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Application of an Improved Clustering Algorithm of Neural Networks in Performance Appraisal Systems

Yun Yi, Zibo Vocational Institute, China*

ABSTRACT

With the development of economic globalization, human resource competition has long become the key core of enterprise development and peer competition. Reasonably formulating an enterprise's employee performance appraisal management system and conducting standardized, fair, and just appraisal management are the basic requirements for the survival and development of an enterprise. This paper studies the application of an improved clustering algorithm based on neural network in an employee performance appraisal management system and explores its application value in the employee performance appraisal management system by using the improved ART2 clustering method that draws on leakage competition and Hebb rules. The experimental results of this paper show that the satisfaction of this system in the four aspects of integrated data management, system stability and convenience, and transparency in performance appraisal are all above 66%. This shows that this system has superior performance and good reference value.

KEYWORDS

Adaptive Resonance Neural Network, Improved ART2 Clustering Method, Performance Appraisal Management System, Self-Organizing Feature Map Neural Network

INTRODUCTION

Through relevant background investigations, companies spend a lot of human and material resources on performance appraisals, but their execution results often are not as good as expected, and many problems in the corporate performance appraisal system have been exposed during the execution. For example, many enterprise managers simply think that performance management is performance appraisal, which results in performance appraisal often being used to "settle the accounts after autumn" in actual work. In addition, the relationship between performance appraisal and employee returns is not strong, which directly affects the enthusiasm of employees at work due to salary differences. Therefore, the application research of the employee performance appraisal management system is the need of the current society. In recent years, employee performance appraisal has attracted the attention of many scholars. The management by objectives method, the key performance indicator method, and the 360-degree performance evaluation method are the most studied evaluation methods in recent years. The comparison table of the three assessment methods is shown in Table 1.

Since the 1990s, the world economy has undergone significant changes, and people have begun to enter the era of the knowledge economy supported by computer technology. Human resources (HR), represented by knowledge workers, has become the object of competition among many high-tech

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Table 1. Comparison of assessment methods

Serial number	Assessment method	Features
1	Management by objectives	Goal-led
2	Key performance indicator method	Divide the goal into sub-goals
3	360-degree performance appraisal method	Multi-view, multi-dimensional, all-round, heavy workload

companies. Corporate management focuses on conducting comprehensive performance appraisals and managing human resources. Therefore, for companies in various countries, it has become an urgent task for many companies to establish a comprehensive employee performance appraisal management system suitable for themselves and to provide a basis for corporate human resource strategic decisions.

Many experts and scholars are mainly concerned with the research on corporate performance appraisals. However, the research done in this area is relatively hollow and only talks about the factors that affect the management of human resources assessment from some aspects. It discusses the methods of the assessment process, focusing on the application of efficient assessment methods in the assessment process to make the assessment fairer and more reasonable. However, there is a lack of corresponding technical support, and most of them do not realize the application of the entire system with the help of science and technology but only provide assessment methods. Therefore, in this paper, the application of an improved clustering algorithm based on neural networks in an employee performance appraisal management system provides a reference for future related research on employee appraisal management systems and provides a reference for enterprises. This article is divided into six sections, first introducing the research background and significance of the thesis; then summarizing the research status of the cluster analysis applications; expounding on the theories involved in this research, including human resources, neural networks, clustering methods; and presenting the realization of the employee performance appraisal management system, followed by a summary of the research content and discussion of the advantages of the system.

RELATED WORK

Cluster analysis is widely used in various disciplines, such as pattern recognition, image processing, machine learning, and statistics. With the rapid development of neural networks, their applications are becoming increasingly widespread. Hao (2019) proposed a new type of wind power forecasting model based on a new expansion and erosion (DE) clustering algorithm. Taking the Yilan Wind Farm in Northeast China as an example, studies have shown that, in terms of wind power forecasting, the new generalized regression neural network (GRNN) prediction model based on the proposed DE clustering algorithm (DE clustering GRNN) outperforms the DP*k*-medoids clustering-GRNN, *k*-means clustering-GRNN and AM-GRNN (Hao et al., 2019). There is no clear warning for the occurrence of an earthquake, and earthquake magnitude prediction is still extremely challenging. Therefore, Yuan proposed an earthquake prediction model based on global seismic data clustering. First, he proposed an improved *k*-means clustering algorithm. Due to the limitations of traditional *k*-means clustering, an earthquake prediction model combined with the clustering results of artificial neural networks was subsequently proposed. He applied the improved clustering algorithm to the U.S. Geological Survey's 1900–2019 Global Earthquake Catalog, and the survey showed that it has better clustering accuracy than the traditional *k*-means algorithm. His research is also effective for earthquake risk analysis in local areas (Yuan, 2021).

With the continuous development of the economy, investment fund projects have become increasingly popular, and forecasting and performance continuity have become hot topics in the financial field. The forecast of fund performance cannot only help investors avoid risks and increase

returns but also help managers learn unknown information from the forecast, to better guide the market and manage the market in an orderly manner. In this regard, Gu (2021) summarized a new PSO-RBF neural network security fund performance prediction method. The prediction results show that the new PSO-RBF has better predictability in fund performance prediction, and its accuracy rate has been greatly improved. At the same time, with the development of social technology, online shopping has become the most popular way of shopping. In this environment, the concept of consumption has gradually changed to be customer-oriented, so customer satisfaction is particularly important. Yang and Ma (2017) proposed an evaluation model based on a BP neural network (Back-propagation neural network). The results show that the BP neural network method has a very good improvement effect on customer satisfaction under the B2C business model.

Enterprise credit risk assessment has also been a hot topic of research by scholars in recent years. Huang (2018) determined the optimal parameters of each network model suitable for risk assessment of Chinese small and medium-sized enterprises through the comparison of several commonly used neural network models. Experimental results show that the probabilistic neural network (PNN) model has the highest AUC value and is robust, and the PNN has the lowest error rate and the second type of error. Hosaka (2019) tried to apply convolutional neural networks to the prediction of corporate bankruptcy. He also used the financial statements (balance sheet and income statement) of 102 companies that were delisted from the Japanese stock market due to bankruptcy and the four quarterly financial statements of 2,062 currently listed companies. He used a total of 7,520 images of bankrupt companies and continuing companies as training for the convolutional neural network based on GoogLeNet. The results show that compared with methods such as linear discriminant analysis and support vector machines, the bankruptcy prediction performed by the trained network has higher performance. In summary, after recent years of exploration, neural networks have been applied to various fields, including earthquake prediction and e-commerce companies. However, there is not much research on the employee performance appraisal management system, and more in-depth exploration is needed.

RESEARCH CONCEPT OF THE EMPLOYEE PERFORMANCE APPRAISAL MANAGEMENT SYSTEM

Human Resources

Human resource assessment refers to the comprehensive use of qualitative and quantitative assessment methods for all employees in the company and the assessment and classification of employees based on their usual performance and contribution to the company, which is an important part of human resource management (Lukovac et al., 2017; Mauro et al., 2017). An example diagram of human resource management is shown in Figure 1. At present, most companies have their own employee performance appraisal system. Performance appraisals can be simply divided into annual appraisals and monthly appraisals. The assessment method is mainly based on the goal assessment method, supplemented by the scale method and the job description method. The assessment content is mainly based on performance and supplemented by ability. The assessment results are mainly used for bonus distribution and staff salary adjustment. The performance appraisal is only one link in the performance management process. Performance management not only includes the development of plans and the completion of the assessment, but it runs through the entire enterprise management process (Galagedera et al., 2018). The goal of performance management is to improve the company's future performance. The performance appraisal is only a summary and evaluation of the performance of the past stage. Therefore, performance management pays more attention to learning from each other's strengths after appraisal and management, combining with the actual situation to give each employee scientific and reasonable feedback, so that they can clarify the direction of their efforts in the future work and maximize the potential for the development of the enterprise. An example diagram of performance management is shown in Figure 2.

Figure 1. Example diagram of human resource management

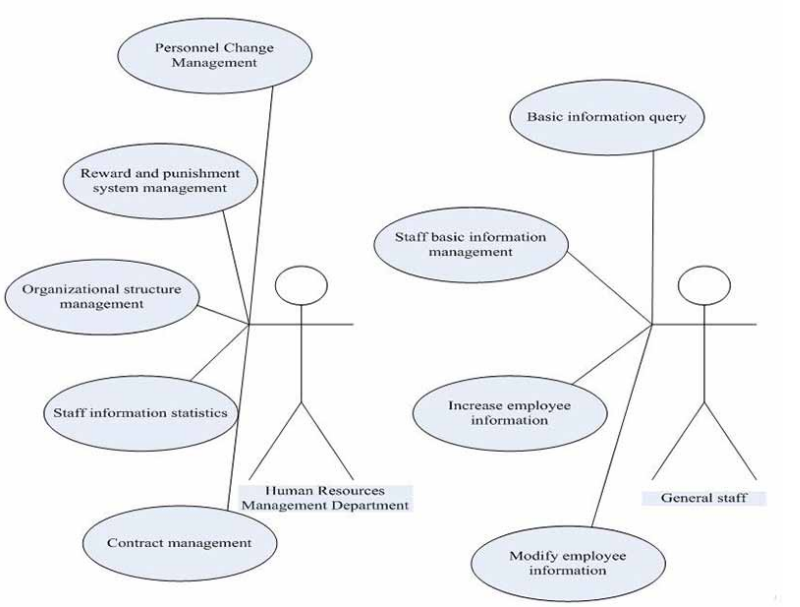
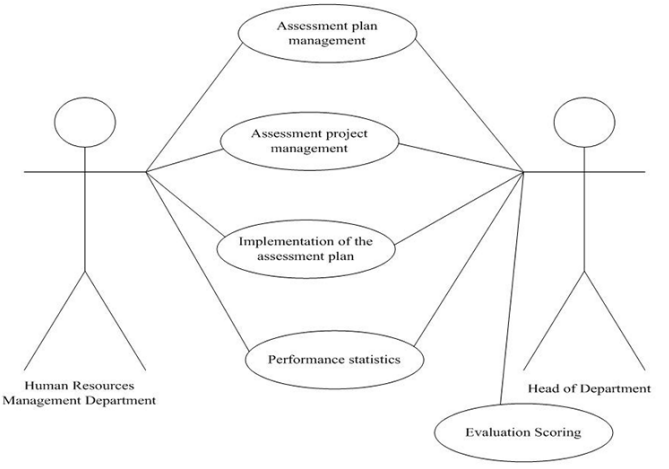


Figure 2. Example diagram of performance management



Neural Network

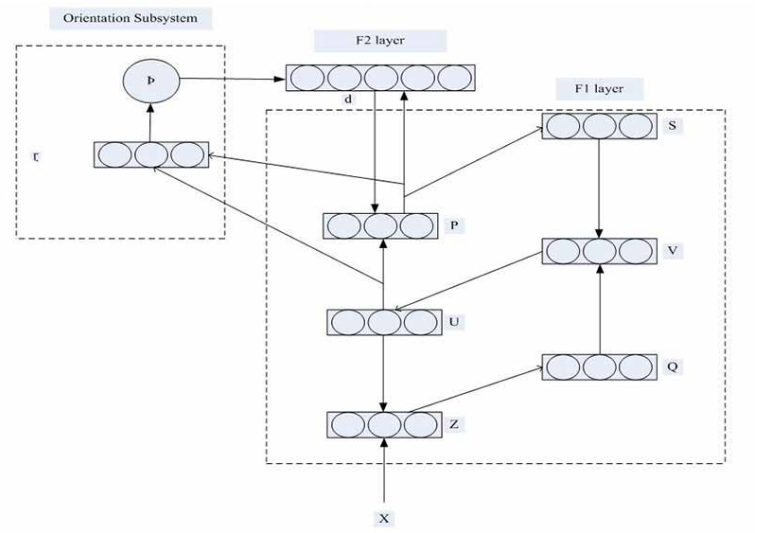
A neural network is made up of multiple connected neurons and relies on the dynamics of the network to external information to achieve the purpose of processing information. It has the characteristics of adaptive signal processing, adaptive equalization, and self-organizing learning ability, and it can classify real data, thus showing great advantages (Chen et al., 2017; Goh & Anthony, 2017). The neural network is one of the important methods in classification technology. As a discipline, it involves linear algebra, stochastic process, set theory, and self-organization theory (He et al., 2019; Ganin et al., 2017). Not only do neural networks have powerful learning capabilities, able to adapt to

various changes in data quickly, but they also can handle complex data relationships. Because neural networks are inspired by the human brain, they all have the characteristics of intelligence. Through the simulation of the learning method, working mechanism, and physical connection structure of the human brain, it is more adaptable to the era of increasing data processing requirements.

Improved Data Clustering Method Based on Adaptive Resonance Neural Network

An adaptive resonance (ART) neural network is a neural network model that simulates the human brain (Gong et al., 2017; Alanis & Alma, 2018). The neural network can learn independently through the theoretical structure of adaptive resonance feedback, recognize any input pattern, and achieve a balanced state, and it has efficient learning abilities (Zhao & Nan, 2017). ATR2 is the main model of the classic adaptive resonance neural network, which can handle any simulation vector. The basic ART2 structure is shown in Figure 3.

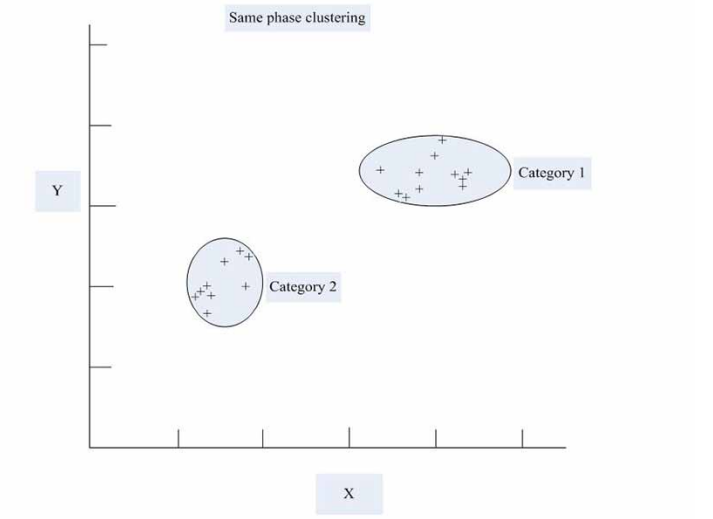
Figure 3. Basic structure diagram of ART2



The adaptive resonant neural network has its shortcomings in the data clustering environment. One is that the neural network setting alert parameters is mostly based on subjective experience and cannot be evenly distributed (Fang & Sun, 2017). The second is that the essence of the network is a one-dimensional structure, which cannot be output to a multilevel structure. The second is that this network is different from Kohonen's self-organizing feature map (SOFM) neural network and has no self-organizing characteristics. Another point is that when the ATR model receives network information, it usually only pays attention to the information of the winning neuron. Not only that, the model only applies to amplitudes that have nothing to do with category characteristics, as shown in Figure 4. The last point is that, according to physiology, V, J^+, and J^- can be approximated by a formula, shown in Equation 1.

$$V = \frac{J^+}{A + D \times J^-} \tag{1}$$

Figure 4. Phase clustering



where:

A represents a positive real number much less than 1.
D represents a positive real number close to 1.
V represents the output of the neuron.
J $^{+}$ represents the sum of all excitatory excitations of neurons.
J $^{-}$ represents the sum of all inhibitory excitations of neurons.

Improved ART2 Data Clustering Method 1

Aiming to address some of the shortcomings of the mentioned ART2 in the clustering operation, the improved ART2 data clustering method can realize the localization of modulus, sensitivity, and warning parameters. Its neural network model is similar to the basic structure of ART2, as shown in Figure 4. According to the neural network structure, the purpose of the network clustering algorithm is to input the vector in each category to the corresponding neural network, as shown in Equations 2–7.

$$\left| \sqrt{\sum_{i=1}^{N} (X(i) - M_j(i))^2} - \frac{\sum_{k=1}^{n_i} \sqrt{\sum_{i=1}^{N} (X_{kj}(i) - M_j(i))^2}}{n_j} \right| \leq \delta_j \tag{2}$$

where:

N represents the spatial dimension.
X_{kj} represents the *k*th input vector of the *j*th category.
n_j represents the number of input vectors in the *j* category.
δ_j indicates the width parameter of the j category.

$$w'_{ji}(k+1) = w'_{ji}(k) + d \times (1-d) \times \left(\frac{u_j(k)}{(1-d)} - w'_{ji}(k)\right), j = 1,2,\ldots,N \tag{3}$$

$$w_{ji}(k+1) = w_{ji}(k) + d \times (1-d) \times (\frac{u_j(k)}{(1-d)} - w_{ji}(k)), j = 1,2,...,N \quad (4)$$

where:

N represents the number of input neurons in the $F1$ layer.
i indicates the number of the winning neuron.
d represents the constant of proportionality that the $F1$ layer transmits the top-down vector to the $F2$ layer.
w_{jr} represents the *j*th bottom-up component of the *j*th winning neuron.
w'_{ji} Represents the *j*th top-down component of the *j*th winning neuron.
$u_j(k)$ Indicates that it is the *j* component of the vector *u* at the time *k*.

$$M_j(K+1) = \frac{(n_j \times M_j(k) + X)}{n_j + 1} \quad (5)$$

where:
M_j represents the category vector of category *j* represents the current input vector

$$\rho_j(K+1) = \rho_j(k) + \Delta_j(n_j) \quad (6)$$

$$\delta_j(K+1) = \delta_j(k) - \Lambda_j(n_j) \quad (7)$$

where:
ρ_j indicates the category *j* warning parameters.
Λ_j and Δ_j indicate that the number of vectors n_j contained in the category grows in the same direction.

Improved ART2 Data Clustering Method 2

The neural network model structure is basically the same as the classic ART2. First, introduce the symbol description in the algorithm: set the alert parameter to *vig* and the lower limit of the alert parameter to $vig_{\min}$; set the original neural network input vector set to $X(0)$, the k_{th} iteration neural network input vector set to $X(k)$, k is the number of iterations, and the initial value is 0. The specific algorithm is as follows:

1. Set a higher initial value of the warning parameter, generally set closer to 1.
2. Based on the judgment of the neuron modulus value, the positions of the $F2$ layer neurons are rearranged according to the modulus value from small to large or from large to small.
3. The number of *if* clusters, the predefined number of $\cdot\rangle$, or the lower limit of the warning parameter $\cdot\rangle$, as shown in Equations 8–12.

$$vig = vig - delta1 \quad (8)$$

$$\theta = \theta - delta2 \tag{9}$$

where:
*delta*1 indicates the decrement value of the alert parameter each time
*delta*2 represents the decrement value of the threshold of the nonlinear function each time

$$\begin{cases} p_j = u_j + d \times w'_{jI} \\ z_j = x_j + a \times u_j \end{cases}, j = 0,1,...,(N-1) \tag{10}$$

$$P_j = \frac{n_j \times num1 + d \times w'_{ji} \times num2}{num1 + num2},\ j = 0,1,\ldots\ldots(N-1) \tag{11}$$

$$z_j = \frac{x_j \times num1 + d \times u_j \times num2}{num1 + num2}, j = 0,1,...,(N-1) \tag{12}$$

where:
i indicates the winning neuron.
u represents the vector generated by the joint action of two positive feedbacks in the input layer.
*num*1 indicates that the top-down vector of the winning neuron has been fused with the number of original input vectors.
*num*2 represents the number of original input vectors fused by the input vector.
N represents= the number of neurons in the input layer.

Improved Data Clustering Method Based on Self-Organizing Feature Map Neural Network

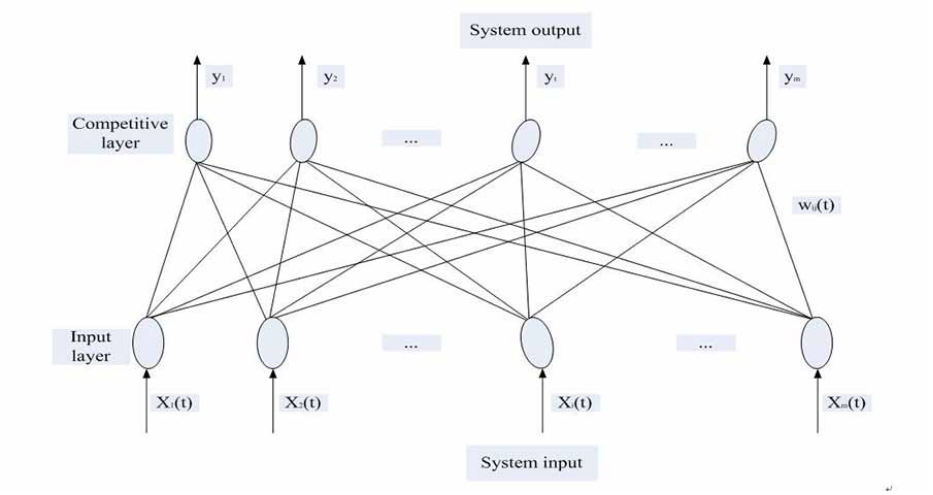
The self-organizing feature map neural network is composed of an input layer and a competition layer. The competition layer is composed of a one-dimensional or two-dimensional array of neurons. The input layer and the competition layer are fully connected (Chen et al., 2017; Perna & Rocca, 2017). The basic one-dimensional self-organizing feature map neural network structure is shown in Figure 5. The basic algorithm is shown in Equations 13–14.

$$\left|W_k - X\right| \le \left|W_j - X\right|, j = 1,2,...,m \tag{13}$$

where:
k indicates the number of the winning neuron.
m represents the number of input vectors in the sample set.

$$W_j(n+1) = \begin{cases} W_j(n) + \eta(X - W_j(n)), j \in \Phi \\ W_j(n) \end{cases} \tag{14}$$

Figure 5. The structure diagram of a one-dimensional self-organizing feature map neural network



where:
η indicates the initial learning rate.
Φ represents the initialization neighborhood.

The classical self-organizing feature map neural network used for clustering has some shortcomings, which are mainly reflected in three aspects. First, the network capacity of the self-organizing feature map (SOFM) neural network is limited. Second, the classical self-organizing feature map neural network cannot produce a network output with a hierarchical structure. Third, the classical SOFM neural network needs to repeatedly input the sample set vector to train the neural network until the feature mapping result at the output of the neural network is stable (Schirrmeister et al., 2017; Zhang et al., 2017).

Improved ART2 Clustering Method (IACLH) Based on Leakage Competition and Hebb Rule

This network model is aimed at the deficiencies of adaptive resonant neural networks and self-organizing map neural networks and draws on the ideas of Hebb and leakage competition, a new neural network model for clustering operation. Its neural network model structure is basically the same as that of classic ART2, as shown in Figure 3. It allows not only for multiple neurons to win and produce output but also for the multiple winning neurons to modify their characteristic connection weights. At the same time, satisfying the learning rules of these two aspects is the leakage competition learning rule. Similar to the Hebb rule is that when the two output layer neurons are more similar, the connection weight between the two should be strengthened (Liu et al., 2017; Yang et al., 2017). The network clustering algorithm is divided into two stages. The first stage is mainly to realize the operation between Layer A and Layer B. The second stage is to map several closely related neurons to a neuron in Layer D according to the degree of correlation between the neurons in Layer C, as shown in Equations 15–20.

$$w_{ji}(k+1) = w_{ji}(k) + d \times (1-d) \times \left(\frac{u_j(k)}{(1-d)} - w_{ji}(k) \right), j = 1,2,\ldots,N, i \in M \tag{15}$$

$$w'_{ji}(k+1) = w'_{ji}(k) + d \times (1-d) \times \left(\frac{u_j(k)}{(1-d)} - w'_{ji}(k) \right), j = 1,2,...,N, i \in M \tag{16}$$

$$w_{ji}(k+1) = w_{ji}(k) + \frac{\theta_i}{\theta_{\max}} \times d(1-d) \times \left(\frac{u_j(k)}{(1-d)} - w_{ji}(k) \right), j = 1,2,...,N, i \in M \tag{17}$$

$$w'_{ji}(k+1) = w'_{ji}(k) + \frac{\theta_i}{\theta_{\max}} \times d(1-d) \times \left(\frac{u_j(k)}{(1-d)} - w'_{ji}(k) \right), j = 1,2,...,N, i \in M \tag{18}$$

where:
N represents the number of input neurons in layer $F1$.
M represents the set of all $F2$-layer neurons that have won the leakage competition.
θ_i represents the degree of similarity between the neuron numbered i in the set M and the input vector.
$\theta_{\max}$ is the similarity degree of the neuron in the set M that is most similar to the input vector.
u_j is the j component of U.
w_{ji} is the jth bottom-up component of the ith winning neuron in LTM(Local Maintenance Terminal).

$$MF_{ij}(k+1) = MF_{ji}(k+1) = MF_{ji}(k) + d2, i \in M, j \in M \tag{19}$$

$$MF_{ij}(k+1) = MF_{ji}(k+1) = MF_{ji}(k) + h\left(\frac{\theta_i}{\theta_j} \right) \times d2, i \in M, j \in M \tag{20}$$

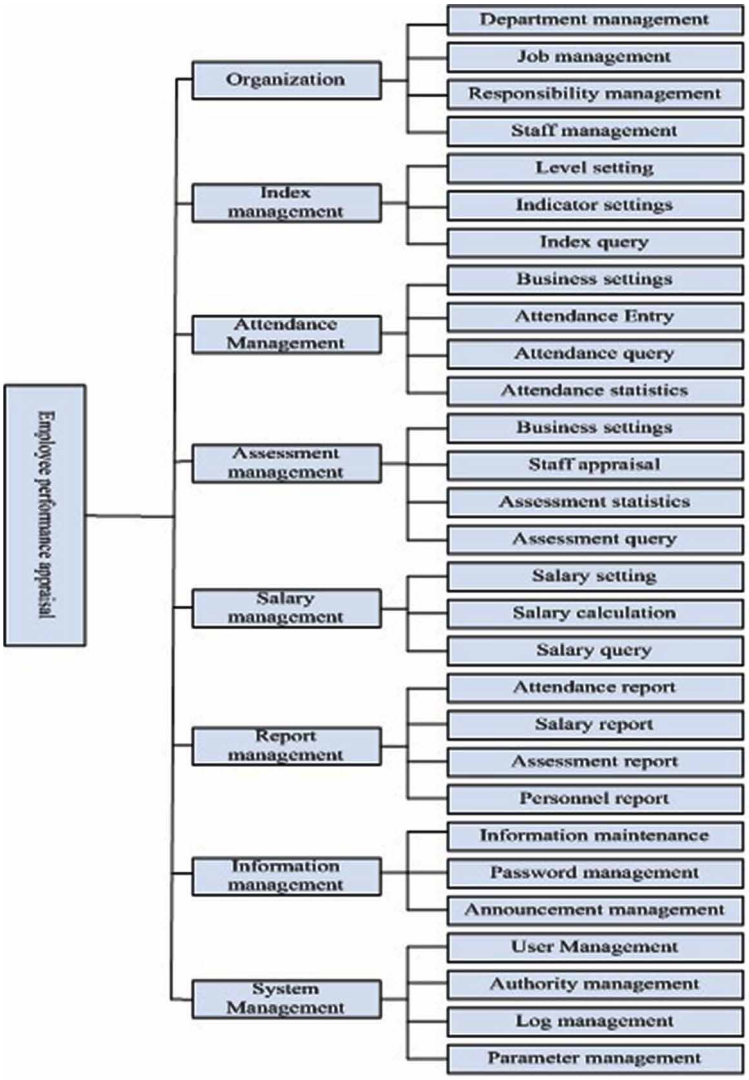
where:
MF represents the $F2$-layer fully connected matrix.
$d2$ represents the correction coefficient of $F2$ fully connected matrix.

Employee Performance Appraisal Management System

With the rapid development of information technology and increasingly fierce commercial competition, enterprises have gradually adopted scientific and modern management in their various transaction processing. Especially for the performance management system of employees, the performance management system adopts certain scientific methods to formulate the corresponding assessment standards. It conducts a fair inspection of the work results of departments or employees within the scope of prescribed practice and assessment. Based on the results of the performance appraisal, the corresponding departments and employees are given corresponding rewards, punishments, and incentives. At the same time, the mistakes in the work are counted and adjusted according to the results of the appraisal, which provides a reference for the formulation of new goals. It further optimizes the allocation of resources and improves the level of corporate management. It is precisely because of this that it is particularly important to design a reasonable and scientific performance management system suitable for each enterprise.

This paper studies the application of the improved ART2 clustering method (IACLH) in the employee performance appraisal system based on the leakage competition and Hebb rule and chooses the employee performance appraisal system of Industrial Company A (China Shenzhen Liou Industrial Co., Ltd.) as the research object. By using the improved ART2 clustering method based on leakage competition and Hebb rules, and according to the business process and functional requirements of Industrial Company A, this paper divides the system into eight functional modules of management, which are: organizational structure management, index management, attendance management, assessment management, salary management, and report forms, information management, and system management functions, as shown in Figure 6.

Figure 6. Functional structure diagram of employee performance appraisal system



For the MySQL database of the performance appraisal system of Industrial Company A, the system uses a view design, which not only improves the efficiency of querying data but also improves the performance of the entity table. All information tables are not listed here, but some are selected for display, as shown in Tables 2–5. These four tables all represent the table structure and view structure of the target system database.

The indicator level information table is used to store the level of the employee performance appraisal indicator system, which needs to be set before the appraisal, as shown in Table 2. Metric information is set according to the metric level. The indicator information table, as the name implies, mainly stores the relevant information of indicators, including the indicator level field, parent indicator ID field, indicator ID field, and indicator name field, as shown in Table 3. The salary information table can store the employee's salary, including job number, skill, salary, and other information, as shown in Table 4. The system menu information table corresponds to the system function module, as shown in Table 5. Finally, according to the analysis of system requirements and the overall design of system functions, UML is used to design and implement the functional modules of the system in detail.

Table 2. Indicator level information table

Serial number	Table field name	Table field description	Type of data	Field length	Allow empty	Primary key
1	sn	System number	char	3		Primary key
2	il	Index level	int	2		
3	rem	Remark	varchar	60	Yes	

Table 3. Index Information Table

Serial number	Table field name	Table field description	Type of data	Field length	Allow empty	Primary key
1	inu	Index number	int	4		Primary key
2	ina	Index name	varchar	70		
3	il	Index level	int	2		Foreign key
4	pin	Parent index number	int	4		
5	iw	Index Weight	float	(4.1)		
6	is	Index score	float	(4.1)		
7	rem	Remark	varchar	60	Yes	

Table 4. Salary information table

Serial number	Table field name	Table field description	Type of data	Field length	Allow empty	Primary key
1	sc	Salary code	char	4		Primary key
2	jn	Job number	char	4		Foreign key
3	wj	Wage jobs	float	(5.1)		
4	sks	Skill salary	float	(5.1)		
5	aus	Auxiliary salary	float	(5.1)		

Table 5. System menu information table

Serial number	Table field name	Table field description	Type of data	Field length	Allow empty	Primary key
1	mi	Menu ID	int	3		Primary key
2	mn	Menu name	varchar	40		
3	ml	Menu link	varchar	70		
4	pmi	Parent menu ID	int	3		

SYSTEM TEST AND APPLICATION

System Test

In this section, we describe testing the system, completing the accuracy test of the system function, and testing the performance and safety of the system. The main purposes of the performance appraisal management system for testing are:

1. Through the design of the system function and database, check whether the system can correctly process the test data and test the scalability of the system.
2. Verify the stability of the system by analyzing the maximum load data volume of the system and the maximum number of people online at the same time.
3. Process the test data of a certain scale through the test system, calculate the throughput and processing time of the system, and verify the efficiency of the system.
4. Check the operation of the system and verify the robustness of the system by running artificially set error test cases.

Test each function point of the system through the system environment test. The verification system can meet the various needs of the enterprise for performance appraisal, including system function and system performance design requirements. The company's internal staff is about 5,000, and individual employees can query the assessment results through the system. The main operators are about 50 people responsible for the daily use and maintenance of the system. The test results show that the main performance of the system has reached the expected requirements, and it can meet the self-service query of the company's employees and the parallel use of the operators. The test operation is in good condition.

System Application

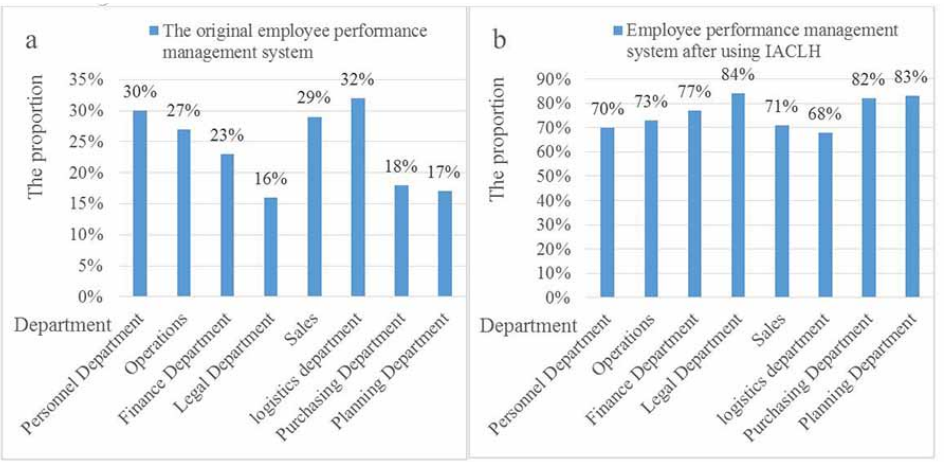
This article provides three days of training for HR specialists, ordinary users, and IT operation users to ensure the normal operation of the system. The training content mainly covers the two aspects of software system application and system operation and maintenance. After two weeks, this article interviewed the application satisfaction of the improved ART2 clustering method (IACLH) in the employee performance appraisal management system based on the leakage competition and the Hebb rule. After comparing the original employee performance management system with the employee performance management system after using IACLH, 2160 people were selected to conduct the interview survey. They are from the personnel department, operation department, finance department, legal department, sales department, logistics department, purchasing department, and planning department (270 people).

Comprehensive Data Management

After the application, not only is the system operation used to replace the traditional manual management method, but more importantly, the overall comprehensive management level has been improved as a whole, and the work process has been reengineered and optimized accordingly. Figure 7 presents the comparative survey results of comprehensive data management found that after the implementation of the system and after the use of IACH, all departments indicated that the comprehensive data management had achieved significant results, with the number of people reaching more than 68%. Among them, the legal affairs department, purchasing department, and planning department have more than 80%. The system not only realizes the performance display of individuals, departments, and companies but also realizes the automatic processing of the assessment of grassroots employees and management personnel. It provides the functions of querying, printing, and exporting the assessment data, and it realizes the display of the relevant assessment indicators of the management department.

Note: Panel A: investigation results of the original employee performance management system. Panel B: The survey results of the employee performance management system after using IACLH.

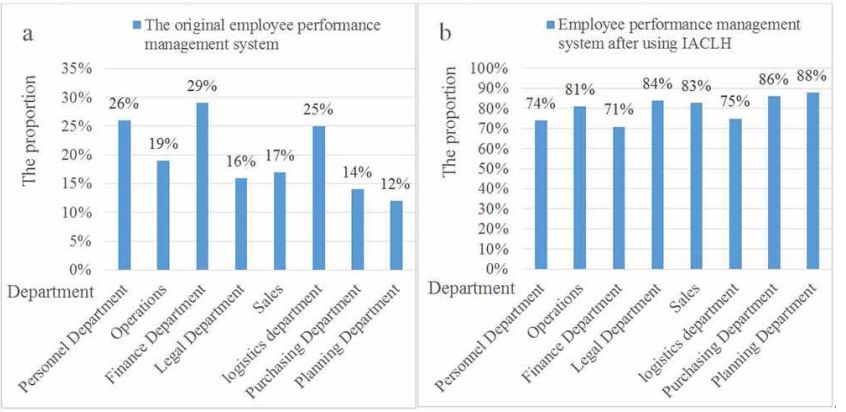
Figure 7. Data integrated management survey results



The Stability of the System

The high stability of the system can guarantee 7×24 hours of continuous work, reducing the possibility of crashes. The comparative investigation result of the stability of the system is shown in Figure 8. The enterprise performance appraisal management system adopts a strict safety guarantee mechanism. Because the company has a very high level of data security requirements for the information system, this system is designed to fully integrate the company's information security requirements to ensure the system's information security at all levels, from architecture to data and from system management to system guarantee. In addition, the system also has good stability. Through the comparative survey results of the two systems, it is found that the stability satisfaction of the employee performance management system after using IACLH is above 70%.

Figure 8. System stability comparison survey results



Transparent Performance Appraisal

Before implementing the performance system, the company's original corporate performance evaluation system had many shortcomings, which was not conducive to fully mobilizing the enthusiasm of all types of personnel and could not reflect the fairness of salary increases and transfers. For example, the assessment of all employees is determined by the person in charge of the department; the subjective factors are too large. There is the possibility of favoritism and fraud. The results of the transparent performance appraisal survey are shown in Figure 9.

Various departments of Industrial Company A believe that the assessment process in the original employee performance management system is not transparent, and it is impossible to form a communication system between the assessor and the assessed. The perspective of the assessment is too single, and it is impossible to evaluate the assessed personnel in multiple dimensions. The inability to provide objective assessment certificates during the assessment process causes unnecessary suspicion of the assessed person and creates a discordant atmosphere in the company, and so on. The employee performance management system after using IACLH is applied, as shown in Figure 9. More than 66% of employees in all departments believe that it has not only achieved fair, accurate, and timely KPI performance appraisal results. It also realizes the complete management functions

Figure 9. Results of the transparent performance appraisal survey

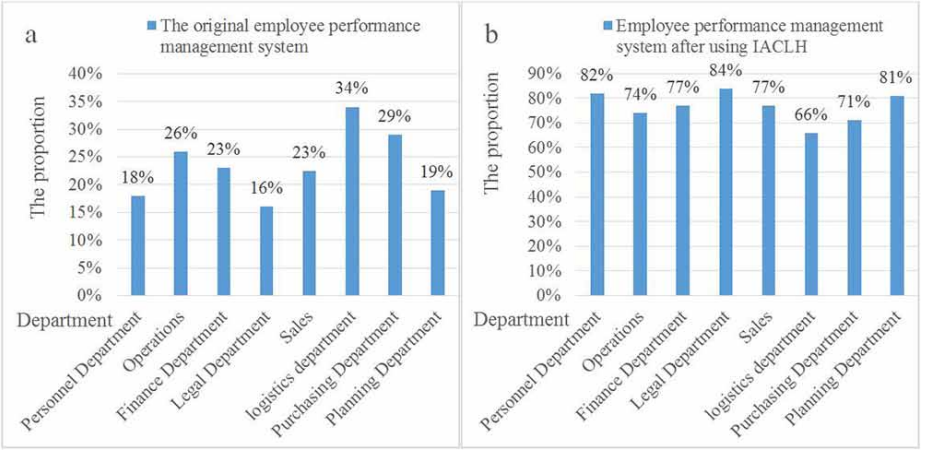
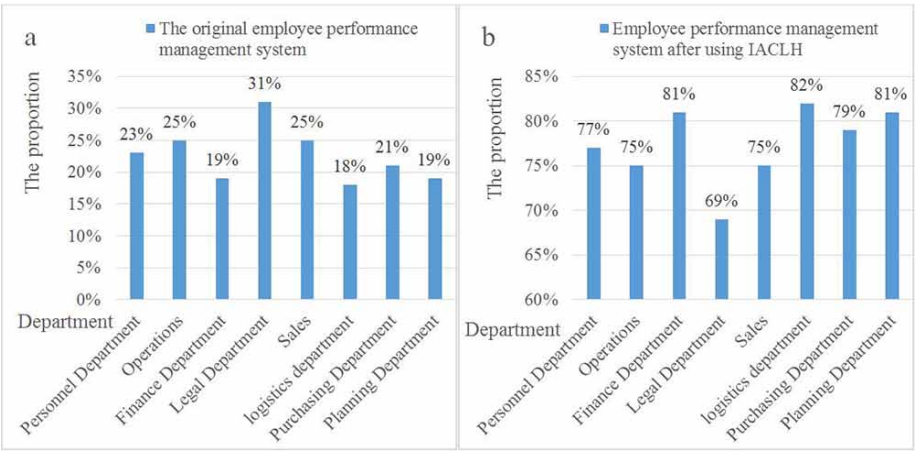


Figure 10. The convenience survey results of the system



of various stages and aspects such as appraisal index allocation, performance record, performance evaluation, performance query, performance adjustment, statistics, and other aspects of the department and individual work performance.

Note: Panel A: Investigation results of the original employee performance management system. Panel B: Survey results of the employee performance management system after using IACLH.

Note: Panel A: Investigation results of the original employee performance management system. Panel B: Survey results of the employee performance management system after using IACLH.

Convenience of the System

The convenience of the system usually refers to the ease of operation and whether the interface is clear and easy to understand. This paper investigates the convenience of the system, and the results are shown in Figure 10. The system interface conforms to the user's daily usage habits, performance management is clear, the operation is convenient, and the interface is friendly. Especially prominent is that the data is clearly organized and easy to query. During the operation of the system, the expected goals were also achieved:

1. The tasks of the company and various departments can be tracked and monitored in the system to monitor the progress of the implementation.
2. The company's annual work can be broken down into various departments, offices, and even individuals.
3. Through the establishment of the KPI system, some of the company's assessment indicators can be quantified and decomposed.
4. Users are very satisfied with the company's performance appraisal system; the satisfaction of each department is 77%, as shown in Figure 10B.

The effective implementation of the system for managers can dynamically monitor the execution of each key task in real time. For example, if the company's management wants to view the progress and status of the execution of each key task of its subordinates, they can enter the supervisor's self-service module.

Note: Panel A: Investigation results of the original employee performance management system. Panel B: Survey results of the employee performance management system after using IACLH.

DISCUSSION

This paper divides the employee performance appraisal management system of Industrial Company A into eight functional modules such as attendance management and appraisal management by using the clustering method proposed in this paper and applies the designed module to the database of the system. Finally, according to the requirements of the system, UML is used to complete the realization of the system function modules. This paper conducts practical research on the application of the improved ART2 clustering method (IACLH) based on leakage competition and the Hebb rule in employee performance appraisal management system through interview investigation. From the data analysis results, the four aspects of the data show that the results are relatively good. In terms of the system, through the test, the performance of the system has reached the expectations of Industrial Company A, with convenient operation, clear functional modules, and excellent stability. In terms of performance appraisal, the original performance management system is not only opaque in the appraisal process, but also all department employees use the same indicators. The assessment is too partial, focusing too much on performance and ignoring the value of employees and the overall development of employees. The system not only optimizes the management of performance appraisal indicators: Performance appraisal is no longer an indicator but is composed of multiple indicators and assigns different weights and proportions. It can be modified when evaluating different departments so that employee work can be better reflected. The stability of the system in terms of comprehensive data management, design, and use of views on the system database. It not only better protects the performance appraisal information in the enterprise and the information of employees and departments but also improves the efficiency of data queries and strengthens the performance appraisal management of enterprise employees.

To further verify the validity of the research in this paper, this paper conducts a comparison of three related approaches: the 360-degree performance evaluation method, the management by objectives method, and the key performance indicator method. The 360-degree performance evaluation method is a comprehensive evaluation method, which is the evaluation of superiors and the comprehensive evaluation of elements such as subordinates, customers, and peers. This method is very fair and has high accuracy, but it requires a lot of work (Islami et al., 2018). The management by objectives method is goal-oriented and is a management system jointly formulated by the superior and the subordinate. The superiors and subordinates actively cooperate to accomplish work goals together, stimulating employee enthusiasm (Williams, 2019).

The key performance indicator (KPI) method is used to determine the evaluation indicators through a systematic method—that is, the enterprise assigns the goal to each department, and each department completes its own assigned goal, thereby achieving the goal (Tziner & Rabenu, 2021). Performance appraisal evaluation is relatively mature in theory and practical application, but it is relatively speaking. Or take the goal as the direction and the actual completion as the evaluation method. It is based on the enthusiasm of employees. Most of them focus on one aspect of development, not all aspects. The 360-degree performance evaluation method is a comprehensive evaluation method, but the workload is a problem that cannot be ignored. Because of this, the research in this paper can not only diversify the evaluation methods but also make the evaluation transparent. It not only focuses on performance evaluation but also enables employees to realize their self-worth and give full play to their potential.

CONCLUSION

In recent years, performance appraisal has been an important issue in human resource management. With the increasingly fierce business competition, the performance appraisal management system has attracted enterprises' attention increasingly. However, in the current era, the performance appraisal management system has not been used rationally, and satisfactory performance has not

been achieved. Most performance appraisal systems have many problems, such as the unreasonable setting of evaluation indicators, inaccurate performance evaluation, and opaque evaluation methods.

This article explores the application of a clustering algorithm in the employee performance appraisal management system by using the improved ART2 clustering method that draws on the leakage competition and the Hebb rule. The article chooses the employee performance appraisal system of Industrial Company A as the research object. The assessment system using this clustering algorithm is divided into eight functional modules, including organizational structure management, assessment management, and system management functions. The logical level is clear, which provides a basis for adding or modifying functional modules in the future. Additionally, this system is also designed in accordance with the information security requirements of Industrial Company A, and the management of the system can be strengthened through role setting and permission access, with its security greatly increased. Finally, this paper passes the system environment test to ensure that the system can meet the various needs of the enterprise for performance appraisal. Through the survey results regarding the implementation effects, the system can improve the fairness and accuracy of the assessment, thereby promoting the progress of the assessment work, and has good application value. The employee performance appraisal management system is a very complex system involving a wide range of areas.

Due to the author's limited time and energy, coupled with resource constraints, this article has some limitations. For example, functional modules need to be further refined and expanded. The compatibility of the improved ART2 clustering method based on leakage competition and the Hebb rule needs to be further explored to further improve the performance of the system.

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