Research on the Matching Model of Talent Team Management of Enterprise A Based on BP Neural Network

Hui Fang[1,2,3], LiLi Song[1,2], and Yong Wang[1,2(✉)]

[1] Institute of Psychology, Chinese Academy of Sciences, Beijing 100101, China
{songll,wangy}@psych.ac.cn
[2] Department of Psychology, University of Chinese Academy of Sciences, Beijing 100049, China
[3] Chengdu Bikai Technology Co., Ltd., Chengdu 610041, China

Abstract. The job matching system occupies an important position in human resource management and plays a pivotal role in the healthy and orderly development of modern enterprises. This study takes BP neural network as the theoretical basis and establishes the human-job matching measurement model for managers of state-owned enterprises according to the job analysis of state-owned enterprises. On the one hand, it overcomes the problem of strong subjective factors in the past general evaluation methods and largely enhances the scope of application of BP neural network; on the other hand, it provides intellectual support and theoretical support for the establishment of a perfect index system for measuring the matching of managers of state-owned enterprises in China, which can reasonably and effectively provide scientific and effective basis for the selection of managers of state-owned enterprises and improve the overall quality of the talent team. On the other hand, it can provide intellectual support and theoretical support for the establishment of a perfect personnel matching index system for state-owned enterprises, which can provide scientific and effective basis for the selection of state-owned enterprises' management personnel and improve the overall quality of the talent team.

Keywords: State-owned enterprises · Managers · BP neural network · Job matching

1 Introduction

Interpersonal relationships enhance the satisfaction of the need to belong, and attributional support provides security to support the individual's need for autonomy. When employees anticipate whether their leaders will tolerate them to show their true selves and the risks that come with showing their truth, relational support from leaders will make employees more willing to express their true selves without psychological burden (Ji 2014). Again, the inclusive leadership style does not emphasize control, but encourages subordinates' autonomy on the basis of relationship, which facilitates the enhancement

of psychological needs and autonomy motivation, while autonomy means that individuals act according to their own will, and in this autonomy-supportive work environment, employees' state is authentic and close to their own. Therefore, the practice of inclusive leadership behavior predicts that employees can express and act according to their own will in an autonomous and supportive work environment.

The "employee-centered" humanistic philosophy is becoming an increasingly important orientation in corporate management in this day and age (Xue 2014). It is of profound theoretical and practical importance for leaders to take care of employees' authenticity in the workplace, to build quality relationships and a developed organizational climate, and to enhance and leverage the value of employees' authentic qualities in order to seek a win-win situation for both employees and the company (Zhang 2022). In order to explore the specific mechanisms behind the relationship, two research variables, employee-organizational match and employee narcissism, are introduced in order to clarify how inclusive leadership influences and induces employees' authenticity, and to provide some reference ideas and insights for organizations and managers to promote the development of employees' authenticity (Wang et al. 2013). By exploring the mediating effect of employee-organizational fit and the moderating effect of employee narcissism between inclusive leadership and employee-organizational fit, we hope to strengthen the expansion of the antecedent variables of authenticity in order to provide a theoretical framework and practical suggestions for the development of employee authenticity in the field of corporate management practice (Ma 2022).

2 Design of Personnel Matching Evaluation Index System for Managers of State-Owned Enterprises

2.1 Principle of Constructing the Index System for Job Matching Evaluation

The core part of the job matching evaluation is to determine the construction method of the job matching evaluation index system, and in the process of constructing the index system, the following principles should be followed.

(1) Principle of scientificity (2) Principle of representativeness (3) Principle of irrelevance (4) Principle of feasibility (5) Principle of revisability.

2.2 Classification and Job Analysis of Management Positions in State-Owned Enterprises

2.2.1 The Significance of Job Analysis

The acquisition of job demand information of an enterprise is mainly carried out through job analysis, which is the basis for analyzing and evaluating whether the position matches with the personnel engaged in the work, and also the basis for developing the evaluation index system (Yu 2022). The significance of enterprise management job analysis is shown in Fig. 1.
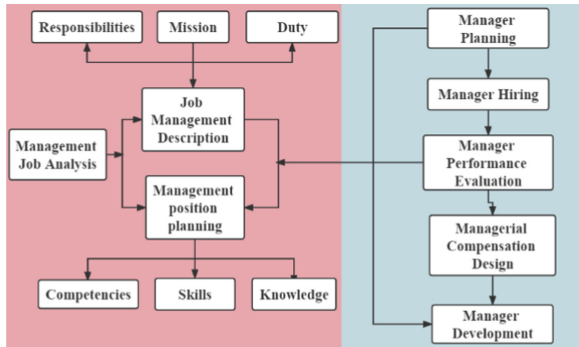
Fig. 1. The significance of enterprise management post analysis

2.2.2 Job Analysis in State-Owned Enterprises

This paper synthesizes previous references and visits to state-owned enterprises to conduct actual research and study, and concludes that usually managers of state-owned enterprises are engaged in three main types of positions: top management, middle management and grassroots management.

2.3 Construction of the Person-Position Matching Evaluation Index System for Managers of State-Owned Enterprises

Personnel matching evaluation indexes are numerous elements that can characterize the characteristics of the subjects. The process of determining the job matching evaluation indexes is to consider the elements that can be used for job matching evaluation, so the evaluation indexes are also called evaluation elements (Deng 2022).

2.3.1 Preliminary Index System of Man-Job Matching for Managers of State-Owned Enterprises

First of all, according to the previous contributions to the job matching index system, the job analysis of management positions, and combined with the KSAO model initially determined the first level of indicators for the job matching of managers in state-owned enterprises. k, A, S and O refer to knowledge, skills, abilities and other traits respectively to get a position, you must meet two types of factors: selection factors and quality ranking factors (Liu 2022).

2.3.2 Optimization of Man-Position Matching Index System for Managers of State-Owned Enterprises

This paper applies the AHP method to filter out the factors that have less influence on the dependent variable (Li 2013). Taking the grassroots managers of state-owned enterprises as an example, the following are the steps to determine the weights of indicators (Tables 1 and 2).

Table 1. Knowledge skills layer judgment matrix

B_2	Educational Background C_{11}	Knowledge of management C_{12}	Professional knowledge C_{13}	Business level C_{14}	weight
C_{11}	1	1	1/2	½	0.1667
C_{12}	1	1	1/2	½	0.1667
C_{13}	2	2	1	1	0.333
C_{14}	2	2	1	1	0.333

Table 2. Basic quality layer judgment matrix

B_2	Physical health C_{21}	Responsibility C_{22}	Stress tolerance C_{23}	Organizational awareness C_{24}	Initiative C_{25}	Dedication C_{26}	Loyalty C_{27}	weight
C_{21}	1	3	5	2	6	4	1/2	0.2399
C_{22}	1/3	1	3	1/2	4	2	1/4	0.1036
C_{23}	1/5	1/3	1	1/4	2	1/2	1/6	0.0448
C_{24}	1/2	2	4	1	5	3	1/3	0.1587
C_{25}	1/6	1/4	1/2	1/5	1	1/3	1/7	0.0312
C_{26}	1/4	1/2	2	1/3	3	1	1/5	0.0676
C_{27}	2	4	6	3	7	5	1	0.3543

Table 3. Experience layer judgment matrix

B_4	ExperienceC_1	Year C_{42}	weight
ExperienceC_{41}	1	2	0.6667
Year C_{42}	1/2	1	0.333

Constructing judgment matrix: According to the steps of AHP, the judgment matrix was constructed first. In this paper, we choose the method of questionnaire survey and form an expert group to rate the importance of each index of the bottom management of company A. The expert group members consist of 4 middle-level, 2 top-level managers and 2 human resource managers of company A. By judging the indexes of different levels on a scale of 1–9, we build the judgment matrix of each level. The weight of each combination of indicators affecting the evaluation of man-job matching is shown in Table 3.

The weight of the combination of indicators: the results show that the weight of C23 is only 0.0086 and the weight of C25 is 0.0060, which accounts for a negligible proportion, indicating that the two indicators of pressure tolerance and initiative cannot affect the

evaluation of the match between the grassroots managers of state-owned enterprises and should be deleted. Similarly, the index of organizational cognition is deleted from the index system of senior management, and the two indexes of style and integrity and initiative are deleted from the index system of middle management. The optimized index system for measuring the match between managers of state-owned enterprises is shown in the table (Liu 2022).

3   Feasibility of BP Neural Network for Job Matching Evaluation

In recent years, many experts and scholars at home and abroad have conducted in-depth analysis and research on personnel and job matching evaluation methods such as hierarchical analysis and fuzzy comprehensive evaluation method, which have the common point that they all need to determine the weight coefficients of evaluation indexes, thus there is the problem of too much subjectivity in the decision-making process, which affects the decision to a certain extent. The advantages of using neural networks are mainly as follows (Chen 2022).

(1) Artificial neural networks are different from other algorithms, which need to learn through the network to achieve the expected output results, and mainly rely on the expert's learning and past experience to achieve its output results in line with the expected results.
(2) Artificial neural networks have strong self-learning habits and are capable of continuous self-adaptation and self-training.
(3) Artificial neural networks have unique self-organization, self-learning and super fault tolerance, i.e., no matter how complex or large amount of data, they can be classified and the laws can be found, which can solve many problems that are difficult to be described by mathematical formulas.

In this paper, we use BP neural network to build a job matching model for state-owned enterprises and train the sample data after scoring by experts, so that the thinking of neural network is consistent with the employment criteria of enterprises and the experience judgment of experts to ensure that the whole evaluation process is scientific, reasonable and operable. The addition of BP neural network makes job matching efficient and scientific, and the prospect of practical application of neural network in enterprises is promising (Fan 2022).

4   BP Neural Network Structure Determination

4.1   Determination of the Number of Layers

In this paper, a three-layer BP neural network can be used to build an evaluation model for job matching of administrators in state-owned enterprises.

Table 4. Evaluation result standard

grade	0–0.2	0.2–0.4	0.4–0.6	0.6–0.8	0.8–1
rank	Bad	Pass	Moderate	Good	Excellent

4.2 Determination of the Number of Neurons in the Input Layer

The number of neurons in the input layer is the number of three-level evaluation indicators in the job matching evaluation model of the administrator of state-owned enterprises. The neurons in the input layer serve to receive various input information from outside, and then pass the input data to the next layer in a precise and timely manner, so these data become the information input of this intermediate layer.

4.3 Determination of the Number of Neurons in the Output Layer

For the evaluation of the matching of the grass-roots managers in state-owned enterprises (Fan 2022). Firstly, the neural network model is used to make all the qualitative variables into a quantitative form of output, and the quantitative output results are transformed into qualitative descriptions according to the actual situation of the enterprise, and the number of neurons in the output layer is set to 1 because the output is the result of the matching of human posts, and the output results can be divided into five categories, as shown in Table 4.

4.4 Determination of the Number of Neurons in the Hidden Layer

Too many nodes in the hidden layer can lead to overfitting of the data and can also increase the training time of the network (Wang 2022). A small number of hidden layers can prevent the network from extracting enough information, which can lead to biased accuracy of the training results. Therefore, the number of hidden layers has a great impact on the results of neural networks, and we must find the optimal number of neurons for the network. After our own experimental research based on summarizing the design of a large number of BP network structures, we obtained the following estimation method (Li and Zhou 2022).

$$m = \sqrt{l + n + a} \tag{1}$$

where n represents the number of neurons in the input layer, l represents the number of neurons in the output layer, a is a constant between 1 and 10, and m is the number of neurons in the hidden layer.

$$m = \log_2 n \tag{2}$$

where m is the number of neurons in the hidden layer and n represents the number of neurons in the input layer.

$$m = \sqrt{nl} \tag{3}$$

where m is the number of neurons in the hidden layer, n represents the number of neurons in the input layer, and l is the number of neurons in the output layer.

Through the above analysis, we can get the BP neural network-based job matching measurement model for basic management personnel to be established in this study.

5   Learning Process and Steps of BP Network

5.1   Learning Process of BP Neural Network

The learning process of a BP network is divided into two parts. Before the input, the neural network sets a desired output and a desired error range. The first step is top-down, which is transmitted from the input layer of the network to the hidden layer and then gradually computed to the output layer, where the neural network compares itself to the output values, and when the output values are outside the error range of the desired output, it then moves to the second step, bottom-up (Sheng et al. 2011). Bottom-up means that the values whose outputs do not meet the requirements are returned to the previous layer in turn, and the layer then starts to correct the weights. When returning to the initial layer input layer, it is repeated to the first step until each layer meets the requirements, and finally the output is within the desired error range. This is shown in Fig. 2.

5.2   Learning Steps of BP Neural Network

Input vectors.

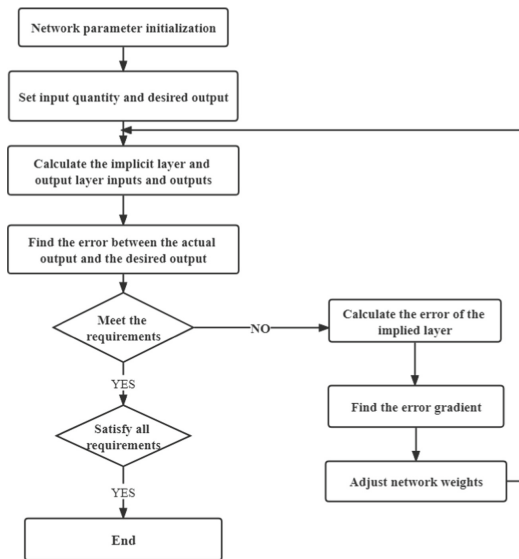$$X_i = (x_1, x_2 \cdots x_m); i = 1, 2, \cdots, m; \tag{4}$$

Fig. 2. BP neural network learning flow chart

Implicit layer input vector.

$$H_i = (h_1, h_2 \cdots h_p); i = 1, 2, \cdots, p;$$ (5)

Implicit layer output vector.

$$Z_k = (z_1, z_2 \cdots z_p); k = 1, 2, \cdots, p;$$ (6)

Output layer input vector.

$$O_j = (O_1, O_2 \cdots O_n); j = 1, 2, \cdots, n;$$ (7)

Output layer output vector.

$$Y_j = (y_1, y_2 \cdots y_n); j = 1, 2, \cdots, n;$$ (8)

Expected output.

$$D_j = (d_1, d_2 \cdots d_n); j = 1, 2, \cdots, n;$$ (9)

The information is first passed into the network through the input layer, and after the processing of the implicit layer reaches the output layer to derive the final result. When the result is similar to the expected result and meets the set error range, the calculation is successful; if the error exceeds the set standard, it is necessary to return the original way and gradually adjust the value until it meets the requirement, and end the calculation.

6 Selection of Model Parameters

Selection of initial weights: After various experiments, it is shown that the initialization method of BP network weights has a great influence on the overall training time of the network. In this paper, after verification, we finally adopt the method of random assignment, and select a random number between $[-1,1]$ as the initial weights.

Learning rate selection: This paper adopts the adaptive learning rate approach. The learning rate of this paper is 0.05 through several calculations and comparative verification.

Definition of error: After comparison and verification, the error bound of this neural network is 0.0001, that is, when the error value is less than or equal to 0.0001, we determine that the learning is over and can stop the calculation and output the result.

BP neural network functions are determined (1) parameter setting function (2) activation function (3) training function.

7 Conclusion

The matching relationship between positions and people is an urgent problem of human resource management in current state-owned enterprises, which is related to the efficiency of the whole human resource management. Among the state-owned enterprises, the problem of matching people and jobs is also usually considered as a key link in human resource management, because it runs through the whole process of human resource management. After summarizing, the conclusions of this paper are as follows.

(1) The construction of the evaluation index system of the personnel-job matching of managers in state-owned enterprises.

Before the evaluation of the manning match of managers in state-owned enterprises, the evaluation index system should be constructed first. According to the contribution of previous people to the manning match index system, this paper conducted job analysis of management positions and combined with KSAO model to construct the evaluation index system of manning match of top, middle and grassroots managers in state-owned enterprises respectively, and screened out the factors (independent variables) with less effect on the dependent variable through AHP and The meaning of each index is explained.

(2) Construction of the evaluation model of the match between managers of state-owned enterprises. The indicators were selected and further screened, and the BP neural network-based model was established for senior, middle and junior managers of SOEs. The structure and learning parameters of the BP neural network model were determined.

(3) Example analysis of managerial staff matching in state-owned enterprises. This paper shows that the neural network method can adapt to the expert's brain to process the input sample data, fully absorb the expert's judgment experience, and can scientifically and effectively evaluate the job matching situation of the managers of state-owned enterprises.

References

Chen Hua. (2022). Exploring the management problems and strategies of small and medium-sized feed production enterprises[J]. China Feed, 121–124.

Deng Y. Y. (2022). Research on the impact of big data on enterprise management decision [J]. Modern Business, 127–129.

Chinese and foreign enterprise culture, 67–68.

Fan ZP. (2022). Analysis of the integration of enterprise management accounting and financial accounting [J]. China collective economy, 133–134.

Ji Nan. (2014). Research on Bilateral Matching Decision Method of Domestic Service Workers and Employers[D].Northeastern University,89–92.

Li Hao, Zhou Zhengyi. (2022). Innovation of enterprise management model in the era of big data [J]. Shanghai Business, 156–158.

Li Xiaoyan. (2013). A Discussion on the Matching of Personnel and Posts in Enterprises[J].Enterprise Research, (20):115–116.

Liu MengYang, Yang Huayuan. (2022). Discussion on the strategy and method of modern enterprise management innovation [J]. Enterprise Reform and Management, 26–28.

Liu Jiahuan. (2022). Discussion on the role of corporate culture in enterprise management [J].

Ma Hongzhou. (2022). The relevance of enterprise management and economic efficiency, 121–123.

Sheng Yongxiang, Tian Lixin, Ma Shaohui. (2011). Research on the matching relationship of industry-university-research personnel based on different industries [J]. Science and Technology Progress and Countermeasures, 28(11): 47–50.

Wang ZiYuan. (2022). Enterprise management innovation based on the network era [J]. 113.

Wang Su, Li Xiping, Wang Xin, Li Shan. (2013). A Research on Personnel-Post Fitting Based on Bilateral Matching Theory[J].Human Resource Management, (12):343–347.

Xue Chengmeng. (2014). Product innovation designer and organization matching research and system development [D]. Chongqing University, 55–57.

Yu Shujiang. (2022). Research on innovation of enterprise management mode in the context of big data[J]. Modern Business, 109–111.

Zhang P. (2022). The integration and development of enterprise management accounting and internal audit, 105–108.