2021 International Conference on Intelligent Transportation, Big Data & Smart City (ICITBS) | 978-1-6654-4854-3/21/$31.00 ©2021 IEEE | DOI: 10.1109/ICITBS53129.2021.00124

Research on the optimization of rural e-commerce human resources based on big data

XueJie Bai，Wenbei Li, Qian Zhang*

Department of Management of Harbin Finance University , Harbin 150030, China
*corresponding author
E-mail: 297306834@qq.com

***Abstract*—In order to improve the accuracy and rationality of rural e-commerce human resource data mining, this paper puts forward the research of rural e-commerce human resource optimization based on big data. This paper analyzes the demand structure of rural e-commerce human resources, and mines the relevant data of human resources personnel of a rural e-commerce enterprise in Heilongjiang Province. Based on the principle of e-commerce information, human resource gain is calculated. This paper analyzes the constraints of rural e-commerce human resource allocation, constructs the objective function of rural e-commerce human resource allocation, and completes the rural e-commerce human resource allocation. The experimental results show that the proposed human resource allocation method has high data mining accuracy and optimization rationality, and can meet the needs of rural e-commerce human resource allocation.**

Keywords-Big data; rural e-commerce; human resource allocation; objective function

1. INTRODUCTION

E-commerce is the behavior of Internet users to purchase products through network platform, while the development of rural e-commerce has been restricted due to the problem of commodity distribution. However, in recent years, with the development of logistics industry, rural e-commerce has developed rapidly. Through the network e-commerce platform, agricultural products can be sold at the same time as online shopping, greatly improving the happiness of farmers [1-3]. However, due to the complex structure of rural e-commerce human resources, the optimization of human resources has always been concerned. Effective and reasonable allocation of rural e-commerce human resources can effectively improve the efficiency and economic benefits of rural e-commerce. Therefore, it is necessary to study a reasonable method of rural e-commerce human resources allocation [4].

Reference [5] proposes a method of human resource allocation based on data mining, which uses information extraction method to complete human resource scheduling and feature extraction, and constructs a regularized planning model to complete the registration of human resource information and positions. Finally, the component mining method is used to complete the human resource data mining and the construction of human resource allocation model. Reference [6] puts forward a human resource allocation method based on multi-stage genetic algorithm. This method uses the stochastic programming method to construct the human resource planning allocation model, integrates the multi-stage decision-making into the genetic algorithm, solves the human resource planning allocation model, and completes the human resource allocation. Reference [7] proposes a human resource allocation method based on ant colony algorithm. This method analyzes the constraints of human resource allocation, and takes the optimal workload allocation as the goal of human resource allocation, constructs the mathematical model of human resource allocation, and uses ant colony algorithm to solve the constructed human resource allocation model to complete the human resource allocation.

In order to accurately mine the rural e-commerce human resource data and improve the rationality of human resource allocation, this paper puts forward the rural e-commerce human resource allocation method based on big data.

2. HUMAN RESOURCE ALLOCATION METHOD BASED ON BIG DATA

2.1 Big data analysis of human resources

Rural e-commerce is a kind of rural e-commerce based on Internet platform which has been rising in recent years. Agricultural products are sold to other cities through the Internet, and villagers can purchase the life and production supplies they need from the network [8-10]. This new mode of rural e-commerce has broken through the traditional mode of agricultural trade, which can promote the development of rural e-commerce effectively.

Human resources refer to the general term of the labor force that carries out a series of production and operation activities in order to create or obtain wealth within a certain space [11]. In the process of production and operation of any enterprise, human resources belong to the first resource, because human resources are the most active and active resources in enterprises. The process of allocating human resources to a certain post and combining resources and materials organically to produce economic benefits is the allocation of human resources [12].

For rural e-commerce enterprises, in the whole process of commodity supply, the impact of reasonable allocation of human resources is very far-reaching [13-14]. The commodity supply chain connects all the production and operation activities of rural e-commerce enterprises as a whole. Through the bridge of rural e-commerce supply chain, the allocation of rural e-commerce human resources can be more clear. The demand structure of human resources in rural e-commerce supply chain is shown in Figure 1.

978-1-6654-4854-3/21/$31.00 ©2021 IEEE
DOI 10.1109/ICITBS53129.2021.00124

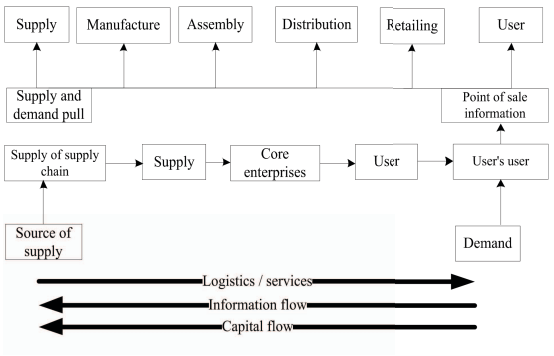

Fig. 1 Demand structure of rural e-commerce human resources

According to the above analysis results of human resources demand, in order to complete the optimization of rural e-commerce human resources more effectively, the largest rural e-commerce company in Heilongjiang Province is selected to carry out human resource related data mining. As of December 2019, the company has a total of 1327 employees. The education distribution results of all employees are shown in Figure 2, and the age distribution results are shown in Figure 3.

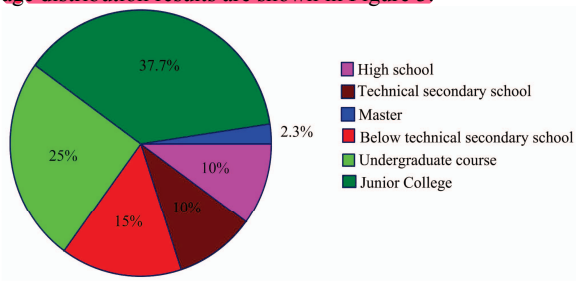

Fig. 2 Education distribution

As can be seen from Figure 2, only 2.3% of the rural e-commerce enterprises have master's degree, and 37.7% have college degree.

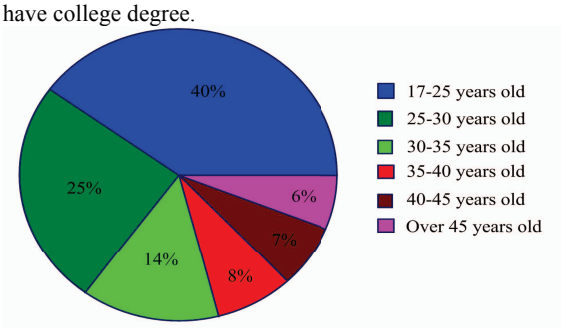

Fig. 3 Age distribution

From the above-mentioned basic situation of human resources of a rural e-commerce company in Heilongjiang Province, it can be seen that the rural e-commerce industry has relatively serious defects in human resource management, because rural e-commerce is an emerging industry with a short history and relatively young development. And personnel education is generally not high, especially in rural e-commerce industry front-line employees are basically college education. Therefore, it is necessary to allocate and manage the human resources of rural e-commerce industry.

In order to achieve effective human resource allocation, big data algorithm is used to deeply mine the human resource data of rural e-commerce industry. The specific calculation process is as follows.

According to the collected rural e-commerce human resources data, calculate the expected amount of information for data sample classification:

$$I(S_1,...,S_m)=\sum_{i=1}^{m} p_i \log(p_i) \tag{1}$$

Among them, $I(S_1,...,S_m)$ is the expected classification information of a rural e-commerce human resources sample data set S, S_m is the number of m-th classification samples, p_i is the probability of the i rural e-commerce human resources sample, and the calculation formula is as follows:

$$p_i=\frac{S_i}{S} \tag{2}$$

Among them, S_i is the number of i-th classification sample of rural e-commerce data, and S is the total number of rural e-commerce human resource data collected.

According to the expected data of rural e-commerce human resource data sample classification, calculate the attribute information entropy of the data sample:

$$E(A)=\sum_{i=1}^{v}\frac{S_{ij}+\cdots\cdots+S_{mj}}{S}I(S_{ij},.....S_{mj}) \tag{3}$$

among them:

$$I(S_{ij},.....S_{mj})=\sum_{i=1}^{m} p_{ij}\log(P_{ij}) \tag{4}$$

In the above formula, $E(A)$ represents the information entropy that divides the rural e-commerce human resource data according to related attributes, A represents an attribute of the rural e-commerce information human resource data sample, and v represents the classification value.

The calculation formula of attribute gain of rural e-commerce human resource data is as follows:

$$Gain(A)=I(S_1,\cdots\cdots S_m)-E(A) \tag{5}$$

According to the attribute gain of rural e-commerce human resource data, complete the classification calculation of human resource data attributes:

$$SplitInfo(S,A)=\sum_{i=1}^{e}\frac{|S_i|}{S}\log\frac{|S_i|}{S} \tag{6}$$

According to the calculation principle of big data, the gain ratio of attribute information of rural e-commerce human resource data is obtained as follows:

$$GainRatio(S,A)=\frac{Gain(S,A)}{SplitInfo(S,A)} \tag{7}$$

2.2 Human resource allocation

In view of the complexity of the rural e-commerce human resource structure, in the process of human resource allocation, the rural e-commerce human resources are divided into m roles, and the number of human resources in each role is r_i. In the rural e-commerce operation process, there are n tasks to be

completed, and the total time to complete all tasks is μ days. If a task j is completed by role i, the total workload of role i is N_{ij}, while the human resources of actual role i on task j is R_{ij}. At this time, the work capacity index of task i is M_{ij}.

Based on the above analysis, this paper makes assumptions on the allocation of rural e-commerce human resources:

(1) The same type of human resource role has the same work ability index for the same task;

(2) For the same type of rural e-commerce tasks, the amount of human resource role input is positively correlated with their work ability index;

(3) Human resources performing different tasks have a certain effective cumulative rate.

The higher the cumulative workload of the role, the more reasonable the allocation of rural e-commerce human resources. The calculation formula of the proportion between role workload and human resource owned value is as follows:

$$\frac{\sum_{j=1}^{n} R_{ij}}{x_i \mu_i}, i = 1, 2, \ldots m \tag{8}$$

The constraints of rural e-commerce human resource allocation are as follows:

(1) During working time μ_t, the sum of human resources invested in all work task items is less than the value of human resources:

$$\sum_{j=1}^{n} R_{ij} \le r_i \mu_t, i = 1, 2, \ldots, m \tag{9}$$

(2) During working hours μ_t, the amount of human resources involved in the same task should be greater than the amount of human resources required for the task:

$$\sum_{j=1}^{n} \frac{R_{ij}}{N_{ij}} \ge 1, i = 1, 2, \ldots, n \tag{10}$$

(3) Prioritize efficiency as the principle of optimizing human resources. According to the work capability index of different roles, assign tasks with the largest work capability index within the scope. Assuming that the sum of the product of the effective cumulative value of the rural e-commerce merchant's human resources and the role work ability index is F, the calculation formula is:

$$F = \sum_{i=1}^{m} \frac{\sum_{j=1}^{n} R_{ij} M_{ij}}{x_i \mu_t} \tag{11}$$

The objective function of rural e-commerce human resource allocation is set as follows:

$$Z = \max \sum_{i=1}^{m} \frac{\sum_{j=1}^{n} R_{ij} M_{ij}}{x_i \mu_t} \tag{12}$$

From the above objective function, we can see that the larger the value of μ_t and the optimal allocation result of rural e-commerce human resources, the greater the value of Z, the shorter the time required to complete the task, the more reasonable the result of rural e-commerce human resource allocation, and the greater the value of $\sum_{j=1}^{n} R_{ij} M_{ij}$, the greater the value of Z, which means the higher the work efficiency of the role, and also improve the rationality of rural e-commerce human resource allocation.

Through the above optimization calculation, the allocation of rural e-commerce human resources is completed, the work efficiency of the role is improved, and the working time is shortened.

3. Experimental Verification

In order to verify the effectiveness of the proposed human resource allocation method based on big data, a comparative simulation experiment is carried out. In order to improve the effectiveness of the experimental results, the parameters used in the experiment are strictly defined. The experimental parameters are shown in Table 1.

Table 1 Experimental parameters

Project	Parameter
Database	MySQL
Operating system	Windows 7
Software	Myeclipse 8.6
Memory	4 GB
Hard disk	250 GB

According to the above experimental parameters, the overall experimental scheme is set as follows: Taking the accuracy of human resource data mining and the rationality of human resource allocation as the experimental comparison indexes, the proposed method is compared with the methods in reference [6] and reference [7].

3.1 Accuracy of human resource data mining

The amount of rural e-commerce human resource data is very large, which can accurately mine human resources and has a key impact on the results of human resource allocation. Therefore, taking the accuracy of human resource data mining as the experimental comparison index, the proposed method is compared with the two traditional methods. The accuracy comparison results of the three methods are shown in Figure 4.

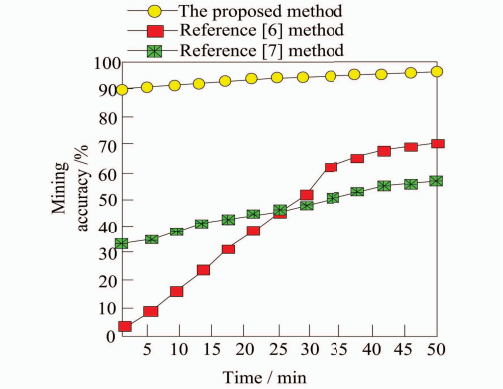

Fig. 4 Comparison of excavation accuracy

According to the comparison results of mining accuracy in Figure 4, with the change of mining time, the mining accuracy of the proposed method is always higher than that of the two traditional comparison methods, and the mining accuracy of the proposed method is always above 90%, while the highest mining accuracy of the two literature comparison methods is up to 80%. Therefore, it fully shows that the proposed method has high accuracy in data mining of rural e-commerce human resources.

3.2 Rationality of human resource allocation

The rationality of human resource allocation directly reflects the effectiveness of rural e-commerce human resource allocation. The comparison results of Human Resource Allocation Rationality of three methods are shown in Figure 5.

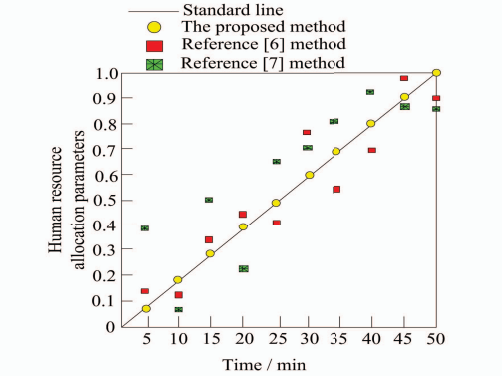

Fig. 5 Comparison of rationality of human resource allocation

By analyzing the rationality of human resource allocation in Figure 5, the results show that the configuration parameters of the proposed method always conform to the standard value of human resource allocation, while the human resource allocation parameters of reference [6] and reference [7] do not conform to the standard value of human resource allocation, so it shows that the proposed method has high rationality of human resource allocation.

4. Conclusion

In order to improve the rationality of human resource allocation as the research goal, this paper proposes a human resource allocation method based on big data. The performance of the method is verified from both theoretical and experimental aspects. The method has higher accuracy and rationality of human resource data mining in human resource allocation. Specifically, compared with the method based on multi-stage genetic algorithm, the accuracy of human resource data mining of the proposed method is greatly improved, up to 96%; compared with the method based on ant colony algorithm, the rationality of human resource allocation of the proposed method is significantly improved, which is basically consistent with the standard value. Therefore, the proposed allocation method based on big data can better meet the requirements of human resource allocation.

Acknowledgements

Basic Scientific Research Operating Funds for Universities of Heilongjiang Province (Scientific Research Projects) in 2020Project No : 2020-KYYWF-E005

References

[1] Wang Qinggang, Zhang Lin, Zhang Jian. Design and implement of agricultural e-commerce system based on mobile Internet[J]. Journal of Computer Applications, 2016, 36(1):286-290.

[2] Wang Jing, Wang Bo, Sun Xueying. Human Resource Management Risk Warning Model Based on GRU Neural Network[J]. Computer and Digital Engineering, 2020, 48(7):1727-1730.

[3] Lin Honghua. Design and Implementation of Rural E-commerce Operation System[J]. Microcomputer Applications, 2019, 35(5):71-73.

[4] Sui Xinyu, Wang Yunqing. Research on data distribution technology of e?commerce based on block chains[J]. Electronic Design Engineering, 2020, 28(7):69-73.

[5] Lv Yixia. Design of human resource optimal structure model based on data mining[J]. Modern Electronics Technique, 2017, 40(24):51-53+56.

[6] Yuan Fangjie, Zhang Jiaping. Human resource management based on a multi-stage genetic algorithm[J]. Journal of Yunnan University of Nationalities(Natural Sciences Edition), 2016, 25(3):275-279.

[7] Wang Xian, Tai Yuhong, Zhang Fei, et al. Research on Human Resource Scheduling Optimization Based on Ant Colony Optimization[J]. Logistics Engineering and Management, 2016, 38(9):77-80.

[8] Zhang Yu. Human resource information management system based on collaborative filtering algorithm[J]. Electronic Design Engineering, 2017, 25(3):23-27.

[9] Zhu Zhengyue, Chen Zengqiang. Modeling of intelligent E-commerce logistics service system based on object-oriented time petri nets[J]. CAAI Transactions on Intelligent Systems, 2018, 13(2):149-159.

[10] Zhou Jingchun. Design and implementation of e-commerce payment system based on SSL protocol[J]. Modern Electronics Technique, 2017, 40(2):167-170.

[11] Hu Wei, Wang Lihua. Design and Implementation of E-Commerce Safety Module Based on Added Salt BCrypt Algorithm[J]. Computer Systems & Applications, 2019, 28(10):82-87.

[12] Wang Ying, Raun Mengli. Risk Estimation Simulation of Excess Trading Transactions Based on Big Data[J]. Computer Simulation, 2018, 35(3):369-372+388.

[13] Lin Honghu. Design and Implementation of Rural E-commerce Operation System[J]. Microcomputer Applications, 2019, 35(5):71-73.

[14] Wang Ding. Research on the Influencing Factors of Rural E-commerce Development Based on Logistic Model[J]. Liaoning Agricultural Sciences, 2018, 34(6):46-49.