

Research on Enterprise Performance Evaluation Based on Decision Tree Method

Zhao Yin^{1,*}, Zhendong Wang²

¹*College of Mathematics & Statistic, Yili Normal University, Yining, Xinjiang, 835000, China*

²*School of Economics & Management, Northwest University, Xi'an, Shaanxi, 710127, China*

**Corresponding author. Email:heartattackyz@163.com*

ABSTRACT

Enterprise performance evaluation is not only a significant means of self-supervision and self-restraint for enterprises, but also a significant management tool for enterprises to implement strategic management. Enterprises have a large number of stakeholders. Enterprise management objectives should be relevant to the stakeholders. The objectives of each stakeholder can be compromised for the long-term steady development of enterprises and the successive growth of the total value of enterprises. Quantitative performance appraisal system of enterprises is the evaluation of various enterprise activity data in a fixed period time facing the management level of enterprises. Effective performance evaluation is beneficial for enterprise managers and other stakeholders to have a comprehensive understanding of the enterprise's operating conditions and development trends, and for enterprises to establish and perfect effective restraint and incentive mechanisms. This paper mainly introduces a quantitative analysis method to improve the reliability and validity of evaluation and save evaluation time by using decision tree method in data mining technology in the process of enterprise management performance evaluation. The purpose is that enterprises should strive to establish an enterprise performance evaluation index system based on value creation, realize the optimal allocation of resources, enhance the management ability of enterprises, and accelerate the renewable development of enterprises.

Keywords: *Performance evaluation, enterprise management, decision tree*

1. INTRODUCTION

Enterprise performance evaluation is the core issue in any economic system, which is closely combined with enterprise management practice. It is a comprehensive evaluation of the performance of business operators, the benefits and efficiency of business management activities within a certain period of time [1]. With the deepening of the reform of central enterprises and the rapid development of social economy, under the premise of increasingly fierce competition after some central enterprises have undergone market-oriented reform, the scientific development of enterprises and objective decision-making analysis are very critical in the reform of operation and management [2]. Enterprises in the modern sense are quite different from those in the traditional sense and are the sum of multilateral contractual relationships. Enterprises facing the environment and based on the concept of circular economy will be favored more and their economic and social benefits will be greatly improved [3]. The application of data mining technology in quantitative performance appraisal management is an essential tool and means to fully mine potential valid information about enterprises [4]. Practical performance evaluation is beneficial to the business managers and other stakeholders of the enterprise to comprehensively understand the business status and

development trend of the enterprise, which is conducive to the establishment of a sound and effective restraint and incentive mechanism, and improve the business management measures [5]. In order to ensure the renewable development of enterprises, enterprises should allot their remainder claims and residual control rights among the main stakeholders, and different supply ways will produce disparate performance levels.

Any company has many stakeholders, such as investors, managers, suppliers, employees, customers, government departments, communities, etc. [6]. They all invest in the company and take on the risks it poses. The survival and development of the company depends on its ability to effectively dispose various stakeholders [7]. The closeness of enterprises in different regions and countries is also getting more durable and stronger, and the relationship between them is also more and more complex, just like a world with ecological characteristics [8]. As a quantitative form of evaluating the results of organizations and individuals, performance is the effective output of the subject to achieve the goal. It includes the relationship between subjectivity and objectivity, quantity and quality, input and output [9]. The goal of enterprise management should be related to the interests of the company, and it is the result of the joint action and mutual compromise of multiple stakeholders. The goals of each stakeholder can be compromised for the long-term steady development of the

enterprise and the successive growth of the total value of the enterprise [10]. According to the strategic thought of sustainable development, the traditional enterprise performance evaluation index system and evaluation method will no longer be fully applicable to enterprises facing the circular economy model [11]. It is the key to ensure the steady operation and scientific development of the enterprise to carry out an excellent inspection of the operation and management process and to carry out a correct assessment and evaluation of the various operating departments and management work within the enterprise [12].

2. BACKGROUND

Performance evaluation originates from the company's pursuit of organizational operation effect and efficiency, and its concepts, models and conclusions are quite rich [13]. Today's enterprises not only have to compete fiercely with domestic enterprises, but also have to compete more fiercely with foreign enterprises internationally [14]. The quantitative performance evaluation system of an enterprise is the evaluation of various enterprise activity data in a fixed period of time in the face of the operation management level of the enterprise [15]. The management of an enterprise should take it as its duty to maximize the purposes of various interest groups. Maximizing the objectives of various interest groups is the maximization of enterprise performance [16]. According to the different dimensions of enterprise performance evaluation, through the use of relevant data mining technology can be useful analysis of historical and current data association, and thus improve the enterprise evaluation benefit analysis [17]. The emergence of high-tech has made the product life cycle shorter and shorter, and the number of products has expanded rapidly, and time has become the key to competition to a certain extent [18]. In the knowledge economy, knowledge exists as the capital of the enterprise. It relies on the continuous innovation and dissemination of knowledge to improve the efficiency of other resources and capital use. Starting from the strategic thinking of circular economy, setting up the enterprise performance assessment index system for circular economy is of great importance to the introduction, implementation and control of the new circular economy model.

3. QUANTITATIVE PERFORMANCE APPRAISAL METHOD BASED ON DECISION TREE

3.1. Quantitative Performance Appraisal System

The establishment of the enterprise's quantitative performance appraisal management system is conducive to the enterprise to change the old-fashioned management mode, at the same time, the management of the company pays full attention to the business process. This includes not

only monitoring of standards during execution, but also monitoring of business operations and operations management. To achieve a comprehensive reflection of the overall performance of the enterprise, the construction of the evaluation index system must strictly follow the relevant principles of the indicator system construction on the basis of systematic analysis [19]. The implementation of office automation and e-government has accumulated a huge amount of data in the field of enterprise management. The traditional query and data processing technology can not solve the information explosion problem faced in reality. The enterprise performance is decomposed into two parts: the task performance and the peripheral performance of the enterprise. It is considered that the two are affected by the various stakeholders' interest requirements and their implementation methods. In addition to the management effect of the enterprise, the establishment of the enterprise performance evaluation index system for the circular economy should also affect the environment in the production and operation of the enterprise [20]. The evaluation index is too complicated to grasp the essence of the evaluation object and affect the operability of the evaluation system. In order to make the evaluation index simple, easy to operate, highlight the main contradictions, the meaning of the index should be accurate. On this basis, the performance of enterprises is evaluated comprehensively from the aspects of financial efficiency, asset operation, debt repayment ability and development ability.

Enterprise quantitative assessment system is composed of enterprise assessment cycle, enterprise assessment and evaluation system, enterprise assessment execution layer and enterprise execution layer, etc. Enterprise financing system can help individuals develop business opportunities, enterprise education system can improve the ability of identifying opportunities for entrepreneurs, and the optimization of enterprise environment can provide more business opportunities for enterprises. Table 1 shows the empirical results of enterprise policies and attitudes. Table 2 shows the empirical analysis results of enterprise policy and enterprise model.

Chinese companies invest in developed countries and collaborate with external sources such as upstream and downstream channels. Reduce input and transaction costs and form exogenous forces. To measure the degree of price competition between a company's congeneric product and the market average price, you can simply write the price competition between a single company's product pricing and the market average price as (Among them A : average, I : investment, Q Quantity or quantity of goods, D demand.):

$$AI_i = \frac{(I_i + Q_i) + (I_i + Q_i - D_i)}{2} = I_i + Q_i - \frac{D_i}{2} \quad (1)$$

Initialize, count the connection weight and threshold, and assign any value:

$$w_{ij} = w_{ij} + a \left(\frac{X_i}{m} - w_{ij} \right) \quad (2)$$

Table 1 Empirical analysis of corporate policies and corporate attitudes

Variable	Perceived skills	Perceived opportunity	Enterprise will	Fear of failure
Corporate funding	0.067	0.135	0.069	0.274
Corporate education	0.057	0.226	0.058	0.382
Business environment	0.017	0.086	0.046	0.023
Type of economy	0.011	0.078	0.084	0.046

Table 2 Empirical analysis of enterprise policy and enterprise model

Variable	Survival enterprise	Opportunity enterprise
Corporate funding	0.354	0.267
Corporate education	0.269	0.153
Business environment	0.082	0.141
Type of economy	1.463	2.546

Consumer preferences are heterogeneous and differentiated products can be used to meet their needs. Provide input samples and expected output:

$$\ln(D_i) = a + \sum_{j=1}^n b_j \ln(p_j) + r_i \ln(Y) + u \quad (3)$$

Enterprises with large social relationships have strong financing capacity and can make their own investment decisions on the basis of market opportunities, thus improving the success rate of enterprises. The specific process can be shown in Figure 1. First, the minimum spanning tree is acquired, and then the cycle is controlled in line with the conditions to cut off the margin with the largest weight. If two clusters need to be obtained, only one of the longest sides needs to be incised.

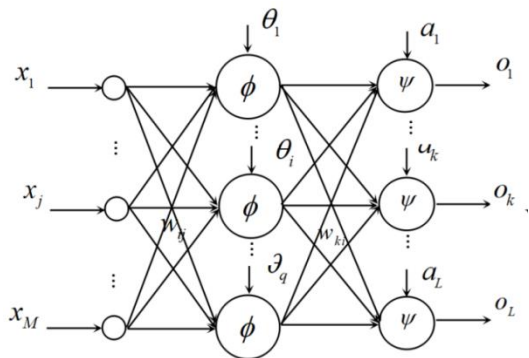


Figure 1 Spanning tree process

Judging the future trend of corporate performance through performance evaluation is the main purpose of performance evaluation, and also an important information demand for formulating and adjusting corporate strategy. If a company has a high market share and the entry barriers of the industry are high, then the company has a strong monopoly power. Fund management is the top priority of financial management. However, a considerable number of group companies suffer from loose management of funds due to restrictions on management models and means. The operating results of a company in 2011-2018 are shown in Figure 2.

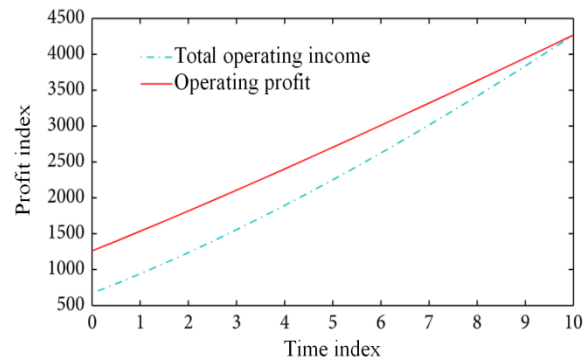


Figure 2 Business performance

When establishing the enterprise performance evaluation index system, it should cover all the factors and links of the enterprise's production and operation, that is, according to the principle of comprehensiveness, the index system should fully reflect all the relevant factors and links of the evaluation object [21]. Decision tree analysis is a machine learning algorithm, which mainly summarizes the hidden

knowledge model from a large number of historical data and predicts new data through this knowledge model[22]. The goal of maximizing the value of an enterprise refers to that an enterprise adopts the best financial strategies and policies through legal operation, and fully considers the time value, risks and benefits of money [23]. Enterprise performance evaluation indicators should have comprehensive comparability, mainly including comparison with budget, comparison with different periods of enterprises, comparison with industry average level, comparison with competitors, etc. In the research field of stakeholder theory, enterprise performance evaluation is the kernel of the whole theory [24]. If the enterprise ignores the interests of some stakeholders, or the realization of their benefits is not flawless, then the behaviour of these stakeholders will affect the performance of the enterprise.

3.2. Quantitative Performance Appraisal System Architecture

Enterprise performance evaluation itself is a complex multi-objective problem, which cannot be determined simply by an indicator. The evaluation indicators should select those indicators that can basically improve the indicator results through subjective efforts, or can distinguish between subjective factors and objective factors. Data mining technology mainly uses statistical mathematics to discover and discover existing knowledge. In the process of quantitative performance appraisal, the data is preprocessed, in-depth analyzed and expressed by manual and automated data collection. The comprehensive evaluation of enterprise performance is a multi-dimensional composite system. Not all evaluation factors can be quantified, and the breadth and breadth of information volume reflected by qualitative indicators are greater than quantitative indicators [25]. Just as profit maximization shifts to the maximization of shareholders' equity, the transition from maximizing shareholders' equity to maximizing corporate value is another leap in the theory of financial management objectives.

In the data warehouse of the enterprise quantitative performance appraisal system, based on the event processing time and post-processing satisfaction of each application system, the data related to the employee appraisal is used as different dimensions to measure the performance appraisal results. The corporate policy scores of innovation-driven economies are higher than those of investment-driven economies. This is mainly because the innovation-driven economy has a higher level of economic development, a more complete policy system, and a higher efficiency in the allocation of corporate resources. Figure 3 is a conceptual model of the impact of corporate policies on entrepreneurial corporate behavior.

The selection of evaluation indicators and the composition of the system should have relative stability. However, with the continuous development of the economic environment, the comprehensive evaluation of enterprise performance should also reflect the dynamic side. In the process of studying international enterprises, it is often proposed to study related concepts from the extension of resources. Entrepreneurs effectively lead and unite employees, and drive the enthusiasm of employees to work, which is conducive to the improvement of corporate performance. Sensitivity analysis can be performed for each influencing factor of a single scheme, and the risk management of the scheme can be performed from the results of the analysis. Table 3 shows the sensitivity analysis of enterprise risk assessment. Table 4 shows the financial situation risk comparison data results

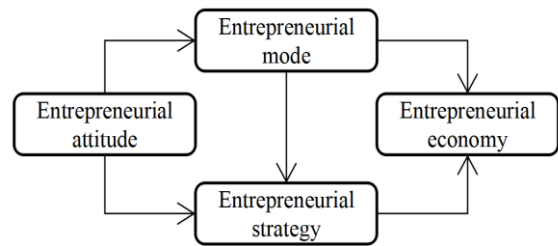


Figure 3 Conceptual model of the impact of corporate policy on entrepreneurial corporate behavior

Table 3 Risk assessment sensitivity analysis

	Evaluation value	Post-change score
Environmental risk	0.747	0.748
Production risk	0.644	0.792
Management risk	0.733	0.766
Technical risk	0.435	0.641
Market risk	0.514	0.794

Table 4 Financial situation risk comparison data results

	Marginal cost rate	Return on assets	Operating cash flow
Marginal cost rate	1	0.59	0.67
Return on assets	0.56	1	0.62
Operating cash flow	0.48	0.69	1

Market forces can promote innovation, which in turn can achieve a higher rate of return than private rate of return, so its impact on the "net effect" of social welfare can be positive. Calculate the output of each unit in the hidden layer:

$$\delta_k^o = (d_k - o_k)(1 - o_k)o_k$$

$$\delta_j^y = \left[\sum_{k=1}^l (d_k - o_k) f'(net_k) w_{jk} \right] f'(net_j) \quad (4)$$

$$= \left(\sum_{k=1}^l \delta_k^o w_{jk} \right) (1 - y_j) y_j$$

Calculate the actual output of each unit of the output layer:

$$K_{s,d} = \frac{1}{MN} \sum_{m=1}^M \sum_{n=1}^N \frac{\left| |W_{s,d}(m,n)| - \mu_{s,d} \right|^4}{\sigma_{s,d}^4} \quad (5)$$

By actively providing differentiated products, enterprises can weaken price competition and gain monopoly profits and market power. Fix connection weights and thresholds:

$$F_r = (A_c + W \tan \varphi) \left[1 - \frac{K}{iK} \left(1 - e^{-\frac{iL}{k}} \right) \right] \quad (6)$$

Calculate the average increment and initial exponential smoothing value for each period in two cycles as shown in the formula:

$$AI_t = \frac{(I_t + Q_t)}{2} \cdot \frac{(I_t + Q_t)}{D_t} \quad (7)$$

Regardless of the direction of development of the enterprise, the business development of the enterprise is ultimately affected by the performance of the enterprise. Therefore, we propose a hypothesis model, and the four capabilities that entrepreneurs have have a positive effect on the performance of corporate international companies. As shown in Figure 4.

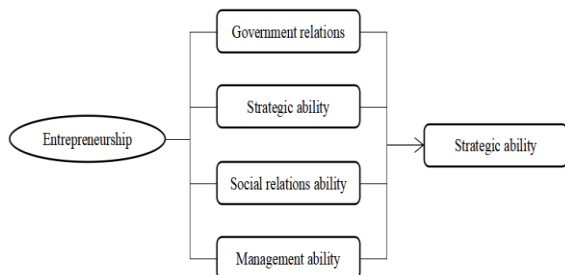


Figure 4 Research model

The goal of maximizing the value of an enterprise contains a lot of contents. Data integration is the process of integrating data from an enterprise integration platform. Its subsystems such as contract management, customer assessment, basic logistics, gold tax invoices and other system data are aggregated and stored in a quantitative performance assessment data warehouse. There is a complete set of index system for the performance evaluation of enterprise management, some of which are numerical data and some are descriptive indicators. After introducing the strategic idea of circular economy into the production and operation of enterprises, the objectives of the production and operation activities of enterprises have changed from pure pursuit of economic benefits to enterprises' pursuit of both their own economic benefits and environmental benefits[26]. Under the background of global economic integration and knowledge economy, the business environment of enterprises has changed dramatically. The quantitative performance appraisal information table contains many fields and attributes. Some attribute fields are unrelated fields in the quantitative performance appraisal system. If these fields are not removed, they may affect the appraisal results imperceptibly in the later stage of performance appraisal.

4. CONSTRUCTION OF ENTERPRISE PERFORMANCE EVALUATION INDEX SYSTEM

Human beings are ushering in a new era of knowledge economy. The essential attribute of knowledge economy is innovation. A series of innovations such as technological innovation, institutional innovation, organizational innovation and management innovation have laid a solid foundation for the emergence and development of knowledge economy. The market has changed from a seller's market to a buyer's market, consumer demand has changed from singleness to diversification and personalization, and the product life cycle has been shortened. Enterprises must continuously research and develop differentiated new products and services in order to adapt to changing customer needs and improve customer satisfaction and retention rate. The goal of maximizing the value of an enterprise overcomes the defect of the goal of maximizing the wealth of shareholders, absorbs the advantages of the concept of maximizing the wealth of shareholders, and is a further development of people's deep understanding of the financial management goals of modern enterprises. The interest

requirements of different stakeholders will not only differ, but may also be conflicting and contradictory. Due to the deterioration of human living environment, the awakening of human environmental awareness has been prompted. In the global scope, from the state to various market economic entities are actively looking for a model of sustainable economic and social development [27]. Figure 4 Research Model Employees' demands for improved working conditions and higher wage levels may conflict with shareholders' demands for maximizing profits. The community's requirement for companies to provide more employment opportunities will also make it difficult for business managers.

According to the research, Chinese enterprises cannot compete head-on with multinational enterprises in research project, and only have a comparative advantage in a definite factor cost. The financial situation risk comparison data is shown in Table 5. The relationship between the financial condition risk weight value and the evaluation value data is shown in Figure 5.

Indicators that measure market structure by market share, concentration, etc. reflect the size of market power. Estimate the price cost of the enterprise based on the output elasticity of the factor, and then get the Lerner index:

$$w(x, y, d) = \exp\left(-\left(\frac{d_g}{r_g} + \frac{d_c}{r_c}\right)\right) \quad (8)$$

Further, assume that the production function of the enterprise during the w period is:

$$C(x, y, d^{(i)}) = \sum_{(x,y) \in N(x,y)} w(x, y, d^{(i)}) \cdot SelfAd(x, y, d^{(i)}) \quad (9)$$

By first-order derivation of variable inputs, you can get:

$$E(x) = \sum_{j=1}^n E_j \quad (10)$$

In the face of the new strategy of sustainable development, the goals of enterprise organizations are more diversified, and they can no longer pursue economic interests. They must also consciously follow social ethics and environmental ethics. In an uncertain environment, the management ability, personality and personal charisma of business leaders or managers influence the efficiency of the top management team and the performance of the company. This makes consumers lack information guidance in the choice, can only refer to the brand, user evaluation and other information, there is a lot of blindness. Rapid assembly, integration, reconfiguration and dissolution of the extension manufacturing capability unit. Figure 6 is a model of the extension manufacturing capability unit.

The real realization of enterprise value maximization is based on the correct handling of various interests of enterprises and the long-term stable development of enterprises. The data mining process in financial analysis generally consists of five main stages of determining financial analysis objects, data preparation, data mining,

result analysis, and knowledge assimilation, as shown in Figure 7.

Table 5 Financial situation risk comparison data results

	Return on assets	Marginal cost rate
Return on assets	0.68	0.69
Marginal cost rate	0.59	0.72

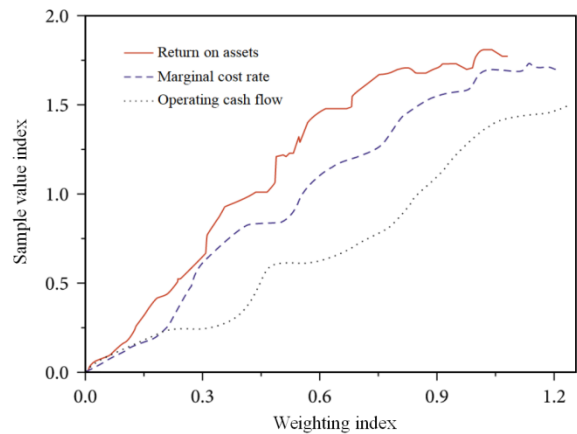


Figure 5 Relationship between financial situation risk weight value and evaluation value data

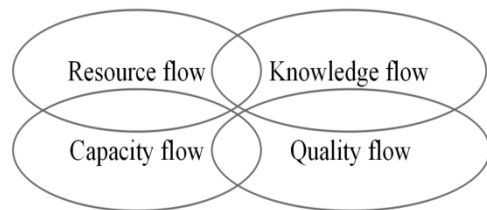


Figure 6 Extension manufacturing capability unit model

Sensitivity analysis can also be performed for each benefit influencing factor of a single design. From the results of the investigation, it can be seen which factor has the greatest impact on the benefit of the project. Applying the change N of each benefit influencing factor, the relationship between the benefit evaluation and the benefit influencing factors of the benefit evaluation value after the change is shown in Figure 8.

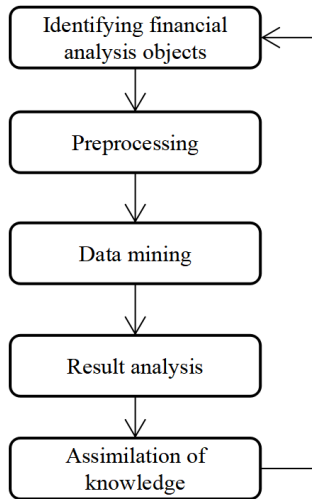


Figure 7 Data mining process in financial analysis and management

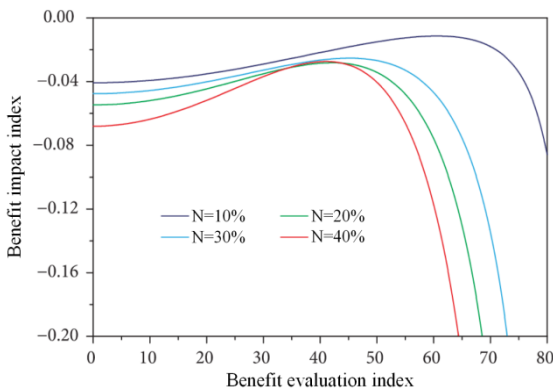


Figure 8 Relationship between benefit evaluation and benefit factors

A decision tree for quantitative performance evaluation is constructed by the above methods, but there are many unrelated branches and leaf nodes in the decision tree, so it is necessary to prune the decision tree reasonably. Every enterprise has many modes to attain the interests of various stakeholders, but some ways work well, while some ways make stakeholders unsatisfied, which affects the performance of the enterprise. We need to design a structured survey to measure the task performance and the surrounding performance of the enterprise, and let the relevant stakeholders evaluate their attitudes and willingness, and use statistical software to calculate the performance score of the enterprise. The investor of knowledge capital strengthens the innovation ability of enterprises, changes the distribution mechanism of enterprises under the theory of capital employment labor, and enables the profit distribution of enterprises to be shared

by the owners of knowledge capital and industrial capital. The enterprise performance evaluation index system is an organic system, in which various factors are interrelated and restrict each other, which together affect the overall level of enterprise performance.

There will also be a big gap between the setting of accounting subjects and the requirements of the accounting system, and pre-withdrawal has not been carried out as required. There are also many problems in the management of income and expenses. Inconsistency between the book and the actual situation occurs from time to time. The existence of agency problem makes the time preference of asset managers unavoidably internalized in the investment decision-making activities of financial institutions. The comparison data of financial situation risks are shown in Table 6. The data relationship between risk weight value and evaluation value of financial situation is shown in Figure 9.

To measure the price competition between a company's congeneric products and the average market price, the price competition between a company's products and the average market price can be briefly written as follows:

$$y_i = f\left(\sum_j w_{ij}x_j - \theta_i\right) \quad (11)$$

Initialize, count the connection weight and threshold, and assign any value:

$$w_j = g_i / \sum_{j=1}^n g_i \quad (12)$$

Provide input samples and expected output:

$$CPV(k) = \sum_{j=1}^k \lambda_j / \sum_{j=1}^m \lambda_j \quad (13)$$

Calculate the output of each cell in the hidden layer:

$$f(t) = \sum_{j=1}^N \sum_{k \in Z} d_k^j \phi_{jk}(t) + \sum_{k \in Z} c_k^N \phi_{Nk}(t) \quad (14)$$

Table 6 Financial situation risk comparison data results

	Return on assets	Marginal cost rate
Return on assets	0.65	0.72
Marginal cost rate	0.48	0.61

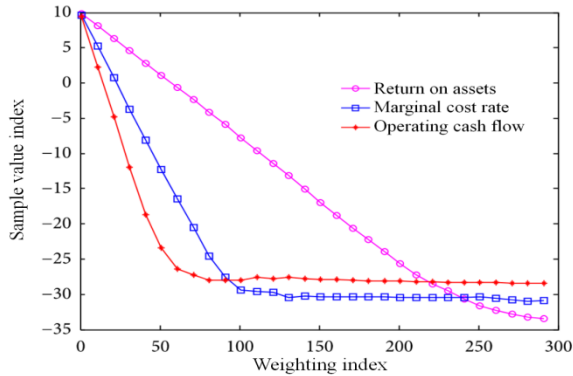


Figure 9 Relationship between financial situation risk weight value and evaluation value data

In the design of enterprise performance evaluation indicators, the indicators must be closely related to the above factors, that is, the key factors affecting the level of enterprise performance should be embodied in the evaluation indicators. The traditional structuralist school also points out that market structure affects the behaviour of enterprises. When the importance level is low, the customer management capacity has a relatively huge impact on the marketing performance. However, the other two sub-indicators market learning ability and marketing promotion capacity have important impact on marketing performance, but to a lesser degree. As shown in Table 7, the structural parameter estimation and significance test of performance indicators.

Table 7 Performance indicator structure parameter estimation and significance test

Path description	Path coefficient
Market learning ability → influence performance	3.34
Marketing ability → marketing performance	3.45
Customer Management Capabilities → Marketing Performance	3.77

Enterprise performance appraisal system is the embodiment of the relevant value of enterprises at all levels of organizations and employees, and at the same time, enterprise management pays comprehensive attention to the business process. China is a socialist market economy country, and the modern enterprise system has a unique and complex development process in China. Implementing the new model of circular economy and promoting cleaner production in enterprises can improve the overall quality of enterprises, improve the management system of enterprises and promote the progress of production technology. Because there are many tentative factors in practical problems, when using decision tree construction algorithm to itemize such data,

the resulting decision tree will become huge and mathematical. Profitability refers to an enterprise's ability to acquire profits, reflects its financial structure and operating performance, and is a comprehensive reflection of its operating ability, debt paying ability and development ability. The average training cost ratio of employees can better reflect the importance that enterprises attach to human investment, and also better reflect whether enterprises are committed to long-term development and improve the long-term performance of enterprises. Only by constantly developing innovative products and services can enterprises gain competitive advantages. At the same time, when the product is in a leading position in the market, it usually can obtain excess profits.

5. CONCLUSIONS

Enterprise performance evaluation is one of the most concerned issues in enterprise management. It is the best way for enterprises to find their own shortcomings and establish their core competitiveness. Decision tree, as a necessary data mining technology, is a very useful fuzzy mathematics evaluation tool for dealing with enterprise performance evaluation with a lot of descriptive data and provides a broad space for reasonable quantification of evaluation. Based on the decision tree method, this paper analyzes the research status of enterprise performance evaluation at home and abroad from two aspects of enterprise performance evaluation methods and evaluation indicators, and summarizes its research results and existing problems. Enterprise performance evaluation is one of the most concerned issues in enterprise management. It is the best way for enterprises to find their own shortcomings and establish their core competitiveness. In the future, enterprises should try to build an enterprise performance evaluation index system based on value creation, so as to realize the optimal allocation of resources, to better improve the management ability of enterprises, and help the renewable development of enterprises.

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