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Research Article

Human Resource Decision-Making and Recommendation Based on Hadoop Distributed Big Data Platform

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The innovative development of an enterprise is a necessary factor for its long-term development, and science and technology is a necessary driving force for its development. An effective management of human resources management will find more high-quality talent, and it will also be efficient management of the enterprise staff. The efficiency of the traditional human resource management is relatively low; the approach will produce larger errors for the enterprise. This study combines the Hadoop distributed platform and big data technology to conduct a decision recommendation research on the relevant factors of human resource management. In this study, the decision tree is used to classify the data related to human resource management. The data feature of human resource will be predicted by the neural network method, and human resource managers will refer to the prediction data from the output layer of neural network. Human resource managers will make corresponding decisions and recommendations. The research results show that Hadoop technology and big data technology have better accuracy in human resource management recommendation system, which contains ConvLSTM method and decision tree method in this study. The maximum prediction error of the ConvLSTM algorithm in predicting the relevant factors of the human resource decision-making system is only 2.67%, and this part of the error comes from the employee-job matching index. The smallest forecast is only 1.98%.

1. Introduction

At present, the development of the global economy has entered a relatively rapid period. The current economy is different from the previous economic development model [1]. The modern economic development model has presented a globalized and innovative development model, which requires the participation of more technical and innovative talents [2, 3]. At the same time, the development of the enterprise economy also presents a globalized development model, which requires the introduction of more comprehensive talents [4]. The development of enterprise is related to products quality, and it is also related to decision-making and employees. An enterprise from the top management to the technical staff can have a better technology and professionalism, which is more conducive to the development of the enterprise. The technology and quality of staff depend on the recruitment and management of human resource managers. Human resource is an important part of the enterprise; it will directly communicate with employees and even top managers of the industry and output performance [5, 6]. Therefore, an enterprise development not only needs to pursue the enterprise product quality as well as the enterprise performance, but also needs to carry on the enterprise culture; this has manifested the enterprise regarding the staff attention and the support [7]. For the economic globalization, enterprises need to do a good balance between human resources and performance management, which is conducive to the long-term development of enterprises.

Human resource management involves many aspects; it will involve staff recruitment [8, 9], staff performance management, and reward and punishment measures, and so on. Human resource management is a complex task,

especially in the recruitment and management of employees. To a certain extent, the development speed of an enterprise also depends on the level of employee performance and employee satisfaction [10, 11]. In the rapid development of science and technology today, automation has slowly replaced the artificial way, which requires the staff to have a better technical level and higher scientific literacy. The staff who have a better technical level and higher scientific literacy can improve the speed of enterprise operation and long-term development of stability [12]. The development of modern enterprises has broken the model of traditional enterprise development, and it needs to pay more attention to the life and satisfaction of employees. Only by improving the relevant treatment of employees, it will stimulate their engagement and enthusiasm for work. Likewise, it is a complex task for the human resource management department to find the employees who are suitable for the job nature of the company among many people [13]. Human resource managers not only need to recruit high-quality employees, but they also need to deal with daily reward and punishment measures and management measures, which requires human resource managers to maximize the enthusiasm of employees. Today is an era of data; it will generate a lot of cumbersome data no matter in which industry. Human resource managers will also face a lot of cumbersome data. If they only rely on their experience to process these data, it will consume a lot of time and material resources [14, 15]. At the same time, there will be many mistakes and inevitable human factors in this way of human resources, which will affect the related work of the human resource management department. In the long run, it also affects the well-functioning and long-term development of the business. The advantage of big data technology is to deal with tedious data. It believes that big data technology will bring new directions and methods to the development of human resources.

Big data technology has been successfully applied in many fields. It can not only perform efficient classification tasks on massive data of research objects, but also find a nonlinear mapping relationship from these tedious data. These nonlinear mapping relationships are a relationship that is difficult to discover by manual methods or empirical formulas [16, 17]. With the development of big data technology, it has emerging methods such as deep learning and reinforcement learning. Deep learning allows for deeper network layers, which provides technical support for prediction and classification tasks on larger datasets. Reinforcement learning is an environment-dependent learning algorithm that can make real-time adjustments in response to changes in the environment. Big data technology can already be applied to most of the current research fields. Human resource management will involve many factors; there are complex relationships between these factors; big data technology will be a good mapping between these human resources data. At the same time, the big data technology will make the corresponding forecast to these human resources data, which is a valuable research and task for the enterprise human resources manager [18, 19]. Big data technology can better handle nonlinear high-dimensional data, and it mainly includes supervised learning and unsupervised learning methods. The ConvLSTM algorithm is also a supervised learning algorithm in big data technology. The Hadoop distributed platform takes the computer system and the Internet as the basic platform, and it will realize the sharing and transmission of data. It will share different data and cases, and it has great use value in different fields.

This research mainly uses the Hadoop distributed platform and big data technology to study the decision-making method and recommendation system of human resources. This research is divided into five parts. The first part mainly explains the problems of human resource management and the advantages of big data technology in human resource management. The second part mainly introduces the research status and defects of human resource management. The third part introduces the method and process of Hadoop distributed platform and big data technology application in human resource recommendation and decision-making system. The fourth part mainly introduces the feasibility and accuracy of the application of big data technology in human resource management recommendation and decision-making system. Section 4 demonstrates the accuracy and feasibility of the ConvLSTM algorithm in human resource decision-making systems using linear correlation coefficients, average errors, and prediction scatterplots. The fifth part mainly summarizes the related human resources research, which mainly summarizes the defects of human resources and the research of this paper.

2. Related Work

Human resource management will have an important impact on the long-term development and marketing of enterprises. Reasonable allocation of human resources is the key to the success of an enterprise, and many researchers have carried out a lot of research on the related work of human resources. Zheng and Ma [20] believed that human resource management planning is important for human resource management work, it can predict the needs of human resources, and it can also promote the long-term strategic development of enterprises. They used the self-organizing map SOM artificial neural network method to predict the relationship between various factors of human resource management and personnel needs. They also verified the feasibility and accuracy of this method through the actual data of the enterprise, which can well meet the forecasting needs of human resources. Many researchers have also used neural network technology to fully study the relevant factors in human resource management, and it has also achieved good research results. Lin et al. [21] believed that the traditional human resource model can no longer meet the development model and requirements of today enterprises. In order to improve human resource management and job matching, they used an autoencoder neural network method and cloud computing to study the relationship between human resources and job matching. The research results show that this method can improve the employees-job matching index, and it is also beneficial to

improve the efficiency of human resource managers. The reasonable human resource management method is significance to the diversification of the economy and society. Shi and Li [22] found that there are irregularities in the human resource management team and differences in the balance of talent quality, which affect the development of the enterprise. They built a recurrent neural network RNN to study the relationship between human resources and enterprise development. This model fully considers the relationship between employee-job matching and the balanced development of enterprises. The results of this study show that this method can significantly improve the job match and work efficiency of employees. Liu et al. [23] found that individual differences and the recommendation process of employees will affect the management of human resources, and they proposed a data mining human resources recommendation algorithm to solve this problem. The positive matrix factorization (PMF) model is used to deal with implicit HR data and similarity data. They also used neural network methods and weight-based recommendation algorithms for comparison and validation. The research results show that the information that this recommendation algorithm can process will contain more human resource information and the human resource information span is larger than other algorithms. Dai et al. [24] believed that the rational allocation of human resources and the management of human resources is a complex task. They used the Petri net allocation model of neural network method to study the characteristics of human resource scheduling process and human resource mobility. The results of this study show that the neural network model has an accuracy of 78.85% in the process of predicting human resources factors. At the same time, they suggested that this model should be applied in the human resource management of small and medium-sized enterprises as much as possible. Zeng and Qi [25] concluded that human resources are the cornerstone of business operations. They used the method of Internet + artificial intelligence to study the defects of human resources, and they also used the fog computing model to establish the optimal human resources allocation model. The research results show that the operation efficiency index of the company is above 0.8. Through this model, the matching degree of personnel and positions has reached more than 50%. This method is feasible in human resource management. Zhao et al. [26] believed that the market competition of enterprises has transformed into the competition of talents, which shows the importance of human resources. This study divides human resource management objectives into two evaluation indicators: comprehensive and professional. It adopts the fuzzy comprehensive evaluation method to analyze the human resource management system of enterprises. From the above literature review, it can be seen that many methods have been adopted in the field of human resources, including neural networks and machine learning methods. However, they are rarely studied for HR decision-making by using ConvLSTM method and Hadoop distributed platform. The ConvLSTM algorithm can better extract the time characteristics of human resource management decision-making systems. Traditional big data technology hardly considers the time characteristics of human resource decision-making management, which is also the innovation of this research. This study uses ConvLSTM to analyze the influencing factors of human resources, which will accurately provide effective recommendations and decisions for human resources. The Hadoop distributed framework can provide a good computing and storage platform for the training and testing process of ConvLSTM.

3. An Application of Hadoop Distributed Platform and Big Data Technology in Human Resource Recommendation

3.1. The Introduction to Big Data Methods. Big data technology can well fit the nonlinear relationship between complex data, which requires a good distribution of weights and biases [27, 28]. Big data technology has also been well applied in many fields; it can fit the nonlinear relationship between unknown data efficiently and quickly [29, 30]. The data of human resources employee performance and employee promotion have complex characteristics, which cannot be discovered by human resource managers through experience or professional knowledge, which requires the role of big data technology. Not only can big data technology effectively classify different influencing factors of human resources, but these classified data represent different human resources characteristics [31]. The data of human resources also have complex relationships; it is difficult to distinguish these characteristics by human resource managers [32]. Big data technology can also well complete the recommendation and decision-making scheme of human resources through neural network or machine learning and other methods. ConvLSTM is quite different from other big data technologies. Its main advantage is that it can better extract the temporal features of human resource decision-making systems. There is a relatively obvious time correlation in the human resource decision-making system.

3.2. The Introduction to Hadoop Distributed Platform and ConvLSTM Algorithm. Hadoop is a distributed platform, and its cluster capability can improve computing and storage capabilities, which is a valuable platform for operations with large amounts of data. The two core parts of the Hadoop distributed platform are HDFS and MapReduce. HDFS can provide storage for massive data, and MapReduce provides computing for massive data, and the efficient computing and storage capabilities of Hadoop can be performed between them. In order to make more effective use of Hadoop clustering capabilities and big data technology, this study organically integrates these methods. Figure 1 shows the application scheme of Hadoop distributed platform and big data technology in human resource recommendation and decision-making system. The Hadoop distributed platform can provide more data for the human resource decision-making system, and it realizes the information sharing of the human resource decision-making system. It can further provide more successful case data for the ConvLSTM

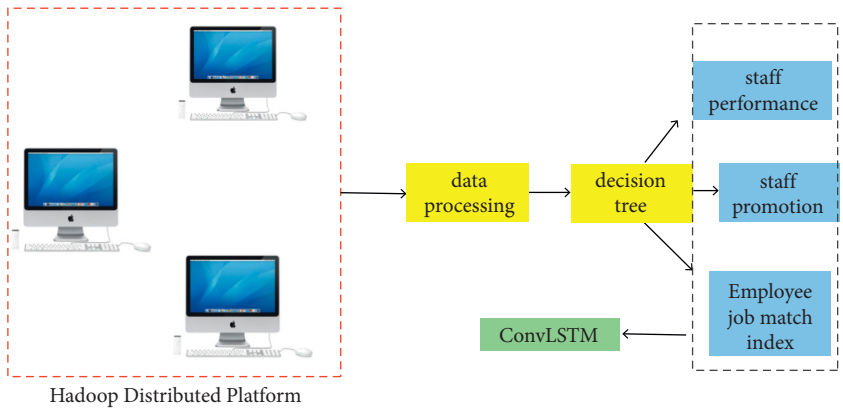

Figure 1: The application process of Hadoop platform and big data in human resource decision-making system.

algorithm. First of all, this research will collect data from the Hadoop distributed platform. These HR-related factor data will be effectively classified using the decision tree method. This is because the collected HR-related data has a certain degree of confusion, which is not conducive to neural network methods for decision-making and recommendation. The classified data will be input into the ConvLSTM neural network system for prediction. The classification of human resource data and the processing of recommendation prediction will be calculated and stored in the Hadoop distributed system. When it collects data through the Hadoop distributed platform, there will be data confusion, which is not good for the prediction of the ConvLSTM algorithm, which requires the classification of different types of HR-related factors. Decision trees can be effectively classified according to the distance relationship of features.

The relevant influencing factors of human resources are not only strong correlation between data, but also a certain time correlation between them. If only the convolutional neural network is used to extract the features of the data, this may cause inaccuracy of the data prediction. The human resource decision-making and recommendation system in this study mainly uses the ConvLSTM neural network to make predictions on relevant data, and these output data will help human resource managers make decisions and refer to them. Figure 2 shows the detailed calculation process of the ConvLSTM neural network. It can be seen that ConvLSTM method is related to the process of LSTM, but it can handle convolution operations. This is because the dot product operation of LSTM has been converted into convolution operation, which allows the ConvLSTM to handle feature extraction tasks. After the data of human resource decision-related factors passes through the decision tree, it will be divided into three different types of data. These data will be input into the ConvLSTM algorithm in the form of time series, which will use the sliding window to determine the corresponding label data. The learning rate used in this study is 0.0001, which will speed up the training convergence. The number of network layers of ConvLSTM is set to 4. The number of parameters of the fully connected layer is set to 256.

It is similar to the LSTM method, the ConvLSTM method also contains many gates of computation, and it can also handle time-dependent features. Equation (1) shows the calculation method of the input gate, which not only needs to input the current state information, but also needs to input the useful information of the historical state. Equation (2) shows the calculation process of the forget gate, which is a more critical process. It needs to forget and filter some historical state information according to the distribution of weights.

$$i_t = \sigma\left(W_{xi} * x_t + W_{hi} * h_{t-1} + W_{ci} \circ C_{t-1} + b_i\right) \tag{1}$$

$$f_t = \sigma\left(W_{xf} * x_t + W_{hf} * h_{t-1} + W_{cf} \circ C_{t-1} + b_f\right). \tag{2}$$

Equation (3) shows the calculation process of the memory gate.

$$C_t = f_t \circ C_{t-1} + i_t \circ ELU\left(W_{xc} * x_t + W_{hc} * h_{t-1} + b_c\right). \tag{3}$$

Equation (4) shows the calculation method of the output gate, which not only needs to output the predicted value of the current state, but also needs to output the predicted value of the historical state information. Equation (5) shows the operation of the output value through the activation function, which nonlinearizes the output value.

$$o_t = \sigma\left(W_{xo} * x_t + W_{ho} * h_{t-1} + W_{co} \circ C_t + b_o\right), \tag{4}$$

$$h_t = o_t \circ ELU\left(C_t\right). \tag{5}$$

In the calculation process of ConvLSTM, the calculation of weight and bias will involve the process of derivation. Equations (6) and (7) show the calculation method of weight and bias.

$$\Delta\omega_{ji} = -\eta \frac{\partial E}{\partial \omega_{ji}}, \tag{6}$$

$$\Delta u_{ij} = -\eta \frac{\partial E \partial}{\partial u_{ij}}. \tag{7}$$

3.3. The Introduction to the Process of Human Resources Data Processing. In this study, it mainly studies the impact of

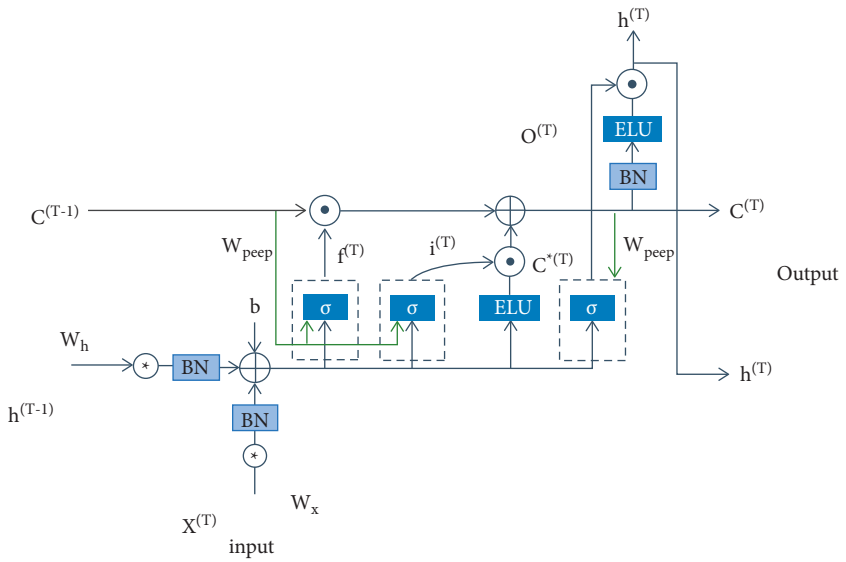

Figure 2: The detailed calculation process of ConvLSTM in human resource system.

three indicators of employee performance, employee promotion, and employee-job match index on human resource decision-making and recommendation systems. These three factors are also important factors in the decision-making process of human resources. At the same time, the data of the three human resources influencing factors collected in this study will be processed and classified. The classification process of the data will take the form of a decision tree. Figure 3 shows the classification process of the decision tree method in the three-factor data of human resources. The decision tree will be branch by the weights and bias, and branches will be customized by the user. The number of branches $N = 3$ was used in this study. And each branch will contain 4 different influencing factors. The datasets of human resource will be output by the decision tree algorithm, which can automatically perform the tasks of data operations and human resource data classification. This method is more efficient and it can save a lot of time. In Figure 3, the red line represents a feedback mechanism. The prediction results of the related factors of human resources in this study will also be fed back to the Hadoop distributed platform as a data, which will continuously improve the database of human resources management.

In a decision tree approach, it will have many different metrics to evaluate. Entropy is a relatively common evaluation index, and equation (8) shows the calculation process of entropy.

$$H(D) = -\sum_{l=1}^{L} \frac{|C_l|}{|D|} \log_2 \frac{|C_l|}{|D|}. \tag{8}$$

Equation (9) shows the calculation process of conditional entropy, which is a calculated value of entropy under certain constraints. In the calculation process of human resource data, it will involve three variables for related classification processing, and it will use conditional entropy for related evaluation.

$$H(D/A) = \sum_{J=1}^{n} \frac{|C_j|}{|D|} H(D_j). \tag{9}$$

Information gain is also an evaluation index used by decision trees, which is different from the calculation process of entropy. Equation (10) shows how the information gain is calculated.

$$g_r(D, A) = \frac{g(D, A)}{H_A(D)}. \tag{10}$$

Among the different approaches to big data, error is one that is often mentioned. It will calculate the error between the actual value and the predicted value, and it will also affect the direction of gradient descent. The mean square error is a common error calculation method, and equation (11) shows the calculation process of the mean square error.

$$J = \frac{1}{2} \sum_{k=1}^{l} \sum_{r=1}^{o} (x_k - \chi_r)^2. \tag{11}$$

Before using the decision tree to process the relevant data of human resources influencing factors, the data preprocessing process is a process that must be passed. It requires data preprocessing operations no matter what kind of research object and different research algorithms are used. This is because datasets tend to vary widely in both features and magnitude of data. In order to better use the neural network method, data preprocessing is a process that this research goes through. In this study, the data on the influencing factors of human resources will be normalized, and the data of human resource-related factors are processed into Gaussian distribution data, which will be in the interval 0 to 1. It will facilitate the operation of weights and convolution. Data preprocessing is beneficial to improve the convergence of the learning process.

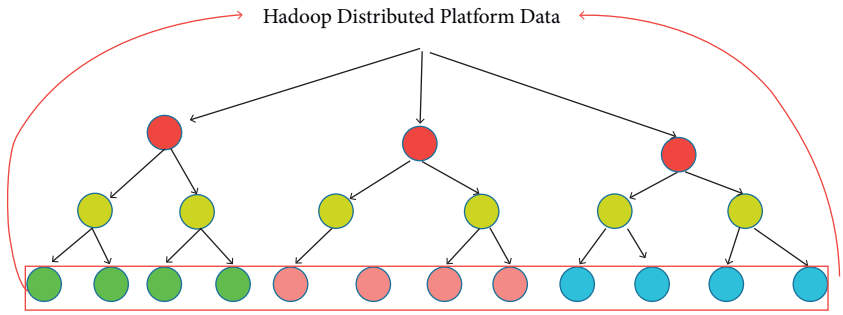

Figure 3: The human resource data classification process using decision tree method and Hadoop.

4. Result Analysis and Discussion

The human resource data selected in this study come from the relevant human resource data of a chemical company in Shandong. These data will include employee performance, employee promotion, and other data. The factors of employee performance, employee promotion, and employee-job matching index are important for human resource management. This decision tree and neural network methods were used to predict and classify human resources. The output data will help human resource managers to make decisions and recommend tasks. The first step is that the data will be classified by a decision tree. Figure 4 shows the error of classification results for the three influencing factors of human resources. In general, the decision tree has relatively high accuracy in classifying the three factors of employee performance, employee promotion, and employee-job fit index. The largest classification error is only 2.67%, which is mainly due to the matching index between employees and positions. Compared with the other two human resource factors, the larger mutation results in a larger error in the employee-position matching index. And it also involves the level of employees themselves and job changes. Therefore, this data of employee-job matching index has high instability. The smallest classification error is only 1.98%, which is a completely acceptable error for human resource managers.

In this paper, it chooses three factors to evaluate the accuracy of big data technology in human resource decision-making and recommendation systems, where the three factors include employee performance, employee promotion, and employee-job fit index. Through the above research, we can know that the matching index between employees and positions has a high mutation. In order to more intuitively understand the accuracy of the ConvLSTM method in predicting the influencing factors of human resources, this study separately analyzes the distribution of the employee-job matching index. Figure 5 shows the prediction of the employee-job matching index. It can be seen that the predicted value of the employee-job matching index is in good agreement with the actual matching index within a one-month cycle, regardless of the index value or the index change trend. At the same time, it can be seen from Figure 5 that the employee-job matching index has a large mutation over time, which is difficult for neural networks to predict. However, when the peak value of the employee-position matching index and the change trend are relatively large, the neural network method has a relatively good predictive ability.

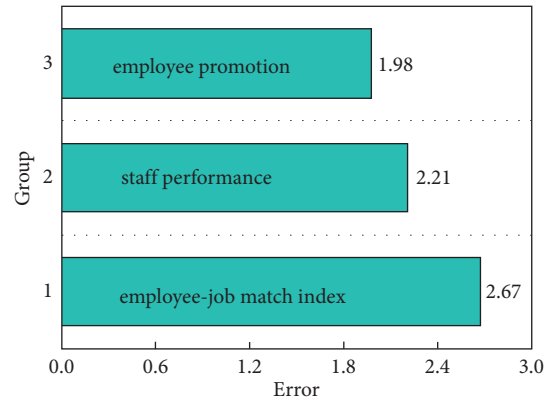

Figure 4: The classification errors of human resource influencing factors data.

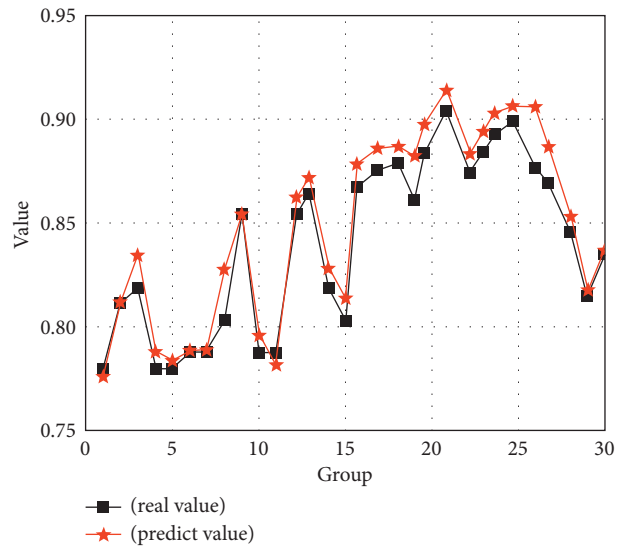

Figure 5: The prediction curves of employee-job match index by ConvLSTM method.

Such good predictive performance of ConvLSTM will benefit human resource managers for efficient decision-making and recommendation tasks. The difference between the predicted value and the actual value of the employee-job matching index is relatively small within a period.

The linear correlation coefficient is a function of $y = x$ to show the difference between the predicted value and the actual value. Not only does it show how effectively the predicted value differs from the actual value, it can also show how the predicted value deviates from the actual value. Figure 6 shows the linear correlation between the employee and job match index. It can be clearly seen from Figure 6 that there is a good linear correlation between the employee and job matching index. Not only is it well distributed on both sides of $y = x$, but these distances are also relatively close. At the same time, the values of the employee-position matching index are also relatively evenly distributed, which not only shows that the neural network method has good prediction performance, but also shows that the decision tree has achieved high accuracy in classifying these data. The linear correlation diagram further illustrates that the neural network method can guide human resource managers to make decisions about the matching index between employees and positions.

Employee performance is one of the important factors affecting the human resources of an enterprise. The main task of human resource managers is to deal with the relationship between employee performance and enterprise development. Effective prediction of employee performance is also valuable work for human resource managers. Figure 7 shows the predicted data distribution of employee performance through the ConvLSTM method. Overall, the prediction error of employee performance is smaller than that of the employee-job fit index. The yellow areas represent places with large errors, and the red areas represent places with small errors. It can be seen that the larger error occurs at the beginning of the month, and the smaller error occurs at the end of the month. This is mainly due to the close relationship between the performance of employees at the beginning of the month and the tasks of the enterprise, which causes a large error. Overall, these errors are enough for HR managers to trust for a one-month cycle.

Employee promotion will not only affect the motivation of employees themselves, but also affect human resource managers to make reasonable decisions. From a long-term development point of view, it will affect the long-term development of the enterprise. Therefore, the development of employee promotion is more important for human resources. Figure 8 shows the predicted distribution of employee promotions. From Figure 8, it can be seen that the forecast errors of employee promotions are all within 2% in a one-month period. The place where the error is higher appears in the middle of the month, which may have a greater relationship with the policy of the company or the satisfaction and change of employees. Figure 9 more intuitively shows the average error of the three factors of human resources. In general, this part of the error is acceptable, the largest error is only 3.32%, and the smallest error is 1.92%.

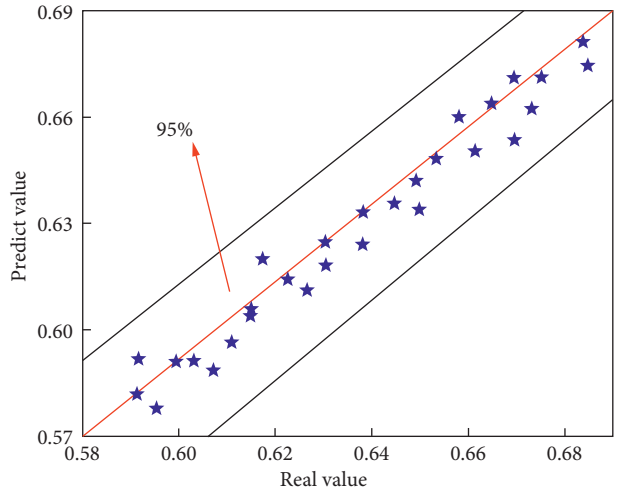

Figure 6: The predictive correlation distribution of employee-job match index by ConvLSTM method.

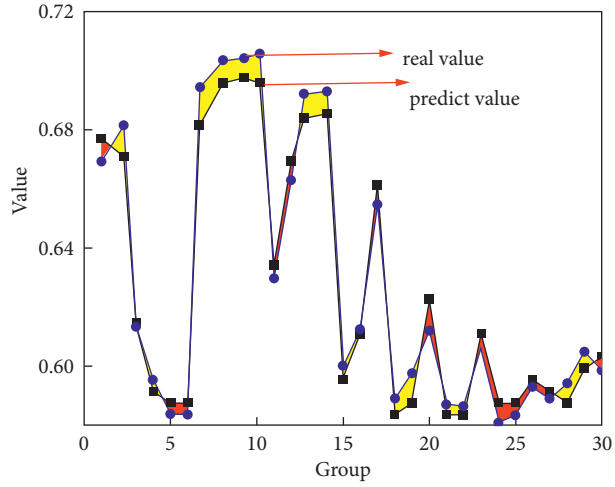

Figure 7: The prediction curves of staff performance by ConvLSTM method.

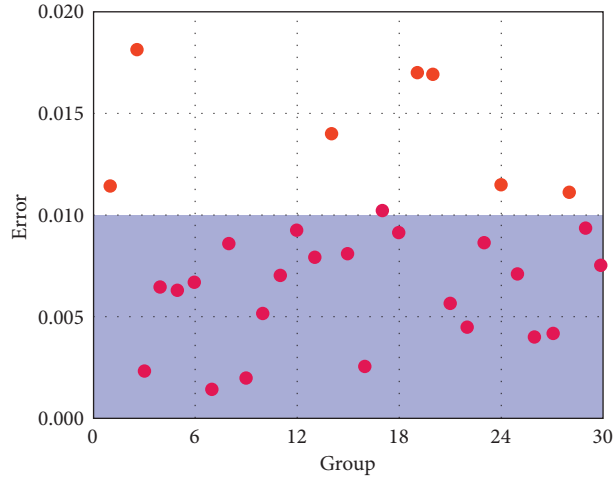

Figure 8: The prediction error of staff promotion.

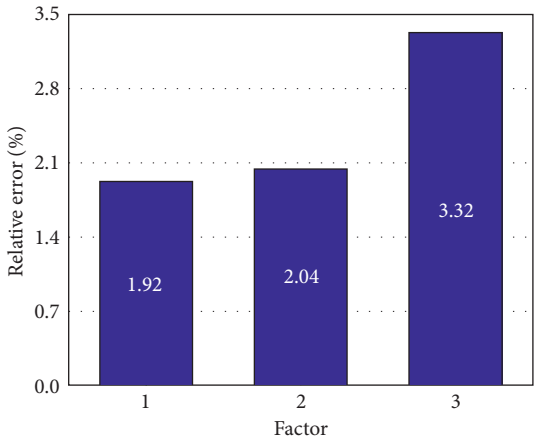

Figure 9: The prediction errors of human resource influencing factors.

For the management of human resources, whether it is employee performance, employee-position matching index, or employee promotion, the neural network method can well match the actual data values. This can provide effective data support for human resource managers.

5. Conclusions

Human resource management has always been an important department of an enterprise. The factors of employee performance, employee-job matching index, and employee promotion in human resource management have complex characteristics, and it is difficult for human resource managers to find similarities and potential information. However, human resource data is more meaningful for enterprise development and human resource decision-making and recommendation. The similarities between these human resource management data can be well fitted by big data technology and Hadoop platform. Hadoop distributed platform can provide an effective platform for the calculation and storage of big data methods, and big data technology can provide algorithm support for human resource data processing, which is a valuable research.

The classification error of the decision tree method for employee performance, employee promotion, and employee and position matching index is all within 3%, and the largest error is only 2.68%. ConvLSTM method can also fit the relationship between these three factors and human resources very well. All prediction errors are within 4%. For the three influencing factors of human resource management data, the employee-job matching index is the most difficult data to predict, because the employee-job matching index has a great relationship with the development of the enterprise and time, and it has a large mutation. However, the ConvLSTM method can also predict the changes and peaks of the employee-job matching index well. Overall, big data technology has good performance in human resource forecasting, which is a valuable research for human resource managers to make decisions and it can help them make rational decisions.

Data Availability

The data used to support the findings of this study are available from the corresponding author upon request.

Conflicts of Interest

The authors declare that they have no conflicts of interest or personal relationships that could have appeared to influence the work reported in this paper.

Acknowledgments

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References

[1] S. Strohmeier, "Digital human resource management: a conceptual clarification," *German Journal of Human Resource Management: Zeitschrift für Personalforschung*, vol. 34, no. 3, pp. 345–365, 2020.

[2] C. Hoon, A. Hack, and F. W. Kellermanns, "Advancing knowledge on human resource management in family firms: an introduction and integrative framework," *German Journal of Human Resource Management: Zeitschrift für Personalforschung*, vol. 33, no. 3, pp. 147–166, 2019.

[3] E. F. Chapman, F. A. Sisk, J. Schatten, and E. W. Miles, "Human resource development and human resource management levers for sustained competitive advantage: c," *Journal of Management and Organization*, vol. 24, no. 4, pp. 533–550, 2018.

[4] H.-P. Sun, W. F. Sun, Y. Geng, and Y. S. Kong, "Natural resource dependence, public education investment, and human capital accumulation," *Petroleum Science*, vol. 15, no. 3, pp. 657–665, 2018.

[5] Z. Lv, Z. Tan, Q. Wang, and Y. Yang, "Cloud computing management platform of human resource based on mobile communication technology," *Wireless Personal Communications*, vol. 102, no. 2, pp. 1293–1306, 2018.

[6] Y. Ramírez and Á. Tejada, "University stakeholders' perceptions of the impact and benefits of, and barriers to, human resource information systems in Spanish universities," *International Review of Administrative Sciences*, vol. 88, no. 1, pp. 171–188, 2022.

[7] R. E. Ployhart, "Resources for what? Understanding performance in the resource-based view and strategic human capital resource literature," *Journal of Management*, vol. 47, no. 7, pp. 1771–1786, 2021.

[8] S. Li, R. Jia, J. H. Seufert, W. Hu, and J. Luo, "The impact of ability-, motivation- and opportunity-enhancing strategic human resource management on performance: the mediating roles of emotional capability and intellectual capital," *Asia Pacific Journal of Human Resources*, vol. 6, no. 1, p. 12293, 2021.

[9] L. Hu, "A resource management method based on organizational behavior theory and hidden Markov algorithm," *Cluster Computing*, vol. 22, no. S2, pp. 4941–4948, 2019.

[10] J. Zhao, H. Liu, and W. Sun, "How proactive environmental strategy facilitates environmental reputation: roles of green human resource management and discretionary slack," *Sustainability*, vol. 12, no. 3, p. 763, 2020.

[11] J. Mahadevan, "Ethnographic studies in international human resource management: types and usefulness," *German Journal of Human Resource Management: Zeitschrift für Personalforschung*, vol. 34, no. 2, pp. 228–251, 2020.

[12] Y. J. Kim, W. G. Kim, H.-M. Choi, and K. Phetvaroon, "The effect of green human resource management on hotel employees' eco-friendly behavior and environmental performance," *International Journal of Hospitality Management*, vol. 76, no. 1, pp. 83–93, 2019.

[13] S. Adomako and N. P. Nguyen, "Human resource slack, sustainable innovation, and environmental performance of small and medium-sized enterprises in sub-Saharan Africa," *Business Strategy and the Environment*, vol. 29, no. 8, pp. 2984–2994, 2020.

[14] J. Barrena-Martinez, M. López-Fernández, and P. Romero-Fernandez, "Drivers and barriers in socially responsible human resource management," *Sustainability*, vol. 10, no. 5, p. 1532, 2018.

[15] W. Huo, X. Li, M. Zheng, and Y. J. Liu, "Commitment to human resource management of the top management team for green creativity," *Sustainability*, vol. 12, no. 3, p. 1008, 2020.

[16] O. Zallé, "Natural resources and economic growth in Africa: the role of institutional quality and human capital," *Resources Policy*, vol. 62, no. 7, pp. 616–624, 2019.

[17] A. Tuncdogan, I. C. Dogan, and M. Barca, "The size of the fight in the dog: the role of teams' active human capital resources within the human capital-task performance relationship," *Strategic Organization*, vol. 4, no. 24, p. 147612702110015, 2021.

[18] Z. Han, H. Ren, S. Yang, and Y. Han, "Human resource practice management for knowledge intensive team: IMPACT on team innovation performance and substitution effect of empowerment leadership," *Sustainability*, vol. 13, no. 9, p. 4801, 2021.

[19] H. L. Liu, "Human resource management and labor relationship adjustment mechanism of port freight trade enterprises," *Journal of Coastal Research*, vol. 103, no. 7, pp. 629–633, 2020.

[20] J. F. Zheng and R. J. Ma, "Analysis of enterprise human resources demand forecast model based on SOM neural network," *Computational Intelligence and Neuroscience*, vol. 7, no. 16, p. 6596548, 2021.

[21] Y. M. Lin, X. M. Lin, and R. B. Xu, "Semi-supervised human resource scheduling based on deep presentation in the cloud," *EURASIP Journal on Wireless Communications and Networking*, vol. 73, no. 1, 2021.

[22] W. Shi and Q. Li, "Human resources balanced allocation method based on deep learning algorithm," *Scientific Programming*, vol. 2021, no. 14, pp. 1–9, 2021.

[23] Z. Liu, Y. Ma, H. Zheng, and D. Liu, J. Liu, Human resource recommendation algorithm based on improved frequent itemset mining," *Future Generation Computer Systems*, vol. 126, no. 10, pp. 284–288, 2022.

[24] W. H. Dai, W. H. Hu, Z. J. Zhu, and X. f. Liao, "Human resource Petri net allocation model based on artificial intelligence and neural network," *Mobile Information Systems*, vol. 9, no. 12, p. 5988742, 2021.

[25] Z. Zeng and L. Q. Qi, "Internet plus artificial intelligence human resource information management system construction innovation and research," *Mathematical Problems in Engineering*, vol. 4, no. 25, p. 5585753, 2021.

[26] C. Zhao, Y. Xue, and T. Niu, "Enterprise human resource management index based on fuzzy system," *Journal of Intelligent and Fuzzy Systems*, vol. 40, no. 2, pp. 3137–3146, 2021.

[27] T. Bányai, C. Landschützer, and Á. Bányai, "Markov-chain simulation-based analysis of human resource structure: how staff deployment and staffing affect sustainable human resource strategy," *Sustainability*, vol. 10, no. 10, p. 3692, 2018.

[28] D. Jia, "Coupling and coordination of marine high-end human resources and marine innovative economic development ability," *Journal of Coastal Research*, vol. 94, no. sp1, pp. 573–576, 2019.

[29] B. Shen, "Construction of performance evaluation system of human resource management in port foreign trade enterprises," *Journal of Coastal Research*, vol. 103, no. sp1, pp. 217–221, 2020.

[30] A. Mohamed, M. K. Najafabadi, Y. B. Wah, and E. A. K. R. Zaman, "The state of the art and taxonomy of big data analytics: view from new big data framework," *Artificial Intelligence Review*, vol. 53, no. 2, pp. 989–1037, 2020.

[31] K. A. Mills, "What are the threats and potentials of big data for qualitative research?" *Qualitative Research*, vol. 18, no. 6, pp. 591–603, 2018.

[32] J. J. Zhang and J. Li, "Development and application of big data in the field of satellite navigation[J]," *Wireless Communications and Mobile Computing*, vol. 8, no. 17, p. 8850350, 2021.