

# Research and Simulation of Enterprise Management Performance Evaluation Model Based on Grey Management Theory

LiMing LiJianYun

(Department of Economics, Qinhuangdao Vocational Technical, China)

**Keywords:** enterprise performance evaluation; human resource management; grey correlation evaluation

**Abstract.** The system design of enterprise performance evaluation is researched, traditionally, there is no effective business enterprise performance management mathematical model, the quantitative venture evaluation of enterprise performance is difficult, and the science and quantitative analysis of enterprise performance management is absent. For this problem, an improved enterprise management performance evaluation model is proposed based on grey management theory, the multiple linear regression mathematical model of performance management tendency degree is established, the overall design of the system is established based on questionnaire survey and case risk data analysis, the performance management the risk evaluation and the prediction algorithm is designed, the mathematical modelling of enterprise performance management model is obtained based on performance management tendency degree computing, the grey correlation evaluation prediction algorithm is proposed, the model factor is evaluated and estimated, the practical applications is taken as the background, and the simulation is completed, the test and simulation results show that the model can improve the performance of enterprise management level, promote the company related reform and rectification, it has good application value in field of enterprise human resources management.

## Introduction

Performance planning and enterprise performance evaluation is the basic link of performance management of enterprise, we need to make reasonable performance plan and the performance management can be realized, performance coaching communication is an important link of performance management, performance management and performance evaluation is a key link of promoting the company related reform and rectification, if the incentive and constraint mechanism of employee has problems, the employee performance management is not likely to be productive<sup>[1]</sup>.

The performance management emphasizes the organizational goals and objectives of the organization and individual, and emphasizes the synchronous growth, a "win-win" situation is formed, performance management embodies the thought of "people-oriented", in all aspects of performance management, enterprise performance evaluation is very important, therefore, the performance management required the participation of managers and employees. The performance management is often seen as a cycle, this cycle was divided into four parts, as feedback performance plan, performance counselling, performance appraisal and performance venture estimation<sup>[2]</sup>.

Enterprise performance management is an inevitable problem need to face for any enterprise, according to traditional thinking, the staff of the enterprise performance management often is an antagonistic event, with rejection and disgust thought. Finally, it leads to vicious spiral, it is unfavorable to the development of enterprises. It is not benefit to the development of the society and profitless. So, the system design of enterprise performance evaluation need to be researched. Traditionally, there is no effective business enterprise performance management mathematical model, the quantitative venture evaluation of enterprise performance is difficult, and the science and quantitative analysis of enterprise performance management is absent<sup>[3,4]</sup>. For this problem, an improved enterprise management performance evaluation model is proposed based on grey management theory, the multiple linear regression mathematical model of performance management tendency degree is established, the overall design of the system is established based on questionnaire survey and case risk data analysis, the performance management the risk evaluation and the prediction algorithm is designed, the mathematical modelling of enterprise performance management model is obtained based on performance management tendency degree computing, the

grey correlation evaluation prediction algorithm is proposed, the model factor is evaluated and estimated, the practical applications is taken as the background, and the simulation is completed, the test and simulation results show that the model can improve the performance of enterprise management level, promote the company related reform and rectification, it has good application value in field of enterprise human resources management, it has certain reference value and application value in enterprise management.

## Enterprise performance evaluation system and overall design

### System model construction

At present, the management of staff is the major business unit of performance evaluation and management, the basic information of staff are extracted, such as age, place of origin, statistical management, professional education, marital status, business skills, performance appraisal, salary etc. The mathematical model is constructed, the data of these information can provide relevant information for the enterprise personnel support, it has a positive supporting role to improve the enterprise human resources management[5]. The function block diagram of enterprise performance evaluation and prediction system is shown in Figure 1. System model is established based on some extent effective quantitative evaluation of some soft information of human resource, it is easily overlooked, to improve the human resources department risk prediction and risk aversion ability, the enterprise performance evaluation system is proposed in this paper, system model construction is carried out.

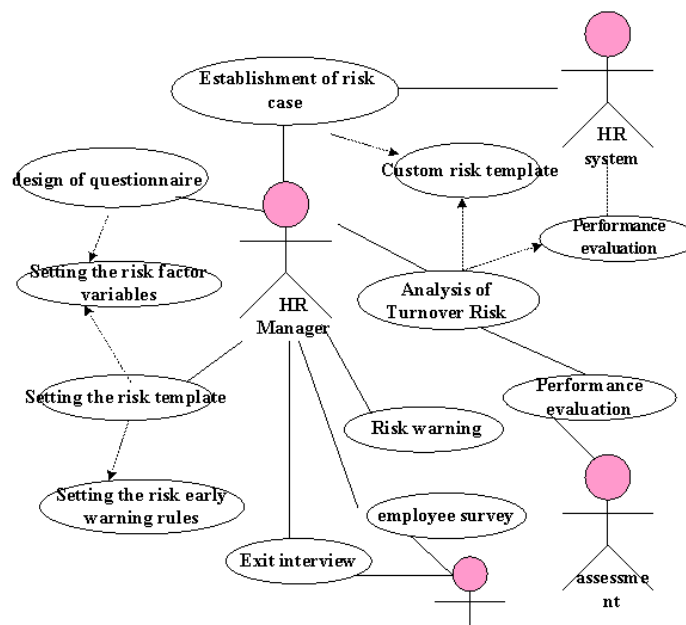


Figure 1 Enterprise performance evaluation system and whole business analysis

In the system design, in the new enterprise intelligent logistics backbone network, if the development quality has obviously disproportionate to the capital investment[6], the unit output method is selected as the calculation method, and the amortization of human cost accounting is constructed, the total income method is used to calculate the human resources costs, the current total revenue is taken as the basis for future calculation of MC, in the new enterprise intelligent logistics backbone network, assumed the final benefit of backbone network is MC, and benefit of backbone network is WS, the intelligent logistics has been developed for the new enterprise, the current profit of the enterprise is D, the amortization of human cost accounting formula is specifically shown as follows:

$$TC = \frac{QW}{WS} \times D \quad (1)$$

Where

$$WS = P \times QW \quad (2)$$

$$\det(A - \lambda I) = 0 \quad (3)$$

In new enterprise backbone network, the fully human cost amortization method is researched, and the new enterprises need to amortize capitalized cost, the network development of the relative amount is matched to the capitalized cost. The new enterprise should take the human cost

amortization into consideration, the human resource consumption is  $YT$ , the calculation formula is shown as:

$$YT = TZ - TC' + WK \quad (4)$$

The risk of performance management in Enterprise is evaluated, and the evaluation factor can be expressed as:

$$TC^* = TC + YT = \left[ \frac{QW}{P \times QW} \times (DP \times DN) \right] + (TZ - TC' + WK) \quad (5)$$

### Performance management venture settings and grey relation management

Through the performance management system, venture enterprise parameter setting is taken, grey relation management is proposed to realize the evaluation of the enterprise performance management cost, recruit staff and related training can be evaluated based on grey relation management, risk probability is defined as the risk and implementation of enterprise performance management. According to the analysis of the function of enterprise performance evaluation, the questionnaire survey is taken as the sampling data, risk prediction evaluation engine is the key technology for enterprise performance management, finally, the information service agent system access and resources are shared, risk prediction evaluation it the key technology for the system design. In the enterprise performance management rules, the risk probability assessment and database information retrieval matching are completed, system design diagram is shown in Figure 2.

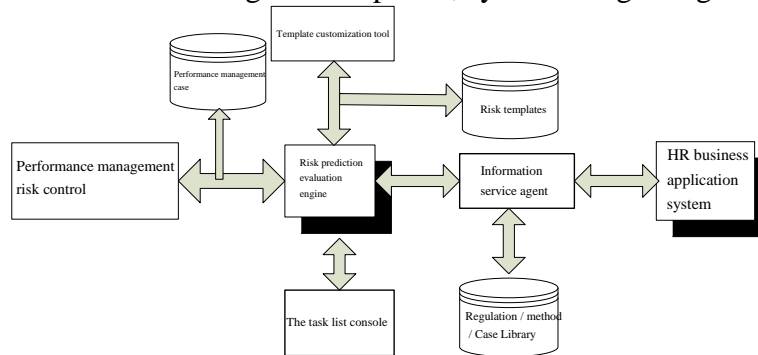


Figure 2 Performance management and risk assessment based on grey relation management

### Algorithm design of performance management based on grey relation theory

#### Tendency degree of enterprise performance management and mathematical modelling

Enterprise performance management tendency is a measure of enterprise performance management intention factor variables, the study found that the tendency of enterprises are positively correlated to specific behavior of enterprise performance management, the correlation coefficient was 0.49, by predicting the tendency of enterprise performance management, the actual behavior of enterprise performance management can be predicted, based on grey relation theory, achieve the purpose of evaluation of enterprise performance.

Based on the multiple linear regression model and grey relation management, the multiple linear regression mathematical model of performance management tendency degree is established, assumed that:

(1) Grey relation of enterprise performance management and related influence factors are linear correlation;

(2) The impact factors are independent of each other.

The grey relevance degree multivariate linear regression mathematical model of enterprise performance management can be expressed as:

$$TTD = a_1x_1 + a_2x_2 + \dots + a_kx_k + \delta \quad (6)$$

In the formula, grey relevance factors are  $a_1, a_2, \dots, a_k$ .  $\delta$  are the perturbation variables, such as the global financial turmoil, employee accident, etc. According to the model, the grey correlation evaluation of the proposed prediction method is obtained, and the algorithm is designed.

The grey discrete differential boundary equation is  $\det(A - \lambda I) = 0$ , discrete differential boundary equation of origin is the only boundary equation, characteristic equation is given, and the boundary of grey discrete differential equation can be expressed as:

$$\begin{cases} \lambda^2 + p\lambda + q = 0 \\ p = -(a_1 + b_2) \\ q = \det A \end{cases} \quad (6)$$

Differential boundary characteristic solution of grey discrete equation is  $\lambda_1, \lambda_2$ , then:

$$\lambda_1, \lambda_2 = \frac{1}{2}(-p \pm \sqrt{p^2 - 4q}) \quad (7)$$

The data sequence is  $\{x_i\}_{i=1}^N$ , the grey correlation evaluation prediction is:

$$S = \text{diag}(\sigma_1, \sigma_2, \dots, \sigma_n), \sigma_1 \geq \sigma_2 \geq \dots \geq \sigma_n \geq 0 \quad (8)$$

Based on phase space reconstruction trajectory matrix  $L$ , the optimal embedding dimension of grey correlation is  $m$ , the enterprise performance management subspace matrix is:

$$X = \begin{bmatrix} x_1 \\ x_2 \\ \vdots \\ x_3 \end{bmatrix} = \begin{bmatrix} a_1^T c_1 & a_1^T c_2 & \cdots & a_1^T c_m \\ a_2^T c_1 & a_2^T c_2 & \cdots & a_2^T c_m \\ \vdots & \vdots & \ddots & \vdots \\ a_N^T c_1 & a_N^T c_2 & \cdots & a_N^T c_m \end{bmatrix} \quad (9)$$

In the cost accounting process of investment, the new enterprise should take the human cost amortization into consideration, so,  $\delta x_i = x_j - x_i$ ,  $x_j$  is  $x_i$  vector of the nearest neighbor, based on the grey relation management, we get  $x_j \in R^m, j \in 1, 2, \dots, N$ . Similarly, the amortized investment cost can be calculated by  $\delta x_{i+1} = x_{j+1} - x_{i+1}$ , obtain  $\delta x_i$  and  $\delta x_{i+1}$ , set the predictor calculation  $J_{x_i}^{(1)}$ , the human resource consumption is:

$$\|x_j - x_i\| \leq \varepsilon \quad (10)$$

After compute  $J_{x_i}^{(1)}$ , QR decomposition is taken to obtain performance evaluation factor spectrum. For an arbitrary orthogonal matrix, its column vectors is taken as the basis of tangent space of  $x_0$ . In order to obtain the performance evaluation factor spectrum, orthogonal columns  $J_{x_0}^{(1)} Q_0$ , as:

$$Q_1 R_0 = J_{x_0}^{(1)} Q_0 \quad (11)$$

$Q_i$  column is the orthogonal basis of  $x_i$ ,  $R_0$  is upper triangular matrix with positive diagonal elements. The enterprise performance management process can be expressed as:

$$Q_2 R_1 = J_{x_1}^{(1)} Q_1 \quad \cdots \quad Q_N R_{N-1} = J_{x_{N-1}}^{(1)} Q_{N-1} \quad (12)$$

Then:

$$J_{x_0}^{(N)} Q_0 = Q_N R^N = Q_N R_{N-1} R_{N-2} \cdots R_1 R_0 \quad (13)$$

For all  $Q_0$ , the enterprise performance management efficiency is:

$$\lambda_i = \lim_{N \rightarrow \infty} \frac{1}{N} \sum_{j=0}^{N-1} \log(R_j)_{ii} \quad (14)$$

$\lambda_i$  is obtained as the performance evaluation factor of data sequence, of course, take the maximum performance evaluation factor for the grey correlation evaluation.

### Enterprise performance management evaluation model

The performance management the risk evaluation and the prediction algorithm is designed, the mathematical modelling of enterprise performance management model is obtained based on performance management tendency degree computing, the grey correlation evaluation prediction algorithm is proposed, the model factor is evaluated and estimated. Taking the phase space  $X_m$  as the center point, the nearest neighbor point is selected as the grey correlation evaluation coefficient  $X_k$ , the Euclidean distance is:

$$d_m(0) = \|X_m - X_k\| \quad (15)$$

$X_m$  and  $X_k$  evolution as  $X_{m+1}$  and  $X_{k+1}$  through one step, the model factor is evaluated and estimated, grey relevance degree influence factor of enterprise performance management is calculated by:

$$\|X_{m+1} - X_{k+1}\| = \|X_m - X_k\| e^{\lambda_i} \quad (16)$$

In the formula,  $X_{m+1}$  is the last component,  $x_{(t_{n+1})}$  is unknown, and it is the only unknown. The calculation expression is:

$$X_{m+1}(m) = X_{k+1}(m) \pm \sqrt{(d_m(0)e^{\lambda_i} +)^2 - \sum_{i=1}^{m-1} [X_{m+1}(i) - X_{k+1}(i)]^2} \quad (17)$$

To obtain data prediction sequence value:

$$x(t_{n+1})' = X_{m+1}(m) \quad (18)$$

### Simulation and result analysis

In order to test the performance of this model, the simulation is taken, the practical applications is taken as the background, firstly, the original research data are sampled by means of questionnaire and investigation, the investigation object is the basic characteristics of the company's core staff, it relates to all ages and of various type of work, sample are shown in Table 1

Table 1 Survey data samples of business management

Statistical characteristics	Number	Effective percentage	Cumulative percentage
Position	Administration	105	48.55
	Technology	27	13.54
	Sales personnel	84	38.24
Working time	Less than 1 year	63	29.32
	1-3 years	88	41.25
	More than 3 years	65	30.58
Sex	Male	158	71.35
	Female	55	28.65
Education	College and below	40	19.44
	Undergraduate course	82	70.74
	Master degree and above	49	18.99
Age	Less than 30 age	159	72.25
	30-40 age	57	23.64
	Above 40 years old	15	4.36

The questionnaire data are analyzed, and the Cronbacha coefficient method is used to survey the overall performance, Cronbacha coefficient is greater than 0.8, the questionnaire is reliable. Factor analysis is conducted on the questionnaire results, by using orthogonal method of rotation, feature compression is obtained for 10 factors, and the performance management level is taken as the comparison index, eigenvalue contribution rate of variance are simulated, the contribution rate of enterprise performance is shown in Figure 3.

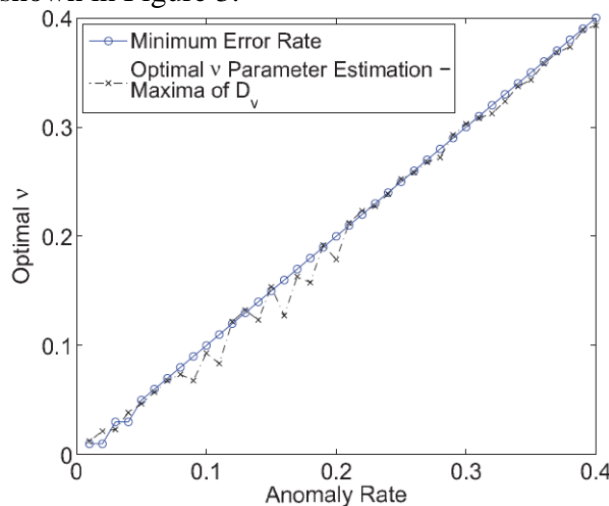


Figure 3. Optimal enterprise performance

From figure 3, it shows that this model can improve the enterprise performance, and improve the performance of enterprise management level, promote the company related reform and rectification, it has better performance than traditional model.

## Conclusions

In this paper, enterprise performance evaluation is researched, an improved enterprise management performance evaluation model is proposed based on grey management theory, the overall design of the system is established based on questionnaire survey and case risk data analysis, the mathematical modelling of enterprise performance management model is obtained based on performance management tendency degree computing, simulation results show that the model can improve the performance of enterprise management level, promote the company related reform and rectification, it has good application value in field of enterprise human resources management.

## References

- [1] Song Minghong, Yu Huafeng, Chen Haiyan. Application of Improved Quantum Evolutionary Algorithm in Computer Network's Routing Choice[J]. Bulletin of Science and Technology, 2014,30(1):170-173.
- [2] Liu Xiangdong. Data Clustering Algorithm and Software Design Based on Disturbance Searching of Logistic Series[J]. Bulletin of Science and Technology, 2014,30(2): 161-163.
- [3] MA Jian- hong, JI Li- xia. Study on Agent Immune Network Monitoring System Model[J]. Computer Simulation, 2013, 30(5): 213-216.
- [4] LIU Luo, GUO Li-Hong, XIAO Hui, Et al. Software Reliability Growth Model Based on Dynamic Fuzzy Neural Network with Parameters Dynamic Adjustment[J]. Computer Science, 2013, 40(2): 186-190.
- [5] Xing Li. Study on Information Recommendation System Based on Cloud Computation[J]. Logistics Technology, 2013, 32(2): 185-188.
- [6] Song Minghong, Yu Huafeng, Chen Haiyan. Application of Improved Quantum Evolutionary Algorithm in Computer Network's Routing Choice[J]. Bulletin of Science and Technology, 2014,30(1):170-173.