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Research Article

Human Resource Management Decision System University Based on Decision Model

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The purpose of university personnel management is to improve the efficiency of running a school by optimizing the allocation of university human resources. Personnel management is one of the most important aspects of university administration, as it plays a key role in the formation of discipline teams and management teams. The use of advanced information technology is to improve the efficiency of personnel management, the establishment of university human resources analysis system, and to promote the school management work. Combining with the achievements of office automation and decision support development, this study analyzes the realization methods and key technologies of human resource management in university decision system, discusses the significance of human resource management in university decision system analysis based on decision model, and constructs human resource management in university decision system. This study first introduces the basic content of human resource management decision model and makes a comprehensive analysis of human resource demand prediction and then constructs a human resource management in university decision model according to the analysis structure. After defining the construction path of the decision-making model of human resource management in colleges and universities, the human resource grading and promotion analysis is carried out to additionally define the prediction of human resource demand in universities. Finally, the decision system is realized and tested by means of mathematical model.

1. Introduction

With the further deepening of the personnel system reform in universities, the human resource management in colleges and universities has been gradually transformed into human resource management and development [1, 2]. The basic purpose of human resource management in universities is to build a good faculty and staff, which is the main guarantee to complete various tasks and improve the quality of running a school and its benefits [3]. Boxall [4] (2013) believed that in order to timely and accurately query and statisticize personnel information, it is necessary to adopt scientific management methods and modern management means to timely and comprehensively track and update the historical, periodic, and random information of the staff. Zhifang [5] (2013) believed that human resource management in university system is one of the key systems of the whole digital campus. At present, the rapid development of network and information technology has provided rich soil for the realization of informatization and paperless human resource management in universities [6]. Establishing a set of human resource management in university system with suitable data structure, diversified operation functions, and network operation ability will greatly reduce the cost of human resource management in university activities, and make it more scientific, reasonable, and efficient [7]. The design of human resource management system in universities should start from demand and function. While ensuring timely, accurate, and safe information, it analyzes data and makes decisions through modeling, providing strong guarantee for human resource managers to determine development goals and formulate talent policies. The success

or failure of any career depends on people, including people's thoughts and behaviors. Therefore, the management of human resources is the core content of career management. Human resource planning is also an important part of human resource management, but also the basis of talent training and team building [8, 9].

The paper organization is as follows: Section 2 discusses the decision model. Section 3 analyzes the construction of decision model of human resource management in university. Section 4 evaluates the test of human resource management decision system in university. Section 5 concludes the article.

2. Decision Model

Here, the introduction of the model is discussed. They analyze the human resource demand forecasting.

2.1. Introduction of the Model. The concept of decision system was first proposed by Michael Scott Morton and Thomas Gerrity in 1970 [7]. Silva and Costa [10] (2013) pointed out that the goal of decision systems is to interactively support decision makers to make orderly decisions on semistructured and unstructured problems by combining the powerful information processing power of computers with the flexible judgment of humans, in order to achieve as satisfactory and objective solution as possible. Lengnick-Hall et al. [11] (2013) pointed out that decision generally includes three aspects: the decision maker has an expected goal; the decision maker wants to make a choice from the subjective will; there are objectively a variety of formulated schemes to choose from, and satisfactory schemes can be selected from these schemes according to a certain evaluation criteria, and to be put into practice.

2.2. Human Resource Demand Forecasting. The accuracy of personnel demand prediction is closely related to the realization of human resource management goals. Planning or planning in management is considered to be the first part of the management process [12]. The task of planning is to clarify the purpose and objectives of the system, and specify the ways and conditions to achieve the objectives, so it is the primary link of management. And how to realize the demand control of personnel are the specific decision-making criteria of personnel recruitment and recruitment in human resource management. Sun et al. [13] (2020) believed that in the human resource management of colleges and universities, according to the overall goal of the development planning of the teacher team, mathematical model theory is used to establish the objective management system of the teacher team structure.

3. Construction of Decision Model of Human Resource Management in University

Here, evaluate the model construction path and discuss the human resource grading. They analyze the human resources promotion and also define the human resource demand forecasting.

3.1. Model Construction Path. In the establishment of the mathematical model of this system, the hierarchical structure system model is adopted according to the known conditions and the current structure to predict the required data, in order to seek for an ideal hierarchical structure and take countermeasures. The decision of human resource management in this system is divided into two parts: personnel supplement calculation and personnel promotion calculation.

(1) Personnel supplement calculation: in the part of personnel supplement, the aim is to calculate the number of teachers to be supplemented in each year prior to the target according to the corresponding educational structure (bachelor, master, and doctor).

(2) Personnel promotion calculation: in the calculation of personnel promotion, the purpose is to calculate the number of teachers that should be supplemented in each year before the target according to the corresponding position structure (professor, associate professor, lecturer, and assistant professor).

Model construction path is shown in Figure 1.

There are two factors that affect the number of people in the hierarchical structure of the system: intrahierarchical shifts within the system. For example, teachers improve their academic qualifications through further study, inside and outside the system flow, namely, personnel introduction or resignation, retirement, and so on [14].

3.2. Human Resource Grading. Suppose the system is divided into K levels from low to high, and the levels are graded once a year and only once. The levels are denoted as $i = 1, 2, 3 \ldots, k$; the parameter t represents the year value.

(1) Representation of staff level vector (by quantity)

$$n(t) = \left(n_1(t), n_2(t), \ldots, n_k(t)\right). \tag{1}$$

In formula (1), $n_i(t)$ is the number of people belonging to grade i in the $\bar{t}$ year. Suppose the total number of people in the whole system in the t year is $N(t)$, then

$$N(t) = \sum_{i=1}^{k} n_i(t). \tag{2}$$

(2) Representation of staff level vector (in proportion)

$$a(t) = \left(a_1(t), a_2(t), \ldots, a_k(t)\right). \tag{3}$$

$a_i(t)$ is the proportion of the number of grade i in the whole system in year t.

$$a_i(t) = \frac{n_i(t)}{N(t)}. \tag{4}$$

The vector form is

$$n(t) = \left(n_1(t), n_2(t), \ldots, n_k(t)\right) = N(t)\left(a_1(t), a_2(t), \ldots, a_k(t)\right). \tag{5}$$

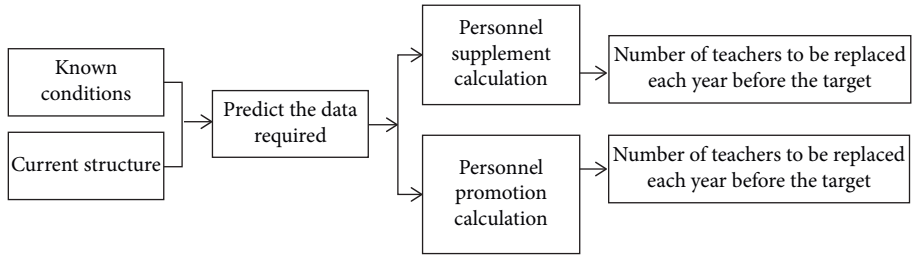

Figure 1: Model construction path.

And $a_i(t) \geq 0$, $\sum_{i=1}^{k} a_i(t) = 1$.

(3) Representation of personnel outflow grade vector (by quantity)

$$\begin{aligned} O(t) &= \left(o_1(t), o_2(t), \ldots, o_k(t)\right) \text{(Planned outflow)}, \\ Q(t) &= \left(q_1(t), q_2(t), \ldots, q_k(t)\right) \text{(Unplanned outflow)}. \end{aligned} \tag{6}$$

In the formula above, $o_i(t)$ is the number of people who quit the system from grade i plan in the t year and $q_i(t)$ is the number of people who quit the system from grade i unplanned in the t year. Let the grade vector of the total number of people who quit the system from grade i in the t year be expressed as

$$\begin{aligned} w(t) &= \left(w_1(t), w_2(t), \ldots, w_k(t)\right), \\ w_i(t) &= q_i(t) + o_i(t). \end{aligned} \tag{7}$$

Suppose the total number of people quitting the system in year t is $W(t)$, then

$$W(t) = \sum_{i=1}^{k} w_i(t) = \sum_{i=1}^{k} q_i(t) + o_i(t). \tag{8}$$

(4) Representation of personnel outflow grade vector (in proportion)

$$\begin{aligned} c(t) &= \left(c_1(t), c_2(t), \ldots, c_k(t)\right) \text{(Planned outflow)}, \\ d(t) &= \left(d_1(t), d_2(t), \ldots, d_k(t)\right) \text{(Unplanned outflow)}. \end{aligned} \tag{9}$$

In the formula above, $c_i(t)$ is the proportion of the number of people who quit from level i in the year t, $d_i(t)$ is the proportion of the number of people who quit from level i in the year t, and $b_i(t)$ is the proportion of the total number of people who quit from level i in the year t, then

$$b_i(t) = c_i(t) + d_i(t). \tag{10}$$

Then the grade vector of the total number of people quitting the system in the year t can be expressed as

$$\begin{aligned} w(t) &= \left(w_1(t), w_2(t), \ldots, w_k(t)\right) \\ &= N(t)\left(b_1(t), b_2(t), \ldots, b_k(t)\right) = N(t)\left(c_1(t)\right. \\ &\quad \left. + d_1(t), c_2(t) + d_2(t), \ldots, c_k(t)\right) + d_k(t). \end{aligned} \tag{11}$$

Then the total number of people who quit the system in year t is

$$\begin{aligned} w(t) &= \sum_{i=1}^{k} w_i(t) = \sum_{i=1}^{k} b_i(t) n_i(t) = n(t) b^T(t) \\ &= \left(n_1(t), n_2(t), \ldots, n_k(t)\right)\left(b_1(t), b_2(t), \ldots, b_k(t)\right)^T. \end{aligned} \tag{12}$$

(5) The level vector of imported personnel (by quantity)

$$r(t) = \left(r_1(t), r_2(t), \ldots, r_k(t)\right). \tag{13}$$

Among them, $r_i(t)$ is the number of people who introduced level i in year t. Assuming that the total number of people introduced to the whole system in year t is $R(t)$, there are:

$$R(t) = \sum_{i=1}^{k} r_i(t). \tag{14}$$

(6) Proportion vector of imported personnel (in proportion)

$$s(t) = \left(s_1(t), s_2(t), \ldots, s_k(t)\right). \tag{15}$$

$s_i(t)$ refers to the proportion of the number of personnel of level i in the total number of people introduced in the year t.

Then the number of people introducing level i in year t is

$$r_i(t) = R(t) s_i(t). \tag{16}$$

The level vector of introduced personnel can be expressed as

$$\begin{aligned} r(t) &= \left(r_1(t), r_2(t), \ldots, r_k(t)\right) \\ &= R(t)\left(s_1(t), s_2(t), \ldots, s_k(t)\right). \end{aligned} \tag{17}$$

(7) Internal personnel level transition matrix:

$s(t) = \left\{P_{ij}(t)\right\} k \times k$ (21). In the formula above, $P_{ij}(t)$ is the proportion of the number of people who transition from level i to level j in level i in year t.

(8) The equation of the total number of people in the year $(t+1)$:

The total number of people in the system is the result of the combined effect of two factors, the withdrawal of internal personnel and the entry of external personnel on the original basis, so the

equation of the total number of people in $(t+1)$ year is

$$N(t+1) = N(t) + R(t) - W(t). \tag{18}$$

(9) The transfer equation of the number of people in each grade:

The number of people from grade j in year $(t+1)$ is the number of people from all grades (including grade j) transferred to grade j, that is, the number of people from grade j after internal flow, plus the number of people entering grade j from outside the system in year $(t+1)$, that is,

$$n_j(t+1) = \sum_{i=1}^{k} P_{ij} n_i(t) + r_j(t) = \sum_{i=1}^{k} P_{ij} n_i(t) + S_j(t) R(t). \tag{19}$$

Its matrix form is

$$n(t+1) = n(t)P(t) + R(t)s(t). \tag{20}$$

(10) Hierarchical structure distribution equation

Assuming that the growth of the total number of people from year t to year $t+1$ is recorded as $M(t)$, then there are

$$\begin{aligned} M(t) &= R(t) - W(t), \\ W(t) &= n(t)b^T(t), \\ R(t) &= W(t) + M(t) = n(t)b^T(t) + M(t). \end{aligned} \tag{21}$$

It is obtained from the matrix form of the transfer equation of the number of ranks:

$$\begin{aligned} n(t+1) &= n(t)P(t) + \left(n(t)b^T(t) + M(t)\right)s(t) = n(t)P(t) \\ &\quad + n(t)b^T(t)s(t) + M(t)s(t). \end{aligned} \tag{22}$$

Through the above matrix and equation, this system has carried out the personnel supplement calculation and the personnel promotion calculation, obtained the prediction result, and completed the realization of the computer human resource management decision.

3.3. Human Resources Promotion

3.3.1. Supplementary Calculation of Personnel. The situation at the beginning of the demand year is that the situation at the end of the demand year is known. $N(t_0)$, $n(t_0)$, and $a(t_0)$ are known, then

$$\begin{aligned} n(t_0) &= n_1(t_0), n_2(t_0), n_3(t_0) = N(t_0)a(t_0) \\ &= \left(N(t_0)a_1(t_0), N(t_0)a_2(t_0), N(t_0)a_3(t_0)\right). \end{aligned} \tag{23}$$

Assuming that the target of t_1 has been set, the size of t_1, the total number of people, and the number of people at each level have been set, which means $N(t_1)$, $n(t_1)$, and $a(t_1)$ are known, then

$$\begin{aligned} n(t_1) &= (n_1(t_1), n_2(t_1), n_3 t_1) = N(t_1)at_1 \\ &= ((Nt_1)a_1(t_1), N(t_1)a_2(t_1)), N(t_1)a_3(t_1), \\ N(t_1) &= N(t_0) + \sum_{i=t0}^{t1} R(i) - \sum_{i=t0}^{t1} W(i). \end{aligned} \tag{24}$$

A relatively stable growth rate can be calculated according to the change curve of personnel mobility in terms of degree structure in the past few years [15].

Total number of dropouts from demand year to target year:

$$W = \sum_{i=t0}^{t1} W(i) = Wt_0(1+e)^{t1-t0+1}. \tag{25}$$

Wt_0 is the total number of people who quit in the demand year.

Total number of dropouts per level:

$$\begin{aligned} W_1 &= \sum_{i=t0}^{t1} W_1(i) = W_1 t_0 (1+e_1)^{t1-t0+1}, \\ W_2 &= \sum_{i=t0}^{t1} W_2(i) = W_2 t_0 (1+e_2)^{t1-t0+1}, \\ W_3 &= \sum_{i=t0}^{t1} W_3(i) = W_3 t_0 (1+e_3)^{t1-t0+1}. \end{aligned} \tag{26}$$

It can be concluded that

$$\begin{aligned} N(t_1) &= N(t_0) + \sum_{i=t0}^{t1} R(i) - \sum_{i=t0}^{t1} W(i) = N(t_0) \\ &\quad - Wt_0(1+e)^{t1-t0} + R(1+f)^{t1-t0+1}. \end{aligned} \tag{27}$$

R_0 is the number of supplementary people in the of demand year.

$$R = \frac{1}{(1+f)^{t1-t0+1}} \left[N(t_1) - N(t_0) + Wt_0(1+e)^{t1-t0}\right]. \tag{28}$$

In the same way,

$$\begin{aligned} R_1 &= \frac{1}{(1+f_1)^{t1-t0+1}} \left[n_1(t_1) - n_1(t_0) + W_1 t_0 (1+e_1)^{t1-t0}\right], \\ R_2 &= \frac{1}{(1+f_2)^{t1-t0+1}} \left[n_2(t_1) - n_2(t_0) + W_2 t_0 (1+e_2)^{t1-t0}\right], \\ R_3 &= \frac{1}{(1+f_3)^{t1-t0+1}} \left[n_3(t_1) - n_3(t_0) + W_3 t_0 (1+e_3)^{t1-t0}\right]. \end{aligned} \tag{29}$$

3.3.2. Promotion Calculation. There are four levels of teaching assistant, lecturer, associate, and professor, that is $K=4$.

Reach the target structure by the target year, allowing for an even rate of promotion each year.

Table 1: Personnel needs forecasting data structure.

Data type	Detailed description	Note
Target year degree planning data	Target year Target year planning Among them:Bachelor:(%) Master:(%) Doctor:(%)	Need to enter
Demand data at the end of last year	Demand year: Demand year planning: Among them:Bachelor:(%) Master:(%) Doctor:(%)	Calculated by system statistics, no input, but can be modified and adjusted
Demand annual planned retirement data	Retired: Among them:Bachelor:(%) Master:(%) Doctor:(%)	Calculated by system statistics, no input, but can be modified and adjusted
Demand annual unplanned exit data	Unplanned exit: Among them:Bachelor:(%) Master:(%) Doctor:(%)	Calculated by system statistics, no input, but can be modified and adjusted
Predicted result data	The number of people should be supplemented in the demand year: Among them:Bachelor:(%) Master:(%) Doctor:(%)	Model measurement results

$$y = \frac{(a(t_1) - a(t_0))}{(t_1 - t_0)},$$
$$a(t_0 + 1) = a(t_0) + y, \tag{30}$$
$$n(t_0 + 1) = N(t_0 + 1)a(t_0 + 1) = N(t_0 + 1)(a(t_0) + y).$$

According to the total number equation, there is

$$N(t_0 + 1) = N(t_0) + R(t_0) - W(t_0). \tag{31}$$

According to the changes in the personnel structure in the past few years, a relatively stable growth rate can be calculated for quitting the personnel of each grade [16]. The number of people quitting in demand year can be known:

$$M(t_0) = R(t_0) - W(t_0). \tag{32}$$

Suppose the transfer matrix is

$$P(t) = \begin{bmatrix} p_{11}(t)\, p_{12}(t)\, 0\, 0 \\ 0\, p_{22}(t) p_{23}(t)\, 0 \\ 0\, 0\, p_{33}(t) p_{34}(t) \\ 0\, 0\, 0\, p_{44}(t) \end{bmatrix}. \tag{33}$$

The vector of transfer number can be expressed as

$$n(t)P(t) = (n_1(t), n_2(t), n_3(t), n_4(t)) \begin{bmatrix} p_{11}(t) p_{12}(t)\, 0\, 0 \\ 0\, p_{22}(t)\, p_{23}(t)\, 0 \\ 0\, 0\, p_{33}(t)\, p_{34}(t) \\ 0\, 0\, 0\, p_{44}(t) \end{bmatrix} = \begin{bmatrix} n_1(t) p_{11}(t) \\ n_1(t) p_{12}(t) + n_2(t) p_{22}(t) \\ n_2(t) p_{23}(t) + n_3(t) p_{33}(t) \\ n_3(t) p_{34}(t) + n_4(t) p_{44}(t) \end{bmatrix}^T. \tag{34}$$

According to the basic equation of hierarchical structure distribution:

$$n(t_0 + 1) = n(t_0)\left(p(t_0) + b^T(t_0)s(t_0)\right) + M(t_0)s(t_0),$$
$$G(t_0) = p(t_0) + b^T(t_0)s(t_0), \tag{35}$$
$$n(t_0 + 1) = n(t_0)G(t_0) + M(t_0)s(t_0).$$

Through the above process, we can calculate the transfer matrix, that is, the promotion ratio, and then calculate the number of promotions and the weight of each position structure.

3.4. Human Resource Demand Forecasting. In the process of human resource management decision making for personnel recruitment and promotion, the requirements of data structure for personnel recruitment forecast and job promotion forecast are different due to the different situation of personnel turnover [17]. Personnel demand forecasting is only concerned with the educational structure of personnel [18]. The calculation of the annual demand for prewithdrawal and prereplenishment is also based on the turnover of staff in the job-grade structure in previous years. Personnel need forecasting data structure is shown in Table 1.

Job promotion prediction data structure is shown in Table 2.

4. Test of Human Resource Management Decision System in University

In this section, discuss the test result and also define the results analysis.

Table 2: Job promotion prediction data structure.

Data type	Detailed description	Note
Target year job structure planning data	Target year: Target year planning: Among them:Assistant:(%) Lecturer:(%) Associate:(%) Professor:(%)	Need to enter
Demand data at the end of last year	Demand year: Demand year planning: Among them:Assistant:(%) Lecturer:(%) Associate:(%) Professor:(%)	Calculated by system statistics, no input, but can be modified and adjusted
Demand annual pre-supplement data	Presupplement: Among them:Assistant:(%) Lecturer:(%) Associate:(%) Professor:(%)	Calculated by system statistics, no input, but can be modified and adjusted
Demand annual pre-exit data	Pre-exit: Among them:Assistant:(%) Lecturer:(%) Associate:(%) Professor:(%)	Calculated by system statistics, no input, but can be modified and adjusted
Predicted result data	The number of promotions required per year: Among them:Assistant:(%) Lecturer:(%) Associate:(%) Professor:(%)	Model measurement results

Table 3: Supplementary personnel measurement.

Target year information		Planned retirement information	
Target year	2022	The number of planned retirees in demand years and target years	12
Number of people planned for target year	1050	Among them:Bachelor:	6
Among them:Bachelor:(%)	20.3	Master:	4
Master:(%)	64.9	Doctor:	2
Doctor:(%)	14.8		
Demand year	2020	Number of unplanned dropouts in demand years and target years	14
Demand data at the end of last year	910	Among them:Bachelor:	4
Among them:Bachelor:(%)	29.7	Master:	7
Master:(%)	61.5	Doctor:	3
Doctor:(%)	8.8		
Predicted results			
The number of people should be supplemented in the year of demand	73	Bachelor	-28
Master	69	Doctor	32

Table 4: Measurement of job promotion.

Target year information			
Target year	2022	Job structure planning number of employees	1050
Assistant (%)	14.95	Lecturer (%)	35.24
Associate (%)	34.86	Professor (%)	14.95
Demand year information			
Demand year	2020	The number of people at the end of the previous demand year	910
Assistant (%)	17.80	Lecturer (%)	32.97
Associate (%)	38.46	Professor (%)	10.77
Demand year exit information			
Assistant (%)	0.99	Lecturer (%)	0.55
Associate (%)	0.99	Professor (%)	0.99
Presupplemental information for the year of demand			
The number of people should be supplemented	73		
Assistant	42	Lecturer	19
Associate	10	Professor	2
Number of promotions in demand years	131		
Assistant	12	Lecturer	61
Associate	43	Professor	15

4.1. Test Results. Take 2020 as the demand year, that is, forecast the number of recruitment and promotion in 2020. At this time, the situation of personnel composition at the end of 2019 is known. Take 2022 as the target year, according to the development plan of the school's teaching staff, the target to be achieved has also been known. Supplementary personnel measurement is shown in Table 3.

The above results show that in 2022, 32 doctors, 69 masters, and 28 bachelors should be introduced.

Measurement of job promotion is shown in Table 4.

According to the above results, 15 professors, 43 associate, 61 lecturers, and 12 assistants should be promoted in the promotion of teaching staff in 2022.

4.2. Results Analysis. By establishing a mathematical model of objective management with a reasonable structure of the teaching staff, the predicted results can intuitively reflect the quantitative demand for the construction of the teaching staff, so it is more accurate and scientific than the previous empirical prediction or manual operation, and has a great impact on guiding practical work. First of all, the supplementary measurement of personnel for managers shows the need to strengthen the training and improvement of the existing faculty. At the same time, the personnel should be supplemented according to the predicted results as a supplementary target, as a reference to the actual work, as close as possible to this target, pay attention to the balance of all kinds of personnel proportion. Secondly, the calculation of job promotion, which means the maximum number of teachers who should be promoted in the year of demand, considering the vacancy of posts and the current situation of personnel, provides a reliable basis for managers to determine various positions.

5. Conclusion

Human resource management is one of the cores of university management, which improves the efficiency of human resource management, in which, school management has a promotion role. The construction of human resource management informatization is system engineering. In the procedure of development, the system has regularly discovered and made up for the defects left over in the design, and gradually upgraded the function of the system. The human resource management decision system is designed and realized by means of mathematical model. Reference for HR management decision making of personnel supplement should be provided. Decision should be able to analyze the general law of personnel flow from the database, combined with the mathematical model designed to make a more reliable prediction of personnel recruitment and promotion.

Due to lack of time, as well as my ability and research experience, there are some limitations on the model of personnel supplement and promotion. The demand report of the supply manager measured by the model can help decision-makers to achieve the management by the objectives of the teaching staff. However, it is often difficult to achieve the demand forecast value due to the influence of various factors in practical work. At the same time, if the target value of the target year is not proved harshly, it will mark the demand forecast and guide the actual operation incorrectly.

This study has the following significance: reduces the work pressure of office staff, improves the work efficiency of human resources management in colleges and universities, and makes the management more scientific and orderly. It also enhances the intelligence of the system. The system analyzes the historical data in the database, provides reference data for the future trend of personnel flow, and predicts the number of school personnel introduction according to these reference data.

Data Availability

The data used to support the findings of this study are included within the article.

Conflicts of Interest

The authors declare that they have no conflicts of interest.

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