Human resource labor dispatch model using an improved genetic algorithm

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Abstract
The management and development of human resources (HR) have become one of the core contents of enterprise management. Enterprises pay more attention to the importance of information technology which results in the development of many labor dispatch enterprises. The rapid development and limited market share of labor dispatch enterprises lead to more fierce competition among the enterprises. With the rapid development of machine learning techniques, more enterprises begin to pay attention to managing the completion of various decision-making activities in operation with the help of computer information systems to save human costs. The labor dispatch model is a valuable addition to China’s core contractual employment paradigms. Based on the improved genetic algorithm, this paper studies the human resource labor dispatch model which is used to optimize the number of people required by the dispatch project and optimize its labor cost. The HR recruitment model is used to calculate the number of people to be recruited for the dispatch project to meet the needs of the project and optimize its project dispatch scheme. The experimental results show that the benefit of dispatching through the artificial selection method (1127) is less than the result calculated by the HR dispatching plan model (1162), which proves the effectiveness of this model. The experimental results of the study depict the usefulness of the research.

Keywords Human resource management · Genetic algorithm · Labor dispatch model, decision making

1 Introduction

Labor dispatch is a common employment trend in both economically developed and undeveloped nations. In China, it is a valuable addition to the labor contract and is a common type of business employment. The advent and growth of labor dispatch help the labor market to develop. Further, it will create more chances for the labor to have a good job and to get more profit. Labor dispatch, on the other hand, has a significant influence on human resource management (HRM) in businesses. We need to standardize this type of employment, take reasonable actions to protect the dispatch workers’ legitimate interests, optimize the work of the human resources (HR) department, promote the fast development of this dynamic labor dispatch in China in order to meet the needs of the economic system and to fix the issues that exist in the labor dispatch operations currently, we need to take certain steps accordingly. With the rapid demographic change, the role of organizations in supporting their employees is of a great importance and needs more attention. Further, due to its significance it attracts the experts and researchers towards this domain. In response to requests for research into how HR practices contribute to pro-diversity climates, researchers have looked at the relationship between age-inclusive human resource practices and age-diversity climates (Böhm et al. 2014).

Multinational companies are looking for new HRM options other than the host country people to operate their international subsidiary. Assigned immigrants are knowledgeable about headquarters, but they are costly and unfamiliar with the host country’s culture. The host country settings are less expensive, but they have limited
understanding of the headquarters’ goals or processes. In order to keep host country national benefits while lowering their drawbacks, researchers have devised a number of strategies (Collings and Isichei 2018), self-initiated immigrants are becoming increasingly popular among multinational corporations (Andresen et al. 2012; Vaiman and Haslberger 2013). When the workers are from the homeland, they can provide the multinational company some of the benefits of allocated immigrants at a lower cost, and they will be better knowledgeable about the host country. As a result, they can serve as boundary-crossers (Furusawa and Brewster 2019).

Samuel proposed the concept of labor dispatch for the first time in the United States (US) in 1920. Samuel’s organization employed many women at the time, taught them relevant skills, and then leased them to businesses who needed inventory work done at night, filling such temporary staffing gaps. In 20 years between 1940 and 1960, this type of work was steadily extended around the world. After being implemented and developed in Europe, America, Japan, and other countries, it has been widely used and promoted in many countries. In the era of knowledge economy, HR as the primary resource of enterprises plays an important role in businesses, which is related to the realization of enterprise objectives and future development. HR planning is the foundation and core of HRM (Zhanzhu 2006). Most enterprises have begun to realize that all links of enterprise business processes, such as product design, production, sales, and service, are inseparable from people’s participation. The quality and morale of employees have become the basis of enterprise survival and development. When an enterprise has unique human resources, then those human resources will become a decisive force in the formation of enterprise strategy (Wen and Ni 2005). A well-established HRM and development will directly improve an enterprise’s internal and external environment, optimize business processes and enhance competitiveness. In this sense, the effectiveness of human resources work in an enterprise has become a strategic factor to promote the development of the enterprise. Further, HR planning is to predict the future personnel demand of the enterprise, analyze the personnel supply, formulate policies, plans and measures, and ensure that the enterprise has the right personnel at the right time (Zhang and Yang 2004).

Labor dispatch, also known as “labor leasing”, is an employment model in which labor owners and users are separated. In this process, labor contracts are signed between dispatch agencies and workers, and labor dispatch agencies send workers to employment enterprises to provide labor services (Cheng et al. 2003). The labor contract relationship exists between dispatch agencies and dispatched workers, but the fact of labor payment occurs between dispatched workers and employing enterprises. The most remarkable feature of labor dispatch is the separation of employment and use of labor. After the introduction of the method of labor dispatch into China, it has achieved great development in a short period (Li 2011). The number of dispatched units (labor companies) and dispatched workers has risen sharply. Labor dispatch has been applied to all walks of life. Labor dispatch workers are used in super large state-owned enterprises such as banks, petroleum and petrochemical, mobile communications, and so on. Further, labor dispatch has become an important part of labor employment in Chinese enterprises.

Although labor dispatch employment is booming in China, it lags in the management of labor dispatch employment. The phenomenon of damage to the interests of dispatched employees caused by non-standard management and operation of labor dispatch agencies and employing enterprises is everywhere. The resulting litigation, petition, and other unstable events have a significant impact on enterprises and society. Most of these problems are caused by the sending unit’s inability to effectively plan human resources and blindly copy and imitate. As a part of HRM, HR planning mainly provides a reasonable decision-making scheme for the human demand, supply, and distribution schedule of enterprises (Zhou and Sun 1999).

Due to the increasing proportion of human cost in the overall cost, the decision-making of HR planning is very important for the success or failure of an enterprise. This is a vital process especially for labor dispatch enterprises with large demand for human resources, labor dispatch enterprises whose human resources are driven by orders and whose demand is intensive, seasonal, and intermittent, and its role in human resource planning is particularly obvious. How to make decisions to control the operations of enterprise personnel, when to hire, how many people to hire, how to allocate, when to fire, how to fire, how to train and provide resources to employee, how to realize the reasonable composition of different types of employees, etc. These decisions on personnel flow directly affect the realization of enterprise economic and social benefits. Therefore, the establishment of HR planning strategy is of a great significance to the sustainable long-term development of labor distribution enterprises. To establish the HR planning strategy of labor dispatch enterprises, we need to establish a mathematical model in line with the actual situation and find out the internal law according to the historical data and parameter estimation (Chen and Wang 1996).
Following are some of the contributions of the current research work;

- To study human resource labor dispatch model which is used to improve the number of people required by the dispatch project and optimize its labor cost.
- The HR recruitment model is used to measure the number of people to be enlisted for the dispatch project to encounter the needs of the project and optimize its project dispatch scheme.
- An intelligent labor dispatch model is proposed based on genetic algorithm.
- The performance of proposed model is better than the other conventional models.

The rest of the paper is organized in the order; Sect. 2 illustrates the related work, Sect. 3 represents the proposed model, Sect. 4 demonstrates the experimental results of the proposed human resource labor dispatch model. Finally, the research work is concluded in Sect. 5.

2 Related work

Many businesses adopt their core business in a market economy for personal reasons or seasonal changes and make changes in their personnel demands according to the situations. However, if they use the original method of employment mechanically, they will most likely confront labor excess, or labor scarcity in some transitory and unanticipated task, disrupting the plan and impeding the development of businesses. On the other hand, labor dispatch may give firms with a timely HR complement as well as a scalable employment mechanism, allowing them to avoid the concerns mentioned earlier. Employers can receive the labor staff quickly by paying service charges to the dispatchers when they are in need of personnel. Employers may either return temporary staff to dispatchers or retain some of them as full-time workers, when they finish their assignments, allowing for a more scalable HR approach.

The dilemma of host country nationals or allotted expatriates being expatriated against the development and usage of local employees has been the focus of international HRM studies in multinational organizations (Harzing and Pinnington 2011; Rui et al. 2017; Stahl et al. 2012).

Though the effective management of assigned immigrants contributes to the organization goals, however, there are some downsides as well, the most significant of which is the expense (Bonache et al. 2012). They can also have a hard time adjusting themselves to new surroundings. Family adaptation, dual-career concerns, and children’s schooling may all be challenging (Javidan et al. 2011). In addition, reintegrating former expatriates at the last of their worldwide project cycle might be difficult (Kraimer et al. 2016).

Chinese enterprises are mostly labor-intensive, the labor outsourcing technique, also known as labor dispatch, has become a key trend among Chinese businesses, as it allows them to profit from employment flexibility and cost minimization. According to Zeng et al. (Zeng 2007), there were a total of 26 k labor organizations in the Chinese labor market in 2006, while the overall outsourced workforce in state-owned firms was reached to 25 million. Zhou et al. (Zhou and Zeng 2008) stated that a flexible connection with the outsourced workforce is not only a practical mean to restrict employment expenses, stemming from an excess supply of labor force in the Chinese labor market, but also an alternative for employment stability in the Chinese workplace. The wages of those contract employees in generic positions had just approached or were even lower than, commercial rates. Employers were also excluded from the quasi-fixed labor costs on contingent employees’ insurance coverage when the labor agency was established. This study proposes a human resource labor dispatch model which is based on the improved genetic algorithm. The following subsection illustrates the main concept, overview, genetic code, and characteristics of genetic algorithm in more detail.

2.1 Overview of genetic algorithm

Genetic algorithm (GA) is a kind of adaptive probabilistic randomized iterative search algorithm evolved from the evolutionary law of Biology (survival of the fittest, survival of the fittest genetic mechanism). In 1975, professor J.H. Holland of Michigan University in the United States (US) noted that learning can be completed not only through the adaptation of a single organism but also through many evolutionary adaptations of a population. Kenneth de Jong used this algorithm to solve optimization problems. Holland’s research on GA begins with the design and implementation of a robust adaptive system that can cope with changing and uncertain environments. He believes that the adaptability of this system is a functional relationship of getting feedback from the environment at any time, so it forms the regenerative plan which we know by the name of a simple GA nowadays. This simple GA is just an abstract model of gene chain with the fixed population size and fixed length for individuals. Parents are randomly selected according to fitness, and new populations are generated according to crossover and mutation operators (Wang and Zhang 2003).

The characteristic of a GA is that its algorithm does not contain the morphology of the problem to be solved. It realizes the overall optimization of the problem by changing the configuration of genes, so it belongs to the
bottom-up optimization method. Similar to the biological evolution process, GA deals with the coding of variable sets rather than the variables themselves. It directly operates on structural objects without the limitation of derivation and function continuity. It has inherent implicit parallelism and better global optimization ability; the probabilistic optimization method can automatically obtain and guide the optimized search space, adaptively adjust the search direction, and there is no need to determine the rules (Zhang and Zhang 2001). These characteristics of the GA have been widely used in combinatorial optimization, machine learning, signal processing, adaptive control, and artificial intelligence. It is one of the key technologies in modern intelligent computing.

2.2 Basic flow of genetic algorithm

The basic steps and flow of the genetic algorithm (GA) are shown in Fig. 1, and are discussed as follows.

Step 1 Select the coding strategy, to convert the parameter set X and domain into bit string structure space S.

Step 2 Define fitness function \( f(X) \).

Step 3 Determine the genetic strategy, including population size, selection, crossover, mutation operators, and their probability.

Step 4 Generate initial population P.

Step 5 Calculate the fitness value of each individual in the population.

Step 6 According to the genetic strategy, the genetic operator acts on the population to produce the next generation population.

Step 7 Iteration termination decision.

The coding method of feasible solution and the design of genetic operation are the two main problems to be considered in the construction of GA, and they are also two key steps in the design of the GA. Different coding methods and genetic operations need to be used for different optimization problems, which are closely related to the specific problem to be solved. Therefore, the understanding of the problem to be solved is the key to the success of the application of GA (Meng and Cai 2001; Guo and Mu 2002).

2.3 Genetic coding

When using GA to solve a problem, the actual decision variables of the problem do not need to be directly operate, but to encode the individuals representing the feasible solution, constantly search the individuals with high fitness, increase their number in the population, and finally is to find the optimal solution or approximate optimal solution of the problem (Wang and Cao 2002). Therefore, the relationship between the practical representation of the feasible solution of the problem and the chromosome bit
string structure of the GA must be established. In a GA, the method of transforming the feasible solution of a problem from its solution space to the search space that the GA can deal with is called coding. On the contrary, the method of individual transformation from genotype in search space to phenotype in solution space is called the decoding method.

Coding is an application of GA, which is not only the primary problem to be solved, but also a key step. So far, many different coding methods have been designed. The basic genetic algorithm uses the binary symbol set \([0, 1]\) composed of binary symbols 0 and 1, that is, the parameters of the problem space are expressed as chromosome bit strings based on the character set \([0, 1]\). The number \(L\) of numbers contained in the chromosome of each individual is called the length of a chromosome or the length of symbol string (Chen and Wu 2009). Generally, the length \(L\) of the chromosome is a fixed number. For example, \(X = 10, 011, 100, 100, 011, 010, 100\) represents an individual, and the chromosome length of the individual is \(L = 20\).

The length of the binary-coded symbol string is related to the accuracy required by the problem. Assuming that the value range of a parameter is \([a, b]\), we use the binary-coded symbol string with length \(L\) to represent the parameter, which can produce \(2^L\) different codes in total. If the corresponding relationship between the parameter and the code is

\[
\begin{align*}
000000000...00000000 & = 0 \rightarrow a \\
000000000...00000001 & = 1 \rightarrow a + \delta \\
... & \\
111111111...11111111 & = 2^L - 1 \rightarrow b
\end{align*}
\]

Then the coding accuracy of binary coding is:

\[
\delta = \frac{b - a}{2^L - 1}
\]

(1)

Assuming that the encoding of an individual is \(x_k = a_{k1} a_{k2}...a_{kl}\), then the corresponding decoding formula is:

\[
x_k = a + \frac{b - a}{2^L - 1} \left( \sum_{j=1}^{L} a_{kj}2^{L-j} \right)
\]

(2)

As compared to the other coding methods, the binary coding method has the advantages of simple coding and decoding operation; Secondly, cross genetic operation is easy to realize; and it is convenient for the theoretical analysis of an algorithm.

### 2.4 Characteristics of genetic algorithm

Genetic algorithm (GA) uses the idea of biological evolution and heredity, which is different from the traditional optimization methods such as enumeration method, heuristic algorithm, and search algorithm. It has the following characteristics;

- GA operates on the coding of parameters rather than the parameters themselves, which enables us to learn from the concepts of chromosomes and genes in biology and imitate the mechanism of heredity and evolution in nature.
- GA uses the search information of multiple search points at the same time. The traditional optimization methods often start the iterative search process of the optimal solution from a single initial point in the solution space. The information provided by a single search point is not enough, the search efficiency is not high, and sometimes the search process is limited to the local optimal solution. GA starts the search process of the optimal solution from an initial group composed of many individuals, rather than from a single individual, which is the unique implicit parallelism of the GA, and as a result, the search efficiency of the GA is high (Sun et al. 2008).
- GA directly takes the objective function as the search information. The traditional optimization algorithm needs not only the value of the objective function but also the derivative value of the objective function and other auxiliary information to determine the search direction. GA only uses the fitness function value transformed by the objective function value to determine the further search direction and search range, without other auxiliary information such as the derivative value of the objective function (Bi and Yan 2007). GA can be applied to the optimization problems, where the derivative of the objective function cannot be obtained or the derivative does not exist at all as well as combinatorial optimization problems.
- GA uses probability search technology. The selection, crossover, mutation, and other operations of GA are carried out in a probabilistic way, so the search process of the GA has good flexibility (Li and Tu 2005).
- GA performs an efficient heuristic search in the solution space, rather than blindly exhaustive or completely random search. GA has no limit on the function to be optimized. It does not require the function to be continuous or differentiable. It can be either an explicit function represented by the mathematical analytical formula, a mapping matrix, or even an implicit function of the neural network, so it has a wide range of applications (Zhang 2005).
- GA has the characteristics of parallel computing, so it can improve the computing speed through large-scale parallel computing and is suitable for the optimization of large-scale complex problems.
3 Proposed human resource labor dispatch model based on improved genetic algorithm

The following subsections briefly discuss the research on human labor dispatch model based on improved genetic algorithm.

3.1 Human resource demand model

For a project, first of all, when working with Party A, the project manager will generate a report with important factors such as the quotation (income) of the project, what kind of work is required, and when the project can be completed. Once the dispatch company decides to accept a project, it starts dispatching human resources to complete the project.

The most fundamental purpose of labor dispatch enterprises in this talent dispatch project is to make profits (Li and Wang 2011). In more simple words, it is “making money” or “offsetting expenditure with the income”. If a project makes the sending enterprise lose money, the cash flow of the sending enterprise will be interrupted, and then it will not be far from bankruptcy. If you want to make money, you must make the income of the project greater than the cost of the project. According to the survey results, we came across that the income of the project mainly comes from a fee paid by Party A for the project. Most of the project costs come from labor costs, recruitment costs, and other expenses. This model classifies all the costs into three categories:

Fixed costs It refers to those costs that do not change with personnel, such as the cost of office supplies and some one-time expenses in the project. The fixed cost has nothing to do with the time factors and type of work, but it will vary according to the nature of the projects.

Variable costs The variable cost here refers to the cost positively related to the dispatched personnel and time (Chi et al. 2019). Because of the particularity of labor dispatch enterprises’ demand for human resources, this model divides variable costs into two types; Variable cost 1 refers to the variable costs for different types of work, such as wages paid to dispatched personnel, overtime pay, etc. Variable cost 2 refers to those variable costs that are not different according to different types of work, that is, the variable cost 2 of different types of work is the same. The variable cost 2 is only related to the project but has nothing to do with the type of work. The variable cost 2 is often realized in travel expenses, meal allowance, and other expenses.

Recruitment costs It refers to the average cost of recruiting and selecting a qualified dispatched employee, including recruitment expenses, training expenses, and other related expenses. The recruitment cost, like the fixed cost, is a one-time cost, which will not change with time and will not vary according to different projects, but it may vary according to the type of work.

Some parameters of the model which are important need to be defined. In addition to the above costs and project benefits, there are some important parameters of the project, such as how many man-hours the project needs to be completed, how much work a dispatched employee does per unit time, etc. according to the needs, the model puts forward the following factors to represent the above concepts:

1. Project revenue (R) Project revenue refers to the income of a project. This income does not throw out the expenditure but is a total income.
2. Fixed cost of the project (C) It refers to the fixed cost of the project as mentioned above.
3. Variable cost of the type of work 1 (W) Corresponds to variable cost 1 as mentioned above.
4. Variable cost of the type of work 2 (M) Corresponds to variable cost 2 as mentioned above.
5. Number of payments for variable costs (D) This factor is a time-dependent parameter, which means how many variable costs have been paid in a project cycle.
6. Man-hours required by the type of work (Q) The man-hours required by the type of work refers to the approximate man-hours required for a certain type of work last night. The workload of the project is usually quantified by man-hours, so different types of work will have different man-hours, which can be reasonably expressed (Zhou and Liu 2019; Ma 2017). The man-hours required by the type of work are usually determined by the project manager or project interface.
7. Working time of the type of work (t) This factor refers to the average working hours of dispatched employees in the current cycle.
8. Number of people required for the type of work (x) This factor represents the number of people required for the type of work. It is unknown for the model and needs to be solved.

There is no doubt that the ultimate goal of talent dispatch is to minimize the above costs or maximize the benefits. The cost here is equal to the fixed cost plus time multiplied by all variable costs. Suppose a project needs different types of work to be completed together, so the objective function is:

$$\min_x C + \sum_{i=1}^n D_i x_i (W_i + M)$$

(3)
where \( C \) is the fixed cost, and the sum of the following pile is the sum of variable costs for different types of work.

For an optimization model, after having the objective function, we also need to design constraints. There are two constraints here: the first constraint requires that the cost of the project should be less than the budget of the project, to obtain profits and income, and make the cash flow of the project should be less than the budget of the project, to fully dispatch rather than idle (because idle employees can’t guarantee working hours (Liu 2018)). Talent dispatch enterprises also need to make an optimal choice on how to dispatch personnel. In this paper, the model judges the advantages and disadvantages of an employee according to the fixed cost of each employee, to determine the dispatch order. Now there are many methods to quantify an employee’s skills, so how to quantify the employee’s skill value is not the research content of this paper. Suppose the skill vector of employee \( k \):

\[
q_k = (a_1, a_2, \ldots, a_i), \quad i \in (a, n)
\]

The meaning of the element in \( q_k \) is: the importance of the \( i \)-th skill of type \( a \) is \( \theta_i \).

The job skill weight vector intuitively reflects the importance of a job’s demand for employees’ ability. The employee’s ability value can be formulated as follows:

\[
s = \varphi \cdot \mu = (a_1 \theta_1 + a_2 \theta_2 + \cdots + a_i \theta_i)
\]

### 3.2 HR dispatch planning model

The following subsections explain the idea and concept of the HR dispatch planning model.

#### 3.2.1 Skill quantification algorithm of dispatched employees

After generating the above dispatch plan, the talent dispatch enterprise also needs to decide what kind of people to dispatch. However, people have different qualities, good and bad, and people are more complex. Some people are versatile and can be competent for many posts, while some people, such as pregnant women, take maternity leave and can’t guarantee working hours (Liu 2018). Talent dispatch enterprises also need to make an optimal choice on how to dispatch personnel. In this paper, the model judges the advantages and disadvantages of an employee according to the skills of employees, to determine the dispatch order. Now there are many methods to quantify an employee’s skills, so how to quantify the employee’s skill value is not the research content of this paper. Suppose the skill vector of employee \( k \):

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\[
s = \varphi \cdot \mu = (a_1 \theta_1 + a_2 \theta_2 + \cdots + a_i \theta_i)
\]

#### 3.2.2 Overall design of dispatch plan model

According to the above-mentioned statements and concepts, it can be calculated that the competency value of all the \( j \)-th employees can be competent for the \( i \)-th type of work is \( s_{ij} \), then a matrix of \( m \times n \) can be obtained to represent the competency value of all the dispatched employees:

\[
\begin{bmatrix}
s_{11} & s_{12} & \cdots & s_{1j} & \cdots & s_{1n} \\
s_{21} & s_{22} & \cdots & s_{2j} & \cdots & s_{2n} \\
\vdots & \vdots & \ddots & \vdots & \cdots & \vdots \\
s_{i1} & s_{i2} & \cdots & s_{ij} & \cdots & s_{in} \\
\vdots & \vdots & \ddots & \vdots & \cdots & \vdots \\
s_{m1} & s_{m2} & \cdots & s_{mj} & \cdots & s_{mn}
\end{bmatrix}
\]

(8)

It is assumed that the optimization model of dispatch is based on the premise that each person only does one job and cannot hold two jobs, that is, \( x_i \) person is required for the \( i \)-th type of work, and \( j \) person only does one job. Let the 0–1 variable \( z_{ij} \) represent: when \( z_{ij} \) is equal to 0, \( j \) person does not do the \( i \)-th type of work, and when \( z_{ij} \) is equal to 1, \( j \) person does the \( i \)-th type of work. The dispatch plan model is as follows:

\[
\max_{z_{ij}} \sum_{i} \sum_{j} s_{ij} z_{ij}
\]

(9)

For the dispatch of multiple projects at different times, modeling can be carried out during dispatch. In a specific project cycle, the objective function is to minimize the idle time of all employees, to ensure that all employees can be fully dispatched rather than idle (because idle employees will certainly not produce value), to achieve the best. At this time, the constraint condition should be: in the project cycle, the available workload of all employees should be greater than the total man-hours required for all projects.

### 4 Experimental results of human resources labor dispatch model

Every project has multiple nature of work and for doing the work there is need for people having expertise according to the nature of the work. Suppose that a dispatch company currently has 16 employees, and the dispatch project has four types of work: Java, Oracle, test, and PM. Their ability test values are calculated according to the ability value calculated by formula 7. The employee competence value for each job is calculated and shown in Table 1. Figure 2 shows the graphical representation of the performance of each candidate for the mentioned four types of tasks.

The human resource requirement for each job is shown in Table 2.

Table 2 shows at least how many people are required for doing a particular task. For instance, the accomplishment of the Java task needs 5 people, the Oracle task needs 3 people, the Testing task requires 4 people, and the PM needs 1 person respectively.
The dispatch planning model is based on 0–1 assignment problem and Hungarian algorithm. Lingo model of dispatch plan is also divided into three-part i.e. set part, data part, and model part. The middle set is as follows:

Table 1 Employee competence value

| Employee name | Java capability value | Oracle capability value | Test capability value | PM capability value |
|---------------|-----------------------|-------------------------|-----------------------|---------------------|
| Zhao Biyu     | 55                    | 50                      | 64                    | 82                  |
| Qian Jianjin  | 79                    | 80                      | 81                    | 50                  |
| Sun feiqiu    | 76                    | 68                      | 89                    | 67                  |
| Li Yudao     | 63                    | 67                      | 59                    | 82                  |
| Zhou Pei    | 63                    | 63                      | 74                    | 76                  |
| Wu Qixiu  | 82                    | 62                      | 61                    | 76                  |
| Zheng Yixiao  | 100                   | 80                      | 92                    | 57                  |
| Wang Bianliang  | 59                    | 52                      | 89                    | 70                  |
| Feng Xizheng  | 87                    | 91                      | 93                    | 67                  |
| Chen Guanyan  | 79                    | 74                      | 51                    | 62                  |
| Chu Shengyu  | 60                    | 80                      | 82                    | 92                  |
| Wei Pingcheng  | 93                    | 51                      | 87                    | 86                  |
| Jiang Fa    | 53                    | 72                      | 71                    | 93                  |
| Shen longbi  | 86                    | 77                      | 92                    | 66                  |
| Han Xiupei  | 95                    | 64                      | 69                    | 73                  |
| Yang Dingbo  | 62                    | 89                      | 99                    | 50                  |

Fig. 2 Each candidate performance and competence value

Table 2 Number of people required for each type of work

| Type of work | Java | Oracle | Test | PM |
|--------------|------|--------|------|----|
| Number of people required | 5    | 3      | 4    | 1  |
sets:
name;
kind: staff_require_number;
dispatch (name, kind): ability_value,
dispatch_flag;
End sets

Where name is the set of employees, kind is the type of work and has an attribute of personnel demand. Dispatch is a derived set, which is generated based on the first two sets, and has a known attribute of ability_value, represents the weighted capacity value of employees, and a 0–1 variable dispatch_flag—used to represent whether dispatch is required or not. The lingo statement is given as follows:

```
data:
   Kind=java oracle Test PM;
   Name=zhao qian sun 1i zhou wu zheng wang feng cheng chu wei jiang shen han yang;
   staff_require_number =5 3 4 1;
   ability_value = 55 50 64 82
       79 80 81 50
       76 68 89 67
       63 67 59 82
       63 63 74 76
       32 62 61 76
       100 80 92 57
       59 52 89 70
       87 91 93 67
       79 74 51 62
       50 80 82 92
       93 51 87 86
       53 72 71 93
       86 77 92 66
       95 64 69 73
       62 89 99 50;
End data
```

This shows that there are a total of 16 people and the number of tasks is 4. The ability value shows the ability score of each person while doing a specific task. The maximum value for each task is 100. The final solution results are shown in Table 3.

4.1 Control experiment (manual selection)

If you do not use this dispatch planning model to calculate the dispatch, you can compare the dispatch results by using the artificial arbitrary method. Suppose there is a dispatching method to compare with this dispatching method. Start from the type of work with the least demand, and select the person with the largest ability value. Then this person can no longer be dispatched by other types of work to meet the needs of the current type of work and start dispatching the person of the next type of work. And so on, until the demand with the largest number of people is met. At present, many distribution enterprises use this similar method to choose personnel dispatch.

In this way, it is still based on Tables 2 and 3. The dispatch results are shown in Table 4.

It can be seen that the benefit of dispatching through the artificial selection method is 1127, which is less than the result 1162 calculated by the HR dispatching plan model, which proves the effectiveness of this model.

5 Conclusion

Chinese enterprises are mostly labor-intensive, the labor outsourcing technique, also known as labor dispatch, has become a key trend among Chinese businesses. In this process, labor contracts are signed between dispatch
agencies and workers, and labor dispatch agencies send workers to employment enterprises to provide labor services. This paper provides a practical solution for the HR planning of labor dispatch companies. Through this model, labor dispatch companies can reasonably and quickly formulate a global optimal or local optimal distribution scheme, and maximize profits. At the same time, a system that can realize the function of the model is developed based on GA. Through the detailed investigation of the operation mode of labor dispatch companies, this paper establishes the most basic HR demand model of labor dispatch enterprises and also establishes the HR dispatch plan model. Through the model simulation process, the usability of the model is successfully verified. The future direction of this work is to investigate more intelligent computational models for the labor dispatch model. In

| Employee Name | Whether to do Java | Whether to do Oracle | Whether to do Test | Whether to do PM | Explanation |
|---------------|--------------------|----------------------|--------------------|------------------|-------------|
| Zhao Biyu     | 0                  | 0                    | 0                  | 0                | This employee will not be assigned |
| Qian Jianjin  | 0                  | 1                    | 0                  | 0                | This employee will be assigned to Oracle type of work |
| Sun feiqiu    | 0                  | 0                    | 1                  | 0                | This employee will be assigned to the Test type of work |
| Li Yudao      | 1                  | 0                    | 0                  | 0                | This employee will be assigned to Java work |
| Zhou Pei      | 0                  | 0                    | 0                  | 0                | This employee will not be assigned |
| Wu Qixiu      | 1                  | 0                    | 0                  | 0                | This employee will be assigned to Java work |
| Zheng Yixiao  | 0                  | 0                    | 1                  | 0                | This employee will be assigned to the Test type of work |
| Wang Bianliang| 0                  | 0                    | 1                  | 0                | This employee will be assigned to the Test type of work |
| Feng Xizheng  | 0                  | 1                    | 0                  | 0                | This employee will be assigned to Oracle type of work |
| Chen Guanyan  | 1                  | 0                    | 0                  | 0                | This employee will be assigned to Java work |
| Chu Shengyu   | 0                  | 0                    | 0                  | 0                | This employee will not be assigned |
| Wei Pingcheng | 1                  | 0                    | 0                  | 0                | This employee will be assigned to Java work |
| Jiang fa      | 0                  | 0                    | 0                  | 1                | This employee will be assigned to PM type of work |
| Shen longbi   | 0                  | 0                    | 1                  | 0                | This employee will be assigned to the Test type of work |
| Han Xiupei    | 1                  | 0                    | 0                  | 0                | This employee will be assigned to Java work |
| Yang Dingbo   | 0                  | 1                    | 0                  | 0                | This employee will be assigned to Oracle type of work |

Such a dispatch shown above is the most effective dispatch.

| Objective function (maximum) | Name | Maximum | Explanation |
|------------------------------|------|---------|-------------|
| Objective                    | 1162 | The total capacity value of all types of work in this way of distribution is 1162 |

Table 3: Results of the dispatch plan
addition, using more people for the experimental work is also one of the future directions of this work as this study takes a sample of 16 people for the testing purposes. Using more people for the experiment will help us in tracking the flexibility and stability of the model.

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**Data availability** The data used to support the finding are cited within the article.

**Declarations**

**Conflict of interest** The authors declared that they have no conflicts of interest in this work.

**Informed consent** We declare that all authors have informed Consent.

**Ethical approval** This paper does not deal with any ethical issues.

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