taking the reference index and the current index as an input and an output, respectively, the frontier of the possible set of index states can be obtained by using the DEA method. Assume that the projection value of the current index B of the evaluation unit in the t-th period on the management frontier is B^*, then the ratio of B and B^* can measure the effective effort of the evaluation unit. The shaded area in Figure 2 represents the possibility of management set, and its upper boundary represents the management front. Let η be the management effectiveness of the evaluation unit, then we have

$$\eta = \frac{B}{B*} \times 100\%. \tag{11}$$

The value of η reflects the effective effort of the evaluation unit (A,B) management. Obviously, the management effectiveness excludes the influence of objective conditions on the evaluation results, and at the same time, it also shows that the difference in management of the evaluation unit produces corresponding benefits. Suppose (A_1, B_1) and (A_2, B_2) are two evaluation units, and the management effectiveness of these two evaluation units are η_1 and η_2, respectively. If $\eta_1 \geq \eta_2$, then the evaluation unit (A_1, B_1) is more (A_2, B_2) is better managed and vice versa.

3.5. Management Effectiveness Measurement Method. According to the above theories, we found that the basic condition for quantitatively describing the effectiveness of management is the establishment of the management frontier [22]. Next, we will introduce a method to measure the management frontier according to the index status of several evaluation units. The measurement and estimation of it is called the forefront of experience management. Assume that the evaluation data of the index state of a certain evaluation unit is (A_j, B_j), $j = 1, 2, \ldots, n$. According to the related idea of convex sets, let $S = \{A_1, A_2, \ldots, A_n\}$ be any set in E. Also, V is a convex combination of S sets, which can be expressed as: $A \in V$ if and only if A can be expressed as $A = \sum_{j=1}^{k} \lambda_j A_j$, $\sum_{j=1}^{k} \lambda_j = 1, \lambda_j \geq 0, j = 1, 2, \ldots, k$. where k is a positive integer, and $A_1, \ldots, A_k, \in S$.

Input and output reference index and current index data (A_j, B_j), $j = 1, 2, \ldots n$ can also be observed; it can be shown to manage possible sets by forming a convex combination V as

$$V = \left\{ (A, B) \mid \sum_{j=1}^{n} \lambda_j A_j = A, \sum_{j=1}^{k} \lambda_j B_j = B, \sum_{j=1}^{k} \lambda_j = 1, \quad \lambda_j \geq 0, j = 1, 2, \ldots n \right\}. \tag{12}$$
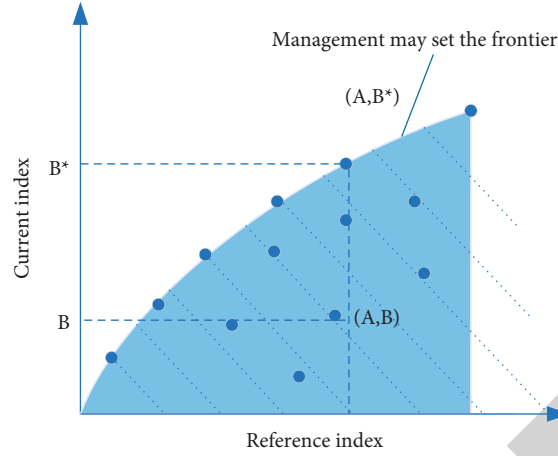
Figure 2: Managing possible sets and their frontiers.

It can be seen from the analysis that this conclusion is not established, the main reason is that in the set $\sum_{j=1}^{n} \lambda_j A_j = A, \sum_{j=1}^{k} \lambda_j B_j = B$ are all equality constraints, and the assumptions governing inefficiencies in possible sets do not hold. Constrain the equality in the set $\sum_{j=1}^{n} \lambda_j A_j = A, \sum_{j=1}^{k} \lambda_j B_j = B$ convert to Inequality Group Constraints $\sum_{j=1}^{n} \lambda_j A_j \leq A, \sum_{j=1}^{k} \lambda_j B_j \geq B$ and assume $(A_0, \sim B_0) = 0, 0$. So, we can get the set as follows:

$$V = \left\{ (A, B) \sum_{j=1}^{n} \lambda_j A_j \leq A, \sum_{j=1}^{k} \lambda_j B_j \geq B, \sum_{j=1}^{k} \lambda_j = 1, \lambda_j \geq 0, j = 1, 2, \ldots n \right\}. \tag{13}$$

The analysis of this management possible set satisfies all construction assumptions, so the set V successfully constructs the management possible set. The reference index and the current index are regarded as an input and an output, respectively, and the $BC2$-DEA method studied by Banker et al. in 1984 can be used to obtain the management possible set, based on which a measurement model of management effectiveness is constructed. Evaluate effectiveness. It should be noted that when using the DEA model to measure management effectiveness, the input and output in this process are no longer the same as the traditional DEA model, and the results obtained have no meaning of pure technical efficiency. The main reason is that input and output are no longer a production process, but a dynamic change in the level of enterprise performance. The DEA model for measuring the effectiveness of enterprise management is as follows:

$$\max Z = \frac{1}{\eta}, \tag{14}$$

$$s.t. \begin{cases} \sum_{j=0}^{n} \lambda_j A_j \leq A_{j0}, \\ \sum_{j=0}^{n} \lambda_j B_j \leq ZB_{j0}, \\ \sum_{j=0}^{n} \lambda_j = 1, \forall \lambda_j \geq 0. \end{cases} \tag{15}$$

If $Z_0 = 1$ in the above model, it means that the evaluation unit is on the frontier of management of possible V. If Z_0 is the optimal value of the above model, then let $\bar{A}j_0 = A_{j0}$, $j_0 = ZB_{j0}$, it will be found that $(\bar{A}_{j0}, B_{j0})$ is located on the management frontier of the management possible set, that is $(\bar{A}_{j0}, B_{j0})$ is the projection of the j-th evaluation unit (A_{j0}, B_{j0}) on the management frontier of the management possible set.

In the management possible set V represented by the shaded area in Figure 2, when $Z_0 = 1$, the evaluation unit $(A, \bar{B})$ is located on the front surface of the management possible set V; when $Z_0 > 1$, the evaluation unit (A, B) is not in management On the frontier of the possible set V, (A, B) is the projection of the evaluation unit (A, B) on the frontier of the management possible set V.

The management front of the management possible set is the envelope of the effective index state and shows the optimal relationship between the evaluation unit reference index and the current index. In addition, it also reflects the degree of the gap between the evaluation unit and the management frontier of the management possible set, based on which we can obtain the evaluation value of the management effectiveness of the evaluation unit. Assuming Z_0 is the optimal value of the model. Suppose Z_0 is the optimal value of the formula (15), so we can get: $\eta = (1/Z^0) \times 100\%$.

According to the above theory, the reference index and the current index are regarded as input and output respectively, and the BC2-DEA model is used to calculate the
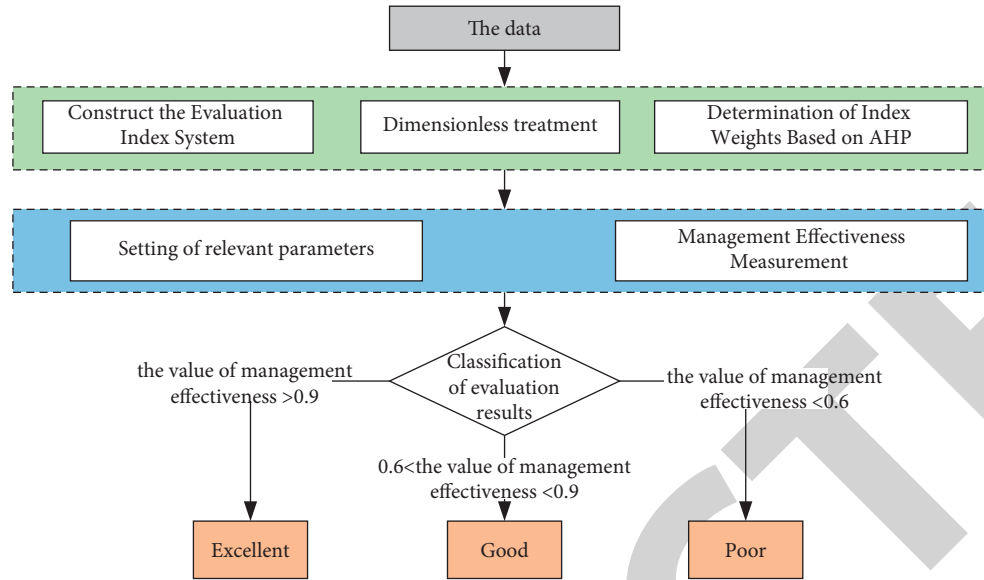
FIGURE 3: The process of enterprise management effectiveness evaluation based on improved AHP.

management effectiveness. The result of the calculation is the evaluation value of the management effectiveness of the evaluation unit. This evaluation method shows the actual benefit produced by the effective effort level of the evaluation unit under the premise of excluding the difference of objective basic conditions between the evaluation units.

Using the reference index and the current index as inputs and outputs, the evaluation model of management effectiveness is used to calculate the evaluation value of management effectiveness η. The size of η represents the difference coefficient between the enterprise's current management behavior and the best (the evaluation value of management effectiveness). When $\eta = 1$, it means that the current index of the company is on the management frontier of the management possibility set and belongs to effective management; when $\eta < 1$, it means that the current index of the company is not on the management frontier of the management possibility set and belongs to ineffective management.

The process of enterprise management effectiveness evaluation based on improved AHP is shown in Figure 3. Firstly, the evaluation index system was established, and the dimension of the evaluation index system was reduced, and then the AHP was used to determine the weight of the index system. Then the relevant parameters of the management effectiveness evaluation model were used to evaluate the management effectiveness of enterprises. Finally, the effectiveness of enterprise management was measured according to the evaluation structure.

4. Results

4.1. Empirical Samples and Data. This paper selects six enterprises as the research objects, including the primary industry, the secondary industry, and the tertiary industry, with a large scale and multiple subsidiaries. The research object is selected by random method, and the typical

enterprises in this province are selected, which has a certain representativeness. According to the established enterprise management evaluation index system, this work used the AHP to analyze the evaluation indicators, the proportion of each index is shown in Figure 4, and the average weight of the index is shown in Figure 5, operation(B3) had the highest weighting, followed by profitability (B1), Marketization (B5), development(B4), and Solvency (B2).

4.2. Management Effectiveness Measurement Results. According to the quantitative value after dimensionless processing and the indicator weights provided, this paper calculates the comprehensive performance scores of the six companies and the performance scores in five aspects. The comprehensive performance of the previous year is the reference index, and the comprehensive performance of the current year is the current index, and the management effectiveness score of each enterprise in the current period is measured. The management effectiveness score is shown in Figure 6.

The averages mask the specific information about the effectiveness of a company in terms of management of firms in their management. Therefore, this paper believes that the management effectiveness of the sample enterprises should be analyzed year by year. The following is a typical analysis of the management effectiveness of sample companies in period t.

Figure 7 shows the reference index, the current index, the frontier ideal value of the current index of the sample companies in the t period. The enterprise 1, 3, 4 has a high level of current management effectiveness, while enterprise 2, 5, 6 has a low level of current management effectiveness. The current index of enterprise management effectiveness in enterprises 1, 4, 5 and 6 is higher than the reference index, indicating that the enterprise management effectiveness has been improved to some extent. The current index of enterprise management effectiveness in enterprises 2, 3 is lower
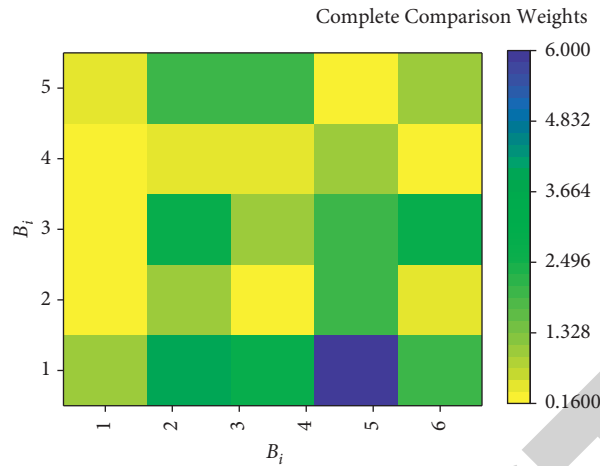
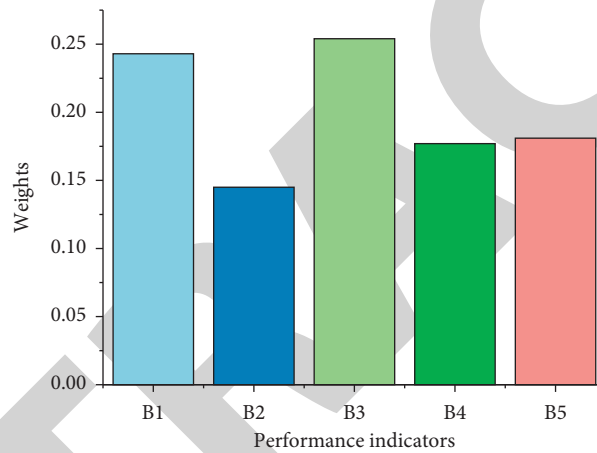Figure 4: Complete comparison matrix.

Figure 5: Enterprise performance evaluation index weight.

than the reference index. Figure 8 shows the enterprise management effectiveness evaluation results. According to the analysis results, the enterprise 4 has the highest enterprise management effectiveness, followed by enterprise 6, 3, 1, 5 and enterprise 2 has the lowest enterprise management effectiveness. There is a large difference between the highest and lowest enterprise management effectiveness, indicating that there is a huge difference in enterprise management effectiveness among different enterprises.

According to the size of the evaluation value of management effectiveness, the sample enterprises are divided into the following three categories: the first category is the enterprises with management effectiveness score greater than 0.85 (including 0.85), which belong to excellent management effectiveness enterprises; the second category is the enterprises with management effectiveness score lower than 0.85 and higher than 0.6 (including 0.6), which belong to enterprises with good management effectiveness, and the third category is the enterprises whose management effectiveness score is less than 0.6, which belong to the enterprises with poor management effectiveness. The enterprise management effectiveness evaluation value classification is shown in Figure 9.

According to the above analysis, it can be reflected that the management effectiveness evaluation method fully considers the differences in the objective basic conditions of the units being evaluated. The evaluation value of management effectiveness objectively reflects the effective efforts of enterprise management, and this method can promote the discovery of gaps between companies and companies in the same industry and to tap their own potential capabilities.

5. Discussion

This paper has carried out in-depth research on the management effectiveness of enterprises, and has also achieved certain results. However, the research work of enterprise management effectiveness evaluation has important theoretical and empirical research value, and the research on management theory has certain forward-looking. But there are still problems that need further research: one of the most important evaluation indicators of enterprises is service quality. If customer satisfaction surveys are included in the evaluation system of enterprise management effectiveness, the evaluation of enterprise management effects will be more comprehensive. Although this paper proves the availability
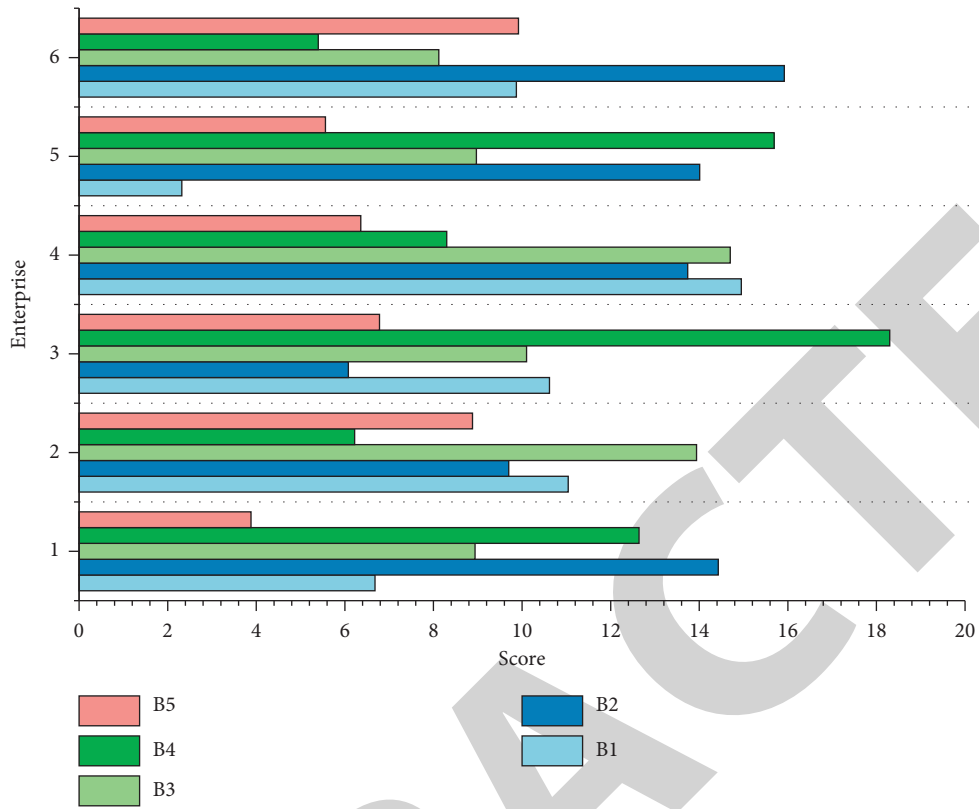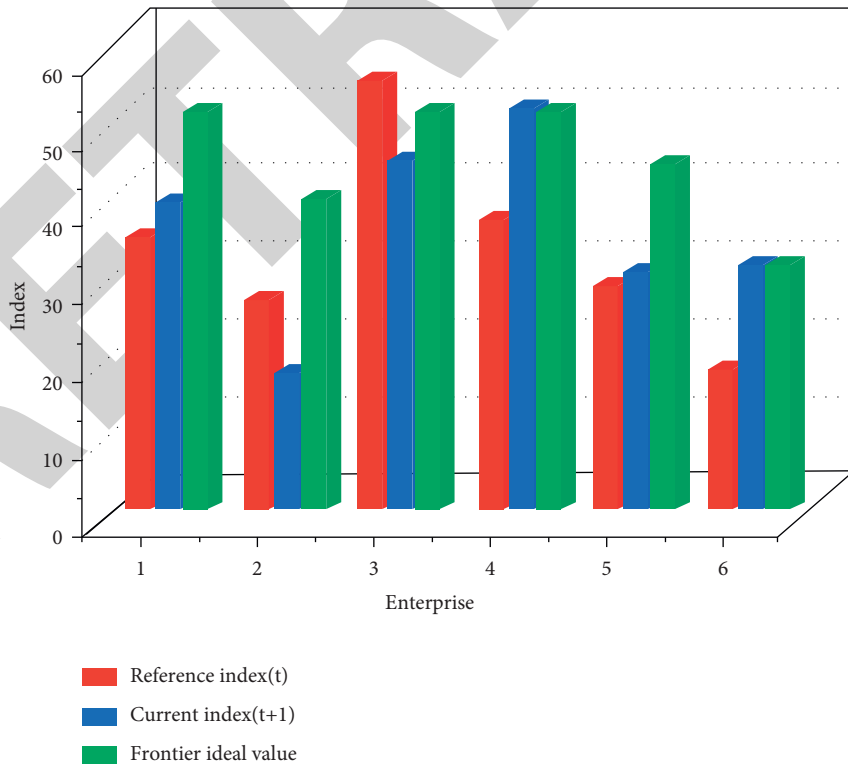
FIGURE 6: Management effectiveness score.

FIGURE 7: The reference index, the current index, the frontier ideal value of the current index of the enterprise.
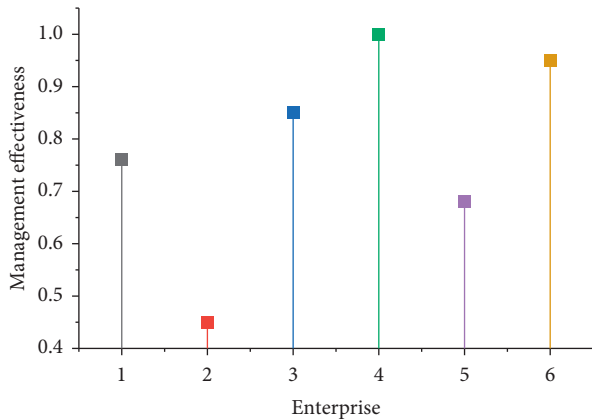
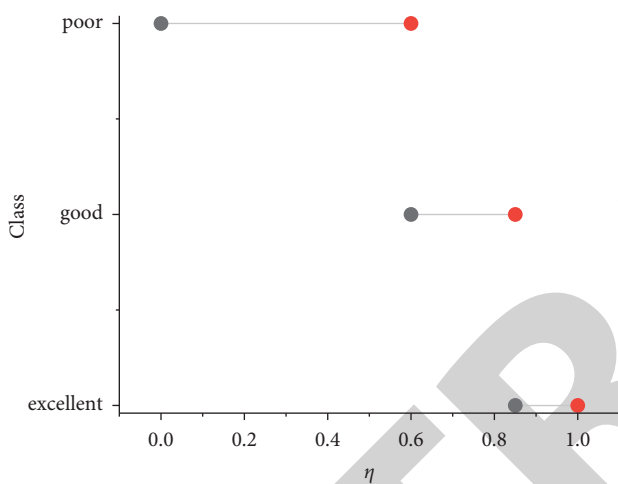Figure 8: Enterprise management effectiveness evaluation results.

Figure 9: Enterprise management effectiveness evaluation value classification.

of the management effectiveness evaluation model, due to the constraints of many objective conditions, this paper only selects a few enterprises as the research object. This research objects here are only some large enterprises of enterprises. Next, the research perspective should be turned to the study of the management effectiveness of small and medium-sized enterprises.

6. Conclusion

According to the design principle of enterprise management evaluation index system, the enterprise management evaluation index system is constructed from profitability, solvency, development ability, operation ability, and marketization ability. A method of calculating performance that integrates AHP and dimensionless processing is proposed, which is a precondition for evaluating the effectiveness of enterprise management. The evaluation of enterprise management effectiveness based on AHP breaks through the subjective limitation of previous qualitative evaluation and provides guidance for quantitative evaluation of enterprise management effectiveness. Through the interpretation of the management effectiveness theory, and on

this basis, the management possible set of the enterprise reference index and the current index is proposed; the enterprise management effectiveness evaluation model is constructed, which provides an effective dynamic for evaluating enterprise management effectiveness. This paper selects six companies as the research object, and conducts an empirical analysis on the management effectiveness evaluation of the sample companies. The empirical results show that the evaluation method of management effectiveness can objectively and fairly describe the pros and cons of the degree of enterprise management.

Data Availability

The experimental data used to support the findings of this study are available from the corresponding author upon request.

Conflicts of Interest

The authors declare that they have no conflicts of interest regarding this work.

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