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Application of Competency Model in Enterprise Human Resource Recruitment Management

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Abstract. Competency is an effective tool for human resource management research. Compared with the traditional recruitment, which lacks the prediction of talents' future performance and creativity, applying competency model to recruitment is conducive to building the core competitiveness of modern enterprises. In contemporary times, to bolster their competitiveness, enterprises must prioritize effective human resource management. This entails refining the recruitment system and attracting top-tier talent using a competency-based model. This paper explores the utilization of the competency model in managing enterprise human resource recruitment. Furthermore, it introduces a talent evaluation approach that integrates fuzzy theory with NN (neural networks). This method uses fuzzy transformation to transform the fuzzy evaluation of hierarchical indicators into the overall fuzzy evaluation, and uses BPNN (Back propagation neural network) to calculate the final result corresponding to the overall fuzzy evaluation. The simulation results show that the MSE (Mean squared error) of this method is about 4.32, and the MAE (Mean absolute error) can reach 1.36, and the evaluation accuracy and reliability of the algorithm are high. It can improve the recruitment quality of human resources in enterprises and promote enterprises to have better development prospects.

Keywords. Competency model, Enterprise, Human resources, Recruitment management

1. Introduction

As society and the economy continue to evolve, various enterprises have also experienced significant growth. With the expansion of enterprise scale, competition among them has intensified, with talent becoming the ultimate determining factor [1]. The primary objective of human resource management is to ensure an optimal match between personnel and their respective positions, thereby enhancing the overall organizational efficiency [2]. At present, enterprises are increasingly dependent on talents, especially high-tech enterprises, and human resources have become a strategic resource, which also means that the risks existing in human resources management of enterprises will lead to the whole business risk of enterprises [3]. Human resource management comprises several key modules, including planning for human resources, recruitment and placement, employee training and development, managing performance,

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administering salaries and benefits, as well as managing employee relations. Different management modules have appropriate tools and mature methods, but they all lack quantitative judgment and data support [4]. The process of enterprise human resource management is full of uncertainty of behavior and results, which makes enterprises have certain risks in human resource management [5].

Research shows that the labor productivity of the best employees in the same position is about 3 times higher than that of the worst employees [6]. However, in real life, the recruitment activities and recruitment results of many enterprises are often not satisfactory, so the theoretical and practical circles began to explore new recruitment models and selection techniques to continuously improve the recruitment effect to meet the human resources needs of enterprises in the development process [7]. Recruitment based on competency model is an effective way to solve the problem of high-quality talent recruitment, which is of great significance for enterprises to obtain sustainable competitiveness [8]. From a statistical point of view, accurate sampling object, appropriate sample size and rigorous model setting can greatly improve the accuracy of competency model, form a unique dictionary of competency model for enterprises, and standardize the standards for selecting and employing enterprises [9]. With the advent of knowledge economy, as the carrier of enterprise's core competitiveness, human resources play an increasingly important strategic role in the sustained and healthy development of enterprises. Therefore, based on the perspective of competency model, this paper discusses its application in enterprise human resource recruitment management, and puts forward a talent evaluation method based on fuzzy theory and NN.

2. Methodology

2.1. Application of Competency Model in Enterprise Human Resource Recruitment Management

There are various explanations about competency model, but on the whole, it refers to the detailed analysis and operation of responsibilities and requirements for enterprise positions, which in turn increases the correlation between enterprise positions and talents, and promotes enterprise human resources to show more obvious characteristics of capacity development [10]. The basic method of competency model is to interview a group of outstanding employees in the same position, summarize their knowledge, skills, characteristics and identity background, compare these characteristics and screen out the most suitable employees on this basis. According to the corresponding characteristics, we can not only clarify the necessary knowledge of employees to complete the work, but also compare and reasonably judge the achievers and ordinary people in the work. Practice has proved that the traditional recruitment concept and method of evaluating the obvious characteristics of candidates, such as experience, education, knowledge and skills, can no longer meet the needs of modern enterprises in selecting and identifying high-quality talents. At the same time, the system constructed by traditional methods has strong subjectivity in terms of samples, sizes and indicators, and it is difficult to have high application value in practical use [11]. In this regard, in modern times, based on the competency model, we should fully combine employees' professional ability to judge whether they meet the requirements of enterprise positions, so as to facilitate enterprises to obtain a solid human resource foundation and promote enterprises to achieve sustainable development goals. The competency model encompasses three primary

components: the designation of competency, its definition, and the grading of behavior indicators. Notably, the requirements for this model vary depending on the position in question.

Recruitment rooted in the competency model involves a comprehensive process of pinpointing, screening, and exploring suitable candidates for critical organizational roles through diverse avenues. This approach aligns with organizational strategies and human resource planning, leveraging the established competency model, with an emphasis on structured behavioral interviews centered on competency, complemented by alternative selection methods [12]. Competency manifests in three dimensions: professionally, as the ability to handle specific, routine tasks; behaviorally, in skills for managing non-routine and arbitrary assignments; and strategically, in the integration of management proficiency with the organizational milieu. To enhance recruitment effectiveness, a holistic approach is necessary, considering both immediate vacancies and future talent needs based on an analysis of the enterprise's current standing and projected growth trajectory. This ensures a solid foundation for the enterprise's long-term success. Enterprise recruitment is a two-way choice, but in order to increase the matching degree between talents and positions, we should actively build a competency model to clearly grasp the recruitment objectives of talents. The development of competency model is a process of constant falsification and improvement, so after the development of competency model is completed, there is usually a process of evaluation and confirmation of competency model. The recruitment system based on competency model can not only evaluate candidates with established work benchmarks and skill requirements, but also implement recruitment according to the strategic demand for candidates' future performance. This competency-based recruitment links the enterprise's strategy, business objectives, work, and individuals, and improves the quality of recruitment and selection while following the effective hiring decision procedure.

2.2. Talent Evaluation Algorithm Based on Fuzzy Theory and NN

In the optimization of human resource recruitment management in real enterprises, it is necessary to select and configure according to the specific situation of organizational structure and the measurement focus of post on staff's ability demand [13]. From the accuracy of the model, the most important thing is to optimize the fuzzification process and improve the self-learning function. Since new data will be added to the system continuously, self-learning should be uninterrupted. BPNN has the characteristics of self-organization, self-adaptation, self-learning and powerful nonlinear mapping ability, and can dynamically and objectively adjust the index weight to get more accurate matching values and results. The influence of each child node on the parent node is reflected as a weight vector. In this paper, the fuzzy similar specific gravity matrix method is used to calculate the weight vector. Assuming that a parent node has M child nodes, the M participating indicators corresponding to the child nodes constitute the indicator universe $U = \{u_k\}$. Let the selected N fuzzy evaluation grades form the universe $V = \{v_k\}$, and let the weight vector corresponding to the child nodes be:

$$P = [p_1, p_2, p_3, \ldots, p_M] \tag{1}$$

Organize evaluators to make a fuzzy evaluation of these M indicators, and then make statistics on the distribution of evaluation levels for each indicator. According to the relevant spatial separation rules, the total number of fuzzy rules is calculated, and the talent evaluation model contains a total of 30 fuzzy rules. While an increase in the number of rules may seem to complicate model construction and related calculations, some rules may not significantly contribute. Therefore, unimportant rules should be eliminated based on their significance to reduce the workload, ultimately screening out the six most critical ones. BPNN, a multi-layer network with backward error propagation, comprises input, hidden, and output layer nodes. The input signal propagates forward to the hidden layer node, undergoes an activation function transformation, and then propagates to the output layer node. The node function reflects the stimulation pulse intensity from lower inputs to upper points. Refer to Figure 1 for the model structure.

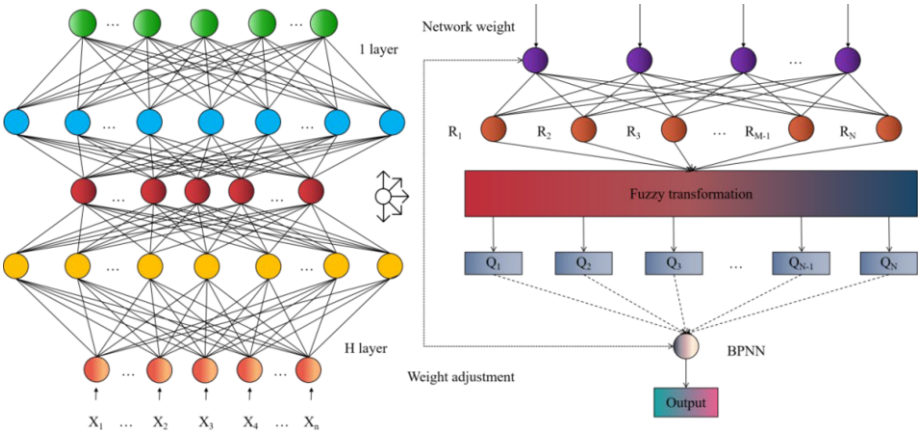

Figure 1. Model structure diagram.

In this paper, the network includes a hidden layer with N nodes, and the transfer function is hyperbolic tangent function. The input corresponding to the hidden layer node i . is:

$$I_i = \sum_{k=1}^{N} W_{ki}^{1} q_k^* \tag{2}$$

The output is:

$$O_i = f\left(I_i\right) \tag{3}$$

The input layer introduces the feature vector $\left(x_1, x_2, x_3, \ldots, x_n\right)$ into the network, and the universe of each input is normalized to [0,1]. The output node is a simple linear threshold unit. By giving the optimization index, the parameter values of the network and wavelet function are modified by the reverse error propagation algorithm, and the optimal learning effect is gradually achieved. The recruitment model based on competency utilizes the competency model as its benchmark for evaluation. This competency model is tailored according to the unique culture, organization, and job

characteristics of the corporation, ensuring high precision and adaptability. Additionally, the BPNN model typically employs the S-shaped function as its transformation function, with a value range of [0,1]. Hence, during network training, the original data must undergo processing and standardization to fall within this [0,1] range. Past experiences indicate that neural networks perform optimally when all input and output values reside between 0 and 1. This necessitates the standardization of extracted data to obtain new values within this range, eliminating any influence stemming from variations in the magnitude of evaluation indices. For numerical continuous fields, data adjustment can be achieved using the following formula:

$$\text{Adjusted value} = \frac{\text{Initial value-min}}{\text{max-min}} \tag{4}$$

Among them, $\max$ and $\min$ are the minimum and maximum values of each index value respectively. The given learning rate in the model is 0.05, the training times are 2,000, and the error precision is 0.01. Simulated in MATLAB.

3. Result Analysis and Discussion

Recruitment plays a pivotal role in an enterprise's ability to acquire vital human resources. For newly established enterprises, effective recruitment is crucial for smooth operations and determines the likelihood of success. For established enterprises, recruiting personnel is essential for efficient human resource allocation and enhancing return on investment. Despite inherent risks in the recruitment process, implementing a competency model-based recruitment mechanism can significantly mitigate these risks. NN mimic the human brain's structure, mapping nonlinear relationships between input features and output conclusions while exhibiting learning capabilities. However, NN requires precise numerical inputs and outputs. Conversely, fuzzy logic lacks learning abilities but excels at handling imprecise or ambiguous inputs. This paper integrates the strengths of fuzzy logic and NN to create a novel talent evaluation method grounded in the competency model. This section aims to validate the method's reliability. Initially, a BPNN is established and trained using samples, culminating in the establishment of the evaluation system. The number of neurons in the network's input layer corresponds to the number of talent evaluation indicators, which may vary depending on evaluation objectives and targets. The output layer's unit count is determined by the number of talent evaluation grades. This paper categorizes talent evaluation into five grades: excellent, good, average, poor, and very poor, reflecting five neurons in the output layer. The network employs 3,500 records for simulation testing and utilizes 2,500 records for NN training. Figure 2 illustrates the algorithm's training outcomes.

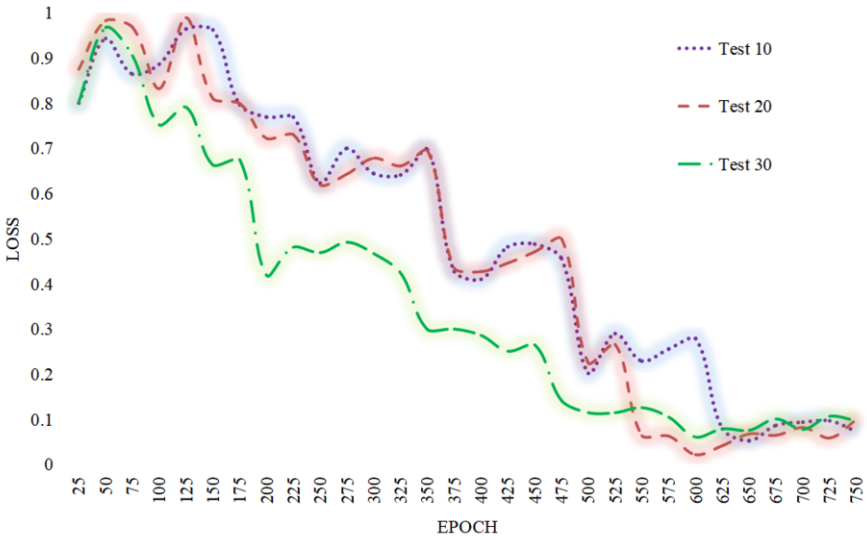

Figure 2. Algorithm training results.

In this paper, the processed data are experimented, and 2,000 records are used as test samples to enter the network to obtain the classification category and the classification matrix of the test set. MSE and MAE are selected to measure the effectiveness of the model, and several experiments are carried out respectively. The formulas for computing these two indicators are provided below:

$$MSE = \frac{1}{n}\sum_{k=1}^{n}\left(y_k - y'_k\right)^2 \tag{5}$$

$$MAE = \frac{1}{n}\sum_{k=1}^{n}\left|y_k - y'_k\right| \tag{6}$$

Where y_k is the actual value and y'_k is the model output value. Figure 3 shows the MSE results of several algorithms. Figure 4 shows the MAE comparison of several algorithms.

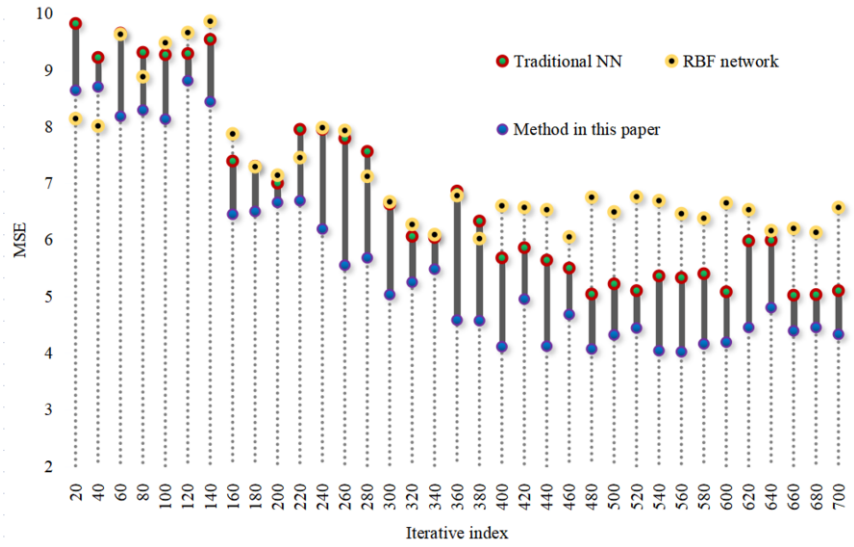

Figure 3. MSE comparison results of the algorithm.

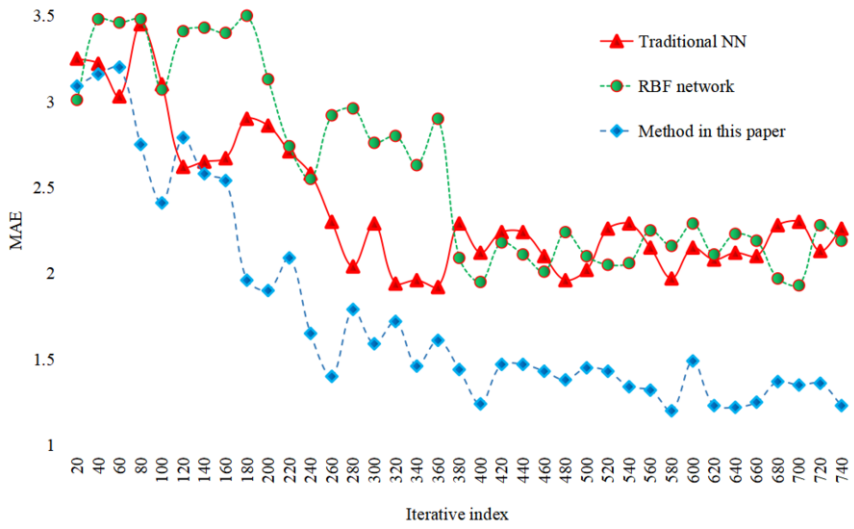

Figure 4. MAE comparison results of the algorithm.

Compared with RBF network and traditional NN, the BPNN in this paper has high accuracy, low error, and fast convergence speed. Specifically, the MSE of this method is about 4.32, and the MAE can reach 1.36. Human resource planning is not immutable. It must be formulated and adapted constantly according to the different development stages of enterprises, the changes of internal and external environment and the specific situation of human resources in enterprises, so as to ensure the rationality and scientificity of human resource planning in enterprises.

Since competency model, we need to pay attention to every link of recruitment, so as to select high-quality talents among many people, and then give full play to the advantages of talents and promote the progress and development of enterprises. In the

construction of competency model, enterprises need to realize the evaluation of ability and quality. For example, communication ability can judge the strength of different employees' communication ability from four levels, and constantly improve the talent training structure in the integration of ability and quality evaluation data, thus promoting the innovation and reform of enterprises. At the same time, through the effective evaluation of competency model, we can find out the competency structure of excellent employees, including competency projects and competency performance behaviors, so as to form the competency model of enterprises. In different positions and organizations, through the construction and evaluation of competency model, we can form our own dictionary of competency model. The proposed methodology in this study is devoid of subjective components and human factors, relying solely on the input of processed data into the network and subsequent computation of evaluation results via MATLAB's NN toolbox. This approach circumvents the potential for subjectivity stemming from manual weight assignments to various indexes or levels, thereby enhancing the reliability and objectivity of evaluation outcomes. Experimental results, depicted in Figure 5, demonstrate the accuracy of talent evaluation across different methodologies on data sets.

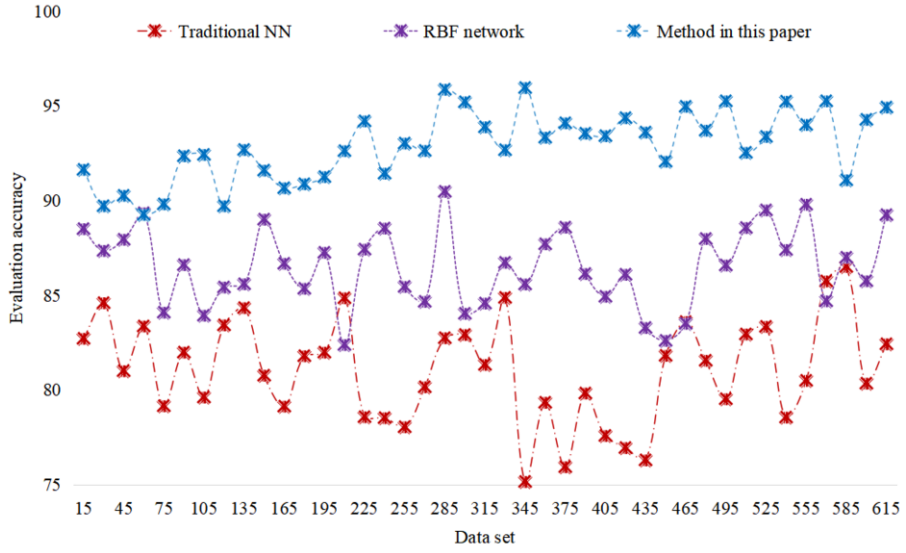

Figure 5. Comparison of evaluation accuracy.

The findings presented in this section reveal that the MSE of the proposed method is approximately 4.32, with an MAE of 1.36, indicating a high level of evaluation accuracy. These results underscore the distinct advantages of the approach, as the model has successfully achieved the intended outcome. Specifically, it can accurately assess talent, fulfilling its intended purpose in enhancing the scientific rigor and precision of recruitment processes within enterprise human resource management. Ultimately, this leads to a substantial improvement in the overall competitiveness of the enterprise.

4. Conclusions

Currently, the landscape of enterprise recruitment is marked by intense competition, with the ultimate focus being on the acquisition of top talent. The creation of a high-caliber talent pool is pivotal in shaping an enterprise's core competitiveness. The establishment of a competency model emerges as a crucial aspect in refining the recruitment processes within an organization and merits serious consideration.

Drawing from the lens of the competency model, this study offers a concise examination of its defining features and developmental stages. Furthermore, it introduces a talent evaluation approach that blends fuzzy theory with NN, aiming to bolster the integration of competency models into recruitment management. This innovative method leverages fuzzy transformations to convert hierarchical assessments into a comprehensive, fuzzy-based evaluation. Subsequently, the BPNN is employed to derive the conclusive result linked to this holistic evaluation.

Simulation outcomes reveal impressive metrics: an MSE of approximately 4.32 and an MAE reaching 1.36, highlighting the algorithm's accuracy and dependability. As enterprises strive to enhance their market standing, they must capitalize on their talent pool. This entails refining the competency model, aligning recruitment practices with corporate culture, and adopting a scientific approach to forecasting recruitment needs.

The implementation of a competency model-centered recruitment system promises to elevate recruitment effectiveness and ensure a stronger alignment between hired talent and job requisites. The aspiration of this research is to contribute to the elevation of recruitment standards within enterprises, enabling them to retain a competitive edge in today's demanding market environment.

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