Research on Performance Evaluation of Industrial Economic Management Based on Improved Machine Learning

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Abstract. Aiming at the problem of poor self-protection ability caused by too many iterations in the performance evaluation system of industrial economic management, a study on performance evaluation of industrial economic management based on improved machine learning is proposed. In terms of hardware design, design and deploy the system storage architecture and network environment for system operation; In software design, the improved machine learning algorithm is used to screen out appropriate evaluation indicators from the set of factors that affect the performance evaluation of industrial economic management. After the evaluation indicators are determined, the rating threshold is divided, and the total score of performance evaluation is calculated according to the score and weight of each indicator, which is compared with the rating table one by one to achieve the performance evaluation of industrial economic management. So far, the overall design of the system has been completed. The test results show that the industrial economic management performance evaluation system designed based on improved machine learning has low sensitivity, high fluency and high self-protection ability.

Keywords: Improving machine learning algorithm · Industrial economic management · Storage architecture · Performance evaluation

1 Introduction

With the rapid improvement of the national economy, many problems will occur in the construction industry, and the factors that cause the problems are also diverse. There are also many reasons that affect the risk of industrial economic management in the details of project management, and it is difficult to find specific reasons for many aspects of industrial economic management [1–3]. Therefore, it is necessary to use scientific and reasonable methods and countermeasures to conduct detailed investigation and analysis of risks in industrial economic management. At present, the knowledge of engineering economics is mostly used to analyze and supervise and manage industrial projects, so as to maximize the economic benefits of enterprises. Incorrect control of economic risks

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can lead to project failure and huge economic damage. Therefore, in order to avoid risks in industrial economic management, enterprise managers must learn to recognize and distinguish risks and adopt efficient and targeted countermeasures to prevent risks. Guo Baitao et al. [4] the network analytic hierarchy process (ANP) method is used to calculate the corresponding weight of each index with the help of Super… Decision software, and the performance evaluation model of new R&D institutions oriented to industrialization is designed from the four dimensions of R&D conditions, innovation activities, innovation benefits and human resources Jiang Hailing et al. [5] constructed an evaluation index system for agricultural green development policies, and used Del's Illegal and Network Analytic Hierarchy Models to evaluate the performance level of agricultural green development policies. However, the performance rating systems constructed by the above methods all have the problems of low fluency and high sensitivity, resulting in poor self-protection ability of the performance evaluation system.

With the improvement of the market economy system, the market competition in industrial production is becoming more severe. In every link of industrial production, there are laws governing the development of economy and management. Industrial economic management is a science that explores the development and change laws of industrial economic management and management theories and methods. Based on this scientific knowledge, many risks existing in industrial economic management can be prevented and estimated to achieve accurate understanding and optimization of appropriate prevention methods. Through these means, production management personnel have the ability to distinguish risks and deal with risks [6]. Mastering the economic relationship and development law of industrial production is an effective way to deal with risks. For the industrial production sector, preventing and avoiding potential risks in industrial production and reducing emerging risks to a lower level will have a negative impact on the cost of industrial production. The savings and improvements in manufacturing quality are very significant. Therefore, this paper proposes a research on the performance evaluation of industrial economic management based on improved machine learning. Through the design of hardware and software, the performance evaluation of industrial economic management is realized, the overall design of the system is completed, and the self-protection ability of the performance evaluation system is improved.

2 Related Deployment of Industrial Economic Management Performance Evaluation System

2.1 Performance Evaluation Indicator Model

The performance appraisal indicator model of industrial economic management is a model that unifies the performance information of all departments and employees of the enterprise. The model functions mainly include:

(1) Department performance. Record the performance of all departments.
(2) Historical performance evaluation: based on the self-evaluation of the performance of all employees and departments, the historical performance of employees and different departments is evaluated and recorded by setting different dimensions from multiple perspectives.

(3) Query statistics. Carry out comparative analysis and real-time query based on employee individual performance score and department performance score.

By establishing a performance evaluation model to analyze the unified information of historical performance and appraisal performance, the cycle of subsequent performance evaluation is greatly shortened, the performance evaluation is accurate and timely, and the analysis performance is fast and accurate, thoughtful and convenient, changeable and flexible, timely and accurate advantages. It can support the adjustment needs of later performance evaluation indicators, realize the process, informatization, and dataization of performance evaluation, and provide a basis for later performance evaluation.

The performance evaluation index model provides a unified information query platform for performance evaluation. The comprehensive indicator evaluation model is divided into assessment decision-making layer, business indicator layer and original indicator layer. It realizes a data center, an information platform and a query system, and relies on the above construction mode to complete the integrated comprehensive statistics of indicator information [7]. The structure of the model is shown in Fig. 1.

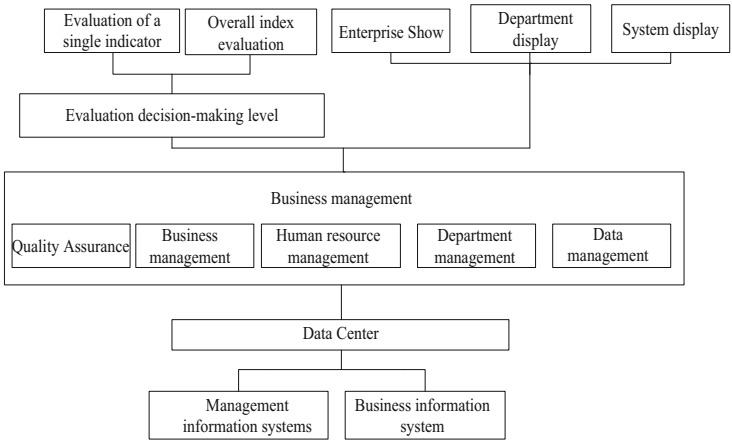


Fig. 1. Performance evaluation index model

According to Fig. 1, the management information system and business information system provide data support for the operation of the data center. The data in the data center can provide important support for business management, including quality assurance, specific business management, human resources management, department management, and data management. The evaluation of individual indicators and the evaluation of overall indicators of the evaluation decision-making level cannot be separated from the support of objective and real data. Relying on data centers can integrate data, speed up later mining, and greatly improve the coupling between different levels. It is not a simple centralized storage of data or a simple stack of storage devices, but a unified processing of the performance information of various departments and employees through the enterprise database, so that all indicators of employees are numbers [8], and provides the best choice support for the post performance evaluation. The relevant

evaluation results are visualized through the enterprise display and part of the display as well as the system display to provide important data support for subsequent enterprise decisions.

2.2 Storage Architecture Design and Deployment

The industrial economic management performance storage architecture is mainly used to store evaluation data and internal data during operation. It is an important part of the entire evaluation system and the basis for the design of the evaluation model [9]. If there is a problem with the data storage, it is difficult to recover in time. Therefore, in the storage architecture design, the N8300 storage is used as the external independent storage device of the entire architecture. At the same time, two physical hosts are designed to share the storage, and two network ports are bound for host shared storage. The storage unit capacity of the used storage configuration is two 2TB LUNs, and the technical level of the disk array is RAID6. The specific structure is shown in the figure below.

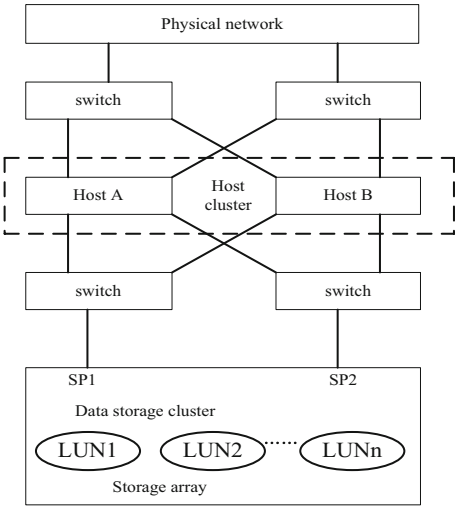


Fig. 2. High availability storage architecture

According to the analysis of Fig. 2, in order to realize the high availability storage of relevant data, the virtual machine files are stored on the external independent storage array connected to the host through the physical network to realize the shared storage of multiple hosts, and the virtual machine file format is converted and stored in host A and host B respectively. On this basis, the file formats in different hosts are converted again and transferred to the data storage cluster through different data transmission channels. The data storage cluster consists of multiple storage arrays, LUN1, LUN2, LUNn ensures that data can be migrated quickly in case of system storage failure. The combination of these technologies ensures the high availability of storage.

2.3 Network Environment Design and Deployment

Network environment deployment mainly includes physical network and virtual network. The physical network functions between hosts, between hosts and external storage, and between hosts and external network communication. In order to reduce network service interruption caused by network equipment and lines, each host is configured with four 1Gbit high-speed network cards, which respectively function on the connection between hosts and external physical networks and between hosts and external storage, at the same time, 4 gigabit switches are equipped to connect the host with the physical network and the host with the external storage [10].

In addition to the above hardware, a complete physical network also needs to use network cables to connect these hardware together, so that the components can access each other. For the host, the electrical port of the network card is mainly connected to the physical switches SW1 and SW2 through the network; the optical port of the network card on the storage is connected to the SW3 and SW4 of the physical switch through the optical fiber. Through the deployment of the physical network, the redundancy of network devices and network paths is realized.

3 Building an Industrial Economic Management Performance Evaluation System that Improves Machine Learning

3.1 Selection of Evaluation Indicators and System Construction

The improved machine learning algorithm is used to search out the influential factors with greater relevance among the factors affecting the performance evaluation of industrial economic management, and determine them as important indicators for subsequent performance evaluation.

In the improved machine learning algorithm, the correlation between influencing factors and performance evaluation is taken as the radius to be searched, fixed between $[-1, 1]$, and different influencing factors in the algorithm show random numbers in the $[-1, 1]$ interval. The search radius is set according to the interval range to improve the convergence speed of the algorithm. At the same time, a suitable search radius should ensure that the algorithm can find as many solutions as possible at the initial stage of the iteration, and help the algorithm search for the optimal solution in a small range at the later stage of the iteration process. In the performance evaluation system of industrial economic management, the formula for calculating the search radius is:

$$rad = radMax * e^{\lg\left(\frac{radMin}{radMax}\right) * \frac{d}{\max gen}} \tag{1}$$

In the formula, d represents the current number of iterations of the algorithm, max gen represents the maximum number of iterations set by the algorithm, and $radMax$ and $radMin$ represent the maximum and minimum search radius. The value of this parameter is related to the size of the search interval.

The algorithm solving process is as follows:

The population is generated according to formula 2, the fitness of the individual is calculated, and the individual with the worst fitness is recorded and added to the set G_0.

$$r_i^m = bestadd^m + (rad * \alpha) \tag{2}$$

In the formula, r_i^m represents the value of the m dimension of the i individual, $bestadd^m$ represents the current position of the population in the m dimension, and α is a parameter representing the random value in the $[-1, 1]$ interval. After the above calculation, update the global optimal fitness and population position. If the global fitness value does not change, update the technical variables [11, 12]. In this case, if the algorithm does not update the global optimal value for many times, start the traction operation. After the traction population is obtained, select the individuals with the opposite evolutionary direction to obtain the individuals with better fitness. Update the position of this individual to the new population position, and search around the updated civilian. Change the search radius and repeat the above process. Update the individuals in the set G_0 in the iterative process. To ensure the diversity of results. The factors that affect the economic management performance evaluation of Dow Jones Industrial are taken as the input of the algorithm, and the final evaluation indicators are shown in the figure below.

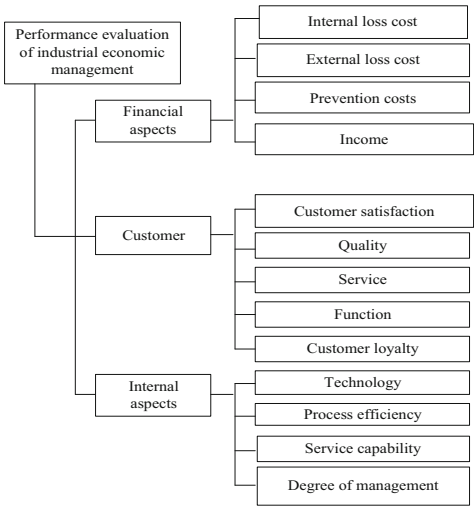


Fig. 3. Performance evaluation indicators of industrial economic management

According to the analysis of Fig. 3, the performance evaluation index system of industrial economic management is composed of three first-level indicators and 13 s-level indicators. Among them, the financial aspect is taken as the primary indicator, and the secondary indicators under this indicator are internal loss cost, external loss cost, prevention cost and income; Take the customer aspect as the primary indicator, and the secondary indicators under this indicator are customer satisfaction, quality, service,

role and customer loyalty; Take the internal aspect as the primary indicator, and the secondary indicators under this indicator are technology, process efficiency, service ability and management level. Under the condition of determining the evaluation index, the evaluation grade is determined according to the grading threshold of the evaluation factors of industrial economic management performance stability.

3.2 Evaluation Algorithm Implementation

The process steps of the mining method of fusing exponential map to represent learning and collaborative filtering matrix decomposition are as follows:

Step 1: First, use the knowledge map to express the learning algorithm to calculate the materialized vector expression of the internal indicator data of the assessment indicator management module;

Step 2: Match the indicator entity in the performance appraisal indicator interaction matrix with the entity in the knowledge map;

Step 3: Select the k-type nearest neighbors with the most similar assessment indicators to be mined in the knowledge graph kernel and introduce them into the matrix decomposition;

Step 4: Calculate the low-dimensional assessment index matrix after matrix decomposition through the collaborative filtering matrix decomposition method, and calculate the predicted score of the assessment index at the same time.

The algorithm objective function after fusion is as follows:

$$L = \sum_{i=1}^{m}\sum_{j=1}^{n} I_{ij}\left(U_i V_j^T - r_{ij}\right)^2 + \lambda_1 \sum_{i}^{m} n_{u_i}\|U_i\|_F^2 + \lambda_2 \sum_{j}^{n} n_{v_j}\|V_i\|_F^2 + \lambda_3 \sum_{j=1}^{n}\left(V_j - \sum_{V_k \in N_{V_j}} sim\left(V_j, V_k\right)V_k\right)^2 \tag{5}$$

In formula (5), N_{V_j} represents the most similar set of k nearest neighbors of assessment indicator V_j. Where, $sim\left(V_j, V_k\right)$ represents the similarity function, and the similarity function in this paper uses the cosine similarity function [13]. The value range of cosine similarity function is between $[-1, 1]$, as shown in formula (6).

$$sim = \left(V_j, V_k\right) = \frac{\sum_{i=1}^{d}\left(V_{jd}, V_{kd}\right)}{\sqrt{\sum_{i=1}^{d}\left(\left(V_{jd}\right)^2\right)}\sqrt{\sum_{i=1}^{d}\left((V_{kd})^2\right)}} \tag{6}$$

In the formula, d represents the dimension of the index entity vector trained by the fusion method. In this paper, it is rounded to an integer, and then it is normalized by means of formula (7).

$$f(x) = (1 + x)/2 \tag{7}$$

This paper uses the collaborative filtering method to minimize the objective function to calculate the performance evaluation index feature matrix U and the index system feature matrix V, and solve it by means of Eqs. (8) and (9).

$$\frac{\partial L}{\partial U_i} = \sum_{j=1}^{n} I_{ij}\left(U_i V_j^T - r_{ij}\right)V_j + \lambda_1 \sum_i n_{u_i} U_i \tag{8}$$

$$\begin{aligned}\frac{\partial L}{\partial V_i} = &\sum_{j=1}^{n} I_{ij}\left(U_i V_j^T - r_{ij}\right)U_i + \lambda_2 \sum_j n_{v_j} V_j \\ &+\lambda_3 \sum_{j=1}^{n}\left(V_j - \sum_{V_k \in N_{V_j}} sim\left(V_j, V_k\right)V_k\right) \\ &-\lambda_3 \sum_{V_k \in N_{V_j}} sim\left(V_j, V_k\right)\left(V_j - \sum_{V_l \in N_{V_j}} sim\left(V_j, V_l\right)V_l\right)\end{aligned} \tag{9}$$

According to the grading standard, the performance evaluation value of industrial economic management is calculated. The calculation results are as follows:

$$Q_i = \frac{\sum_{i=1}^{n} e_i}{n} \tag{10}$$

$$H = \sum_{i=1}^{n} Q_i e_i \tag{11}$$

In the formula, Q_i represents the score of the evaluation index, e_i represents the weight of the i evaluation index, n represents the number of evaluation indexes, and H represents the total score of industrial economic management performance evaluation. Corresponding the calculation result with the performance evaluation grade, the performance evaluation of industrial economic management is realized. So far, the design of industrial economic management performance evaluation system based on improved machine learning has been completed. To sum up, with the support of system hardware, the industrial economic management performance evaluation process is designed, as shown in Fig. 4.

According to Fig. 4, after analyzing the impact of industrial economic management performance evaluation, this paper selects appropriate evaluation indicators from the influencing factors by using improved machine learning algorithm. After the evaluation index is determined, the rating threshold is divided, the total score of performance evaluation is calculated according to the score and weight of each index, and the total score of performance evaluation is compared with the rating table one by one to realize the performance evaluation of industrial economic management.

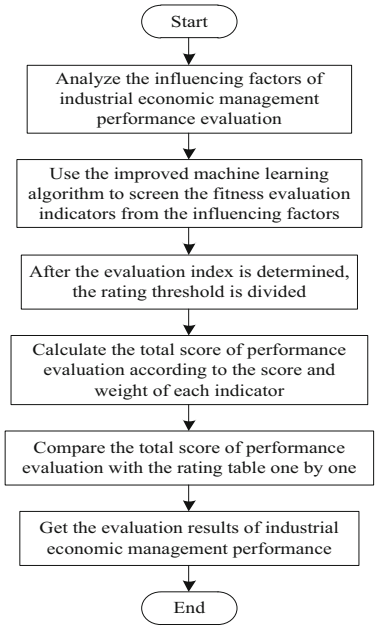


Fig. 4. Industrial economic management performance evaluation process

4 Performance Test

4.1 Test Platform and Constraints

Select a certain regional landscape, build a test platform according to its real industrial economic management performance data, combine with the actual needs of the test, and set the corresponding constraints.

The hardware platform built is: memory 4 GB DDR2667, 200 GB hard disk memory, 8 M cache. In order to better study the relationship between the calculation amount of test performance evaluation and the operating efficiency of the system, it is compared by grades. The hierarchical relationship table is shown in Table 1 (Table 2).

Table 1. Fluency Grading Relationship

Grade	Delay ms	Fluency
I	0−25	Very smooth
II	25−50	Smooth
III	50−75	Generally smooth
IV	75−100	Relatively smooth
V	>100	Stuck and stopped

Table 2. Algorithm sensitivity scoring standard table

Grade	Grading standards	Level description
I	<1.5	Not sensitive
II	1.5−2.5	Mildly sensitive
III	2.5−3.5	Moderately sensitive
IV	3.5−4.5	Highly sensitive
V	>4.5	Extremely sensitive

The obtained test results are graded and compared according to the above-mentioned graded relation table of delay and fluency.

4.2 Fluency Test Results and Analysis

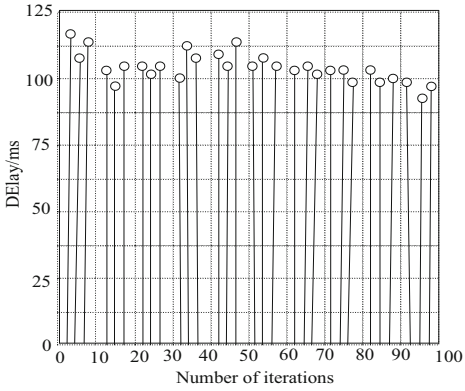
In the built test platform, the designed industrial economic management performance evaluation system based on improved machine learning is used to test the fluency of the system. The performance evaluation system based on network hierarchical analysis in literature [4] and the performance evaluation system based on network analysis in literature [5] are also tested on the same test platform. The test results are as follows:

By analyzing the results in Fig. 5 (a), it can be seen that with the increase of the number of iterations in the system, the system delay in the literature [4] is always between 94 ms and 118 ms, with high delay level, serious blocking phenomenon and low smoothness; According to the analysis of the results in Fig. 5 (b), the evaluation system delay in literature [5] is always between 20 ms and 11 ms. Especially in the early stage, the delay is very high. After 50 iterations, it gradually drops to the normal range, and its smoothness has some problems; By analyzing the results in Fig. 5 (c), we can see that the system delay in this paper is always between 8 ms and 23 ms, and the delay is always at a low level, less than 25 ms, indicating that the system operates very smoothly. In a word, the industrial economic management performance evaluation system based on improved machine learning design has higher smoothness.

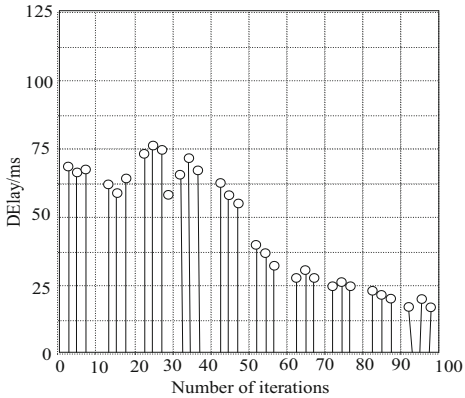
4.3 Sensitivity Test Results and Analysis

The purpose of the sensitivity test is mainly to analyze the resistance of each system to abnormal attacks. The third-party software was used to scan the system in the test, and the evaluation score was directly obtained, and the sensitivity of the system was analyzed by comparing the evaluation score with the standard table.

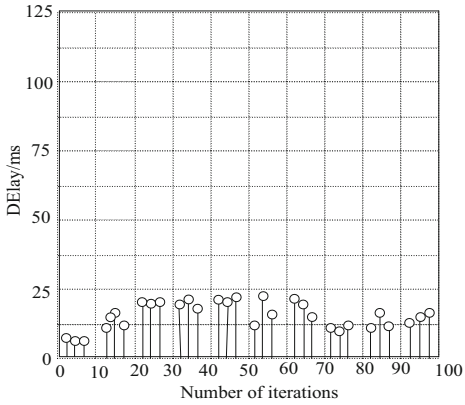
Using third-party software to scan each system, the performance evaluation system and the designed evaluation system in literature [4] and literature [5] obtained scores of 7.9, 4.6 and 0.3, respectively. Comparing the above scores with the grades in the table one by one, it can be seen that the designed industrial economic management performance evaluation system based on improved machine learning has a low sensitivity level and strong self-protection ability. Combined with the fluency test results, it is proved that the designed scoring system is superior to traditional scoring system.



(a) Literature [4] evaluation system 1 test results



(b) Literature [5] evaluation system 2 test results



(c) Test results of the designed evaluation system

Fig. 5. Fluency test results of different evaluation algorithms

5 Conclusion

This paper proposes a study on performance evaluation of industrial economic management based on improved machine learning to solve the problem of poor self-protection ability caused by too many iterations in the performance evaluation system of industrial economic management. This method firstly constructs the performance evaluation index model of industrial economic management, and designs the deployment storage architecture and network environment for system operation; Then, the improved machine learning algorithm is used to screen appropriate evaluation indicators, divide the rating threshold, calculate the total score of performance evaluation according to the score and weight of each indicator, and compare them with the rating table one by one to achieve the performance evaluation of industrial economic management. The test results show that the industrial economic management performance evaluation system designed based on improved machine learning has low sensitivity and high fluency, which can effectively solve the problem of poor self-protection ability, in order to provide a reliable reference for industrial economic management in the future.

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