

Retraction

Retracted: Optimal Allocation of Human Resource Structure Based on Capability Maturity Model Integration

Security and Communication Networks

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This article has been retracted by Hindawi, as publisher, following an investigation undertaken by the publisher [1]. This investigation has uncovered evidence of systematic manipulation of the publication and peer-review process. We cannot, therefore, vouch for the reliability or integrity of this article.

Please note that this notice is intended solely to alert readers that the peer-review process of this article has been compromised.

Wiley and Hindawi regret that the usual quality checks did not identify these issues before publication and have since put additional measures in place to safeguard research integrity.

We wish to credit our Research Integrity and Research Publishing teams and anonymous and named external researchers and research integrity experts for contributing to this investigation.

The corresponding author, as the representative of all authors, has been given the opportunity to register their agreement or disagreement to this retraction. We have kept a record of any response received.

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- [1] L. Hao, "Optimal Allocation of Human Resource Structure Based on Capability Maturity Model Integration," *Security and Communication Networks*, vol. 2022, Article ID 3162328, 10 pages, 2022.

Research Article

Optimal Allocation of Human Resource Structure Based on Capability Maturity Model Integration

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In order to improve the economic benefits of enterprises and provide a scientific human resource management method for enterprises, an optimal allocation method of human resource structure based on the integration of capability maturity model is proposed. According to the capability maturity model and its maturity level, the capability maturity integration model is established, and the optimal allocation algorithm of human resources is designed according to the model principle. By constructing the personnel quality evaluation matrix and personnel allocation matrix, the human resource allocation model is established, and the cooperative game method is used to dynamically optimize the human resource allocation model. The experimental results show that this method effectively improves the economic benefits of enterprises, improves the efficiency of human resource allocation, and completes the preset goal.

1. Introduction

In the era of knowledge economy, human resources have become strategic resources of enterprises, and the construction and development of human resources capacity has also become a strategic issue for the survival and development of enterprises [1–3]. Some studies have shown that in the past decades, some human resource management methods, such as 360 degree performance evaluation, knowledge management, team building, and motivation-based salary system, have no obvious practical effect in some organizations. One of the important obstacles is the lack of organizational commitment and phased improvement [4–6]. In the era of knowledge economy, if enterprises still stick to the mechanical thinking mode and only focus on the local optimization of human resources, it may be difficult to get the expected results. Therefore, it is necessary to study an effective optimal allocation method of human resource structure [7].

In order to improve the effect of human resource allocation, relevant research experts put forward some solutions. Reference [8] proposes an optimal human resource management model based on the marginal utility model. Based on the marginal utility model, under the given conditions of the model, using the diminishing theory of

marginal utility, the enterprise human resource investment degree under each index is solved and the cost investment is calculated. According to the calculation results, optimize the allocation of human resources, increase the elasticity of the added value of per capita wage output value, and improve the annual output value of enterprises and the quality and efficiency of human resource management. The results show that the model can optimize the effect of enterprise human resource management to a certain extent, but due to the complexity of enterprise personnel structure, the efficiency of resource allocation is low. Reference [9] proposes a multiobjective optimization model of human resources for route maintenance tasks. Firstly, the law of the main input distribution of the configuration optimization model is determined by the hypothesis testing method, the queuing theory model of route maintenance is established, and the key indexes of the model are determined. On this basis, a multiobjective optimization model with the objectives of minimum maintenance cost, minimum maintenance time, and maximum availability is established, and the model is solved by NSGA II (nondominated sorting genetic algorithm). Finally, through the actual comparison, it is proved that the model has improved the time, cost, and availability of route maintenance to varying degrees, but the evaluation

score of human resource allocation effect in multiple dimensions is not high, and the expected profit of the enterprise cannot be effectively achieved with the support of this method. Reference [10] proposes a project-oriented enterprise human resource allocation optimization method based on the quality optimization model. From the perspective of optimizing project quality, it gives different quality impact factors to each project and each task of the project in the enterprise, divides the human resources shared by multiple projects in the enterprise according to the skill level, and optimizes the project quality. It is transformed into the problem of the highest human resource skill level of all enterprise project allocation, and an algorithm is designed to optimize the project quality through the optimal allocation of human resources. Finally, the operability of the model is ensured through case analysis, in order to provide a quantitative method and perspective for human resource allocation in project-oriented enterprises. However, there are still some problems in the practical application of this method, which need to be improved.

In view of the shortcomings of the above traditional methods, this paper proposes an optimal allocation method of human resources structure based on the integration of capability maturity model. Taking the continuous improvement of human resource management as the fundamental idea and the means of process management, total quality management, and goal management, this paper constructs an evolutionary and phased human resource management model. The model organically integrates the objectives and practice of organizational human resource management and uses the ability composition of human resource management system and the harmony of operation process to varying degrees to provide a step-by-step development platform for the organization to improve the overall human resource ability.

2. Research on Capability Maturity Model Integration

Capability maturity model integration is a software development standard. If we do according to this standard, we can help software enterprises improve and optimize management and improve product quality and reliability while improving software development level and efficiency. The purpose of this paper is to help optimize the allocation of human resources structure, manage, and improve the software engineering process and enhance the development and improvement ability, so as to develop high-quality software on time and without exceeding the budget. The main concerns are cost-effectiveness, clear focus, process integration, and flexibility. There are five levels in total, representing the five levels of capability maturity of the software team. The larger the number, the higher the maturity. A high maturity level indicates a strong comprehensive software development capability.

2.1. Capability Maturity Model. The capability maturity model is a development model created after studying data collected from organizations contracted with the U.S.

Department of Defense, which funds research. The term “maturity” refers to the form and optimization degree of the process, from temporary practice to formally defined steps, to management result indicators, and then to active optimization of the process. The goal of the model is to improve the existing human resource allocation process, but it can also be applied to other processes. The relationship between the structural components of the capability maturity model is shown in Figure 1. In addition to the initial level, each maturity level contains a corresponding series of objectives, which are set in each process area. These objectives are achieved through corresponding practice, so as to achieve the maturity level. When all practices of the process area are implemented as required, the objectives of the process area are achieved [11–13]. When all the objectives of the process domain are met, the maturity level is reached, and the capability of the enterprise is improved accordingly. In this way, organizational change is carried out at each maturity level, laying a solid foundation for continuous improvement and improvement in the next stage [14].

2.2. Maturity Level. The capability maturity model includes five maturity levels, and each maturity level is composed of basic practices in multiple human resource management fields. These levels have laid a phased foundation for continuous improvement and successful management of human resources [15, 16]. Each maturity level of the capability maturity model represents different levels of organizational management and development of human resource capability. Each maturity level provides a basis for continuous improvement and provides guidance for organizational management and development of human resource capability [17, 18]. The specific maturity level is shown in Figure 2.

2.3. Capability Maturity Integration Model. Capability maturity model integration (CMMI) model includes a series of maturity models, including SW-CMM (software capability maturity model), SE-CMM (system engineering capability maturity model), IPD-CMM (product integration development capability maturity model), PSP (personal capability maturity model), and SA-CMM (software acquisition capability maturity model) [19, 20]. Due to the duplication of various models in content and differences in structure and guidance specifications, training, evaluation, and improvement activities are often repeated, which has a negative impact on process improvement. The capability maturity integration model overcomes the above shortcomings and eliminates the repeated parts.

In the capability maturity integration model, the basic components can be summarized as process areas. Each process area includes specific objectives and general objectives, in which specific objectives need to be realized by implementing specific practical activities, while general objectives can be realized only by implementing general activities. Specific objectives and specific practices are unique in each process area, while common objectives and common activities can be applied to multiple process areas [21, 22]. In order to be structurally compatible with the

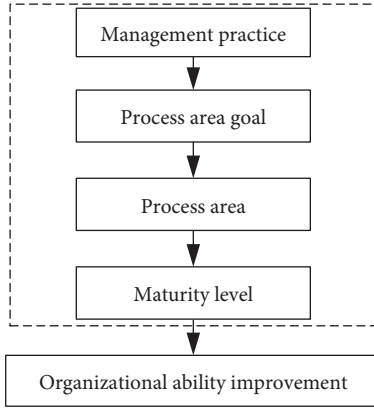


FIGURE 1: Organizational structure of capability maturity model.

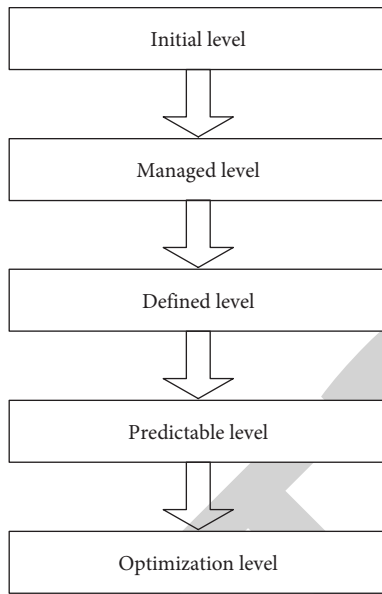


FIGURE 2: Maturity level.

capability maturity model developed in Section 2.1, the stage model of the capability maturity integration model is divided into five maturity levels just like the capability maturity model. Table 1 shows these five maturity levels and the process areas they contain.

3. Realization of Optimal Allocation of Human Resource Structure

According to the capability maturity integration model established in Section 2, it can be seen that enterprise human resource allocation management can be divided into multiple levels. The optimal allocation algorithm of human resources is designed according to the theory and model principle.

3.1. Optimal Allocation Method of Human Resources. In the actual optimal allocation of human resources, it is necessary to select and allocate according to the specific situation of the organizational structure and the focus of the post on the

ability needs of staff. The effective analysis of the above problems can be realized by using the above-established ability maturity integration model [23, 24]. On this basis, it is also necessary to consider the scores of candidates on a variety of competency elements required by the position and the weight distribution of each competency element in different positions.

Set candidate personnel set as $A = [a_1, a_2, \dots, a_n]$, job set as $B = [b_1, b_2, \dots, b_m]$, and capability element set as $X = [x_1, x_2, \dots, x_i]$. In general, positions are in a competitive state, and the number of candidates is often more than the number of positions, so $n \geq m$ in the above set.

3.1.1. Establish Personnel Quality Evaluation Matrix.

When evaluating and scoring personnel, in order to ensure the scientificity and impartiality of the score, various scoring factors and their respective weights in the score should be considered, such as superior evaluation (or evaluation team evaluation), peer evaluation, subordinate evaluation, self-evaluation, and outsider evaluation [25]. In general, the weight of superior evaluation (or evaluation team evaluation) is relatively large, while the weight of other evaluations is relatively small. This paper mainly considers four aspects: superior (or evaluation group) score, candidate self-score, colleague score, and subordinate score.

Quantitative assessments are made for each candidate on a 100-point system, and scores for each ability element of the personnel are obtained. Suppose the evaluation matrix is $(\alpha_{ij})_m$, $(\beta_{ij})_n$, $(\chi_{ij})_n$, and $(\delta_{ij})_n$, where α_{ij} , β_{ij} , χ_{ij} , and δ_{ij} represent the scores of the superior, the candidate, the colleague, and the subordinate on the ability element K_j of the person F_i , respectively.

3.1.2. Establish a Staffing Matrix. The configuration matrix of personnel and positions can be obtained by multiplying the personnel quality evaluation matrix and the post element weight matrix. Therefore, according to the matrix obtained in Section 3.1.1 [26], the personnel configuration matrix is established as follows:

$$(D_{ij})_{n \times m} = \frac{G_1(\alpha_{ij})_n + G_2(\beta_{ij})_n + G_3(\chi_{ij})_n + G_4(\delta_{ij})_n}{H_{ij}} \quad (1)$$

Among them, D_{ij} represents the comprehensive score of personnel F_i in position K_j ; G_1 , G_2 , G_3 , and G_4 are the weights of superior score (or evaluation group), candidate self score, colleague score, and subordinate score in personnel quality evaluation, respectively. The values of G_1 , G_2 , G_3 , and G_4 should be determined according to the specific situation of the organizational structure and the quality of the assessment personnel [27, 28].

3.1.3. Establish a Human Resource Allocation Model.

Suppose the organization has roles, the number of people in various roles is e_i ($i = 1, 2, \dots, N$), there are U tasks to be completed in a certain stage, and the time required to complete all tasks is T (days), the amount of work completed

TABLE 1: Capability maturity integration model level and its process area.

Level	Corresponding name	Process domain
1	Initial stage	Demand target setting
2	Managed level	Demand management, project planning, product quality assurance, configuration management
3	Level defined	Demand development, organization training, project management, risk management, decision analysis
4	Predictable level	Quantitative project management
5	Optimization level	Cause analysis, management decision

by role p_i alone in task u_j is V_{ij} (person/day), the amount of human resources invested by role p_i in task u_j is L_{ij} (person/day), and its corresponding quality capability index is W_{ij} , where $i = 1, 2, \dots, N$, $j = 1, 2, \dots, M$.

(1) Model assumptions

- (1) Personnel in the same type of role have exactly the same quality and ability index for the same task;
- (2) The amount of human resources invested by all roles in the same task is directly proportional to its quality capability index;
- (3) The effective cumulative rate of the role's human resource possession value.

Under the condition that the role's HR ownership value is certain, the greater the role's cumulative workload, the more reasonable the human resource allocation is. The effective cumulative rate of the role's HR ownership value is used to represent the ratio of the role's cumulative workload to the role's HR ownership value [29], that is,

$$Y = \sum_{i=1, j=1}^n e_{ij} \times \frac{V_{ij}}{p_i}. \quad (2)$$

(2) Modeling constraints

- (1) In time T , the sum of the human resources invested by the role in all projects is not greater than the value of its human resources:

$$\sum_{i=1, j=1}^n L_{ij} \leq Y. \quad (3)$$

- (2) In time T , the sum of the workload of the roles participating in the same task is not less than the demand value of the task:

$$\sum_{i=1, j=1}^n V_{ij} \geq C_{ij}. \quad (4)$$

Among them, C_{ij} represents the demand value of the task.

- (3) The principle of efficiency first, that is, as much as possible to let the character engage in tasks with a large quality and ability index. Assuming that the sum of the effective cumulative rate of the human resource possession value of all roles and the product of their quality capability index is S [30], then

$$S = \frac{\sum_{i=1, j=1}^m e_{ij} \times V_{ij}}{\sum_{i=1, j=1}^m L_{ij} \times T}. \quad (5)$$

Let the objective function be ∂ , and its expression is

$$\partial = \max \frac{\sum_{i=1, j=1}^n e_{ij} \times V_{ij}}{u_i p_i \times T}. \quad (6)$$

Among them, $i = 1, 2, \dots, N$ and $j = 1, 2, \dots, M$.

In the objective function, the smaller the value of T , the larger the value of ∂ , the shorter the time to complete all tasks, and the more reasonable the allocation of human resources. The greater the value of $\sum_{i=1, j=1}^n e_{ij} \times V_{ij}$, the higher the work efficiency and the more reasonable the allocation of human resources.

3.2. Optimization of Human Resource Allocation Model Based on Cooperative Game. The above process makes a detailed analysis on the four aspects of superior (or evaluation team) score, candidate self-score, colleague score, and subordinate score, but there are many influencing factors of human resource allocation, and different factors will fluctuate. Therefore, the cooperative game method is used to dynamically optimize the human resource allocation model established in Section 3.1 [31, 32]. In human resource management, there is a certain process to realize the scientific and reasonable allocation of human resources. Before realizing the rational allocation, it is necessary to understand the rationality of the current structure of existing human resources, so as to further scientifically introduce talents, improve the structure, and realize the rationalization of human resources structure allocation. The whole configuration process is as follows:

In order to obtain more outputs under the condition of constant investment in human resources training, so as to achieve the optimal economic benefits, the following objective function model is established:

$$\text{Max } \partial = \sum_{i=1}^n \sum_{j=1}^m C_{ij} Q_{ij}. \quad (7)$$

Among them, $\text{Max } \partial$ represents the optimal solution of the objective function; Q_{ij} represents the coefficient of the decision variable, that is, the output effect coefficient of the human resource training project, and its calculation formula is

$$Q_{ij} = \left[\frac{(Q - Q_{\min})}{(Q_{\max} - Q_{\min})} \right]. \quad (8)$$

Among them, Q represents the total input and Q_{\max} and Q_{\min} represent the maximum and minimum output results, respectively.

On this basis, in order to maximize the comprehensive transaction of input funds, for the above objective function model, the cooperative game method is adopted to set the following constraints:

$$\begin{cases} Q_{\max} - Q_{\min} > 0 \\ Q < Q_{\max} \\ B_{ij} < B_k \end{cases} \quad (9)$$

Among them, B_{ij} represents the total amount of human resource training project funds that can be allocated and B_k represents the total output that can be obtained by the k -th business unit.

Since each resource node has its own resource structure, in order to ensure that each resource node has its own resource structure in the optimal allocation of human resources, the task resources to be completed by each node are reasonably allocated [33, 34]. The allocation process is shown in Figure 3:

Through Figure 3, it can be found that multiple processes need to go through in the optimal allocation of human resources. Therefore, dynamic planning is carried out, and the optimal recursive equation of the optimal allocation model of human resources is expressed as

$$\begin{cases} \sum_{i=1}^N X_i < v(N), \\ \sum_{j=1}^M Y_j \geq c(M). \end{cases} \quad (10)$$

Among them, $v(N)$ represents the resource support obtained by the allocation object and $c(M)$ represents the minimum allocated funds of the project [35, 36].

Thus, through the above process, the design of the optimization configuration method of human resource structure based on the integration of the capability maturity model is completed.

4. Experimental Analysis

In order to verify the significance and value of the human resource structure optimization allocation method based on the integration of capability maturity model, this paper takes a large enterprise as an example to study the application of the method and analyzes the advantages and key capabilities of this method combined with the experimental results.

4.1. Experiment Subject. The enterprise involved in the experiment is a software company mainly engaged in the R&D and sales of application software products and industry solutions with independent intellectual property rights and related computer system integration services. The company has 331 employees, 74.02% of whom have bachelor degree or above, including 193 software product R&D and implementation personnel, accounting for 58.31% of the total.

Taking the enterprise as the research object, this paper compares the optimal allocation method of human resources

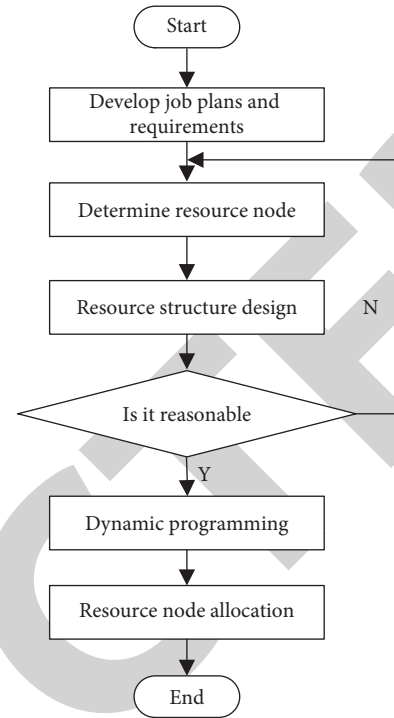


FIGURE 3: Flow chart of resource node allocation.

structure based on the integration of the capability maturity model, the optimal human resources management model based on marginal utility model and the multiobjective human resources optimization model of airline maintenance task. In the experiment, 10 experts were selected to study and judge the ability elements of enterprise employees. These 10 experts are excellent talents in relevant fields. They have more profound research opinions on enterprise human resource allocation and other related contents and have excellent professional consciousness and professional knowledge.

In order to avoid the influence of directional thinking on the test object, the test object will not be put forward in the test process, especially the ability requirements of the test object will not be evaluated or guided nor will specific problems be discussed. Briefly explain the capability items proposed by the test object in the test to confirm whether there is inconsistency in connotation understanding and pay special attention to the capability items that have not yet appeared.

4.2. Analysis of Experimental Results

4.2.1. Analysis of Different Dimensions of the Effect of Human Resource Management. Firstly, different methods are used to compare the scores of different dimensions under human resource allocation, including five dimensions: employees' technology application ability, enterprises' organizational change ability, training professional ability, research and development ability, and project management ability. Score the five dimensions, respectively. The score range is 0–10. The higher the score, the better the effect of human resource allocation. Figure 4 shows the comparison results of human resource management effects of different methods.

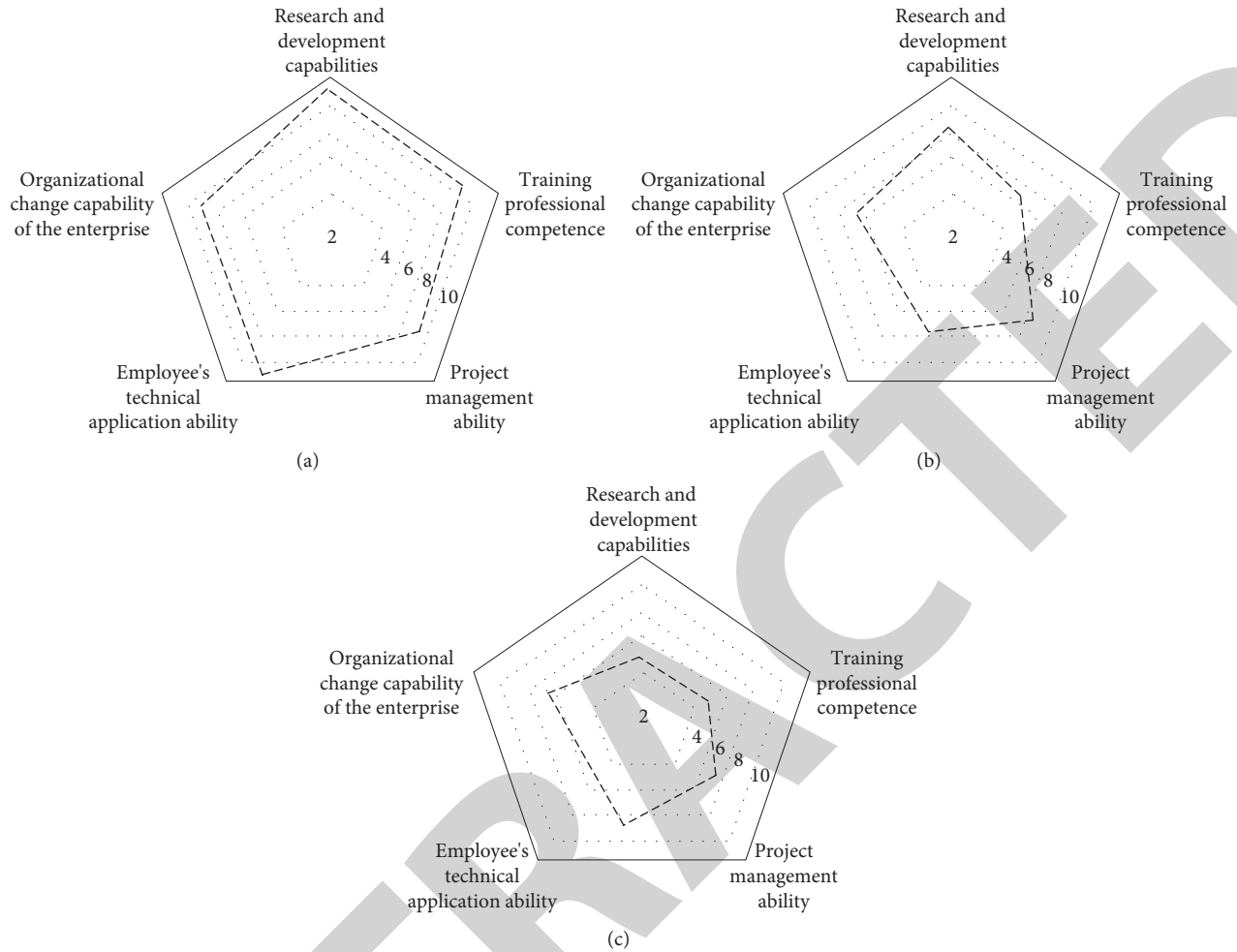


FIGURE 4: Comparison of the effects of different methods of human resource allocation. (a) Method of this article, (b) Human resource management model based on marginal utility model, and (c) Multiobjective optimization model of human resources for airline maintenance tasks.

According to the analysis of Figure 4, the evaluation scores of the five dimensions under the method in this paper are higher than the human resource management model based on marginal utility model and the multiobjective human resource optimization model of route maintenance task, and the advantages are very obvious. Under this method, the scores of employees' technical application ability, training professional ability, and research and development ability have reached more than 8 points, while the scores of each dimension of the two traditional methods have not exceeded 8 points. Therefore, with the support of this method, the effect of enterprise human resource allocation has made progress in multiple dimensions, and the effect of human resource allocation is better.

4.2.2. Expert Evaluation of Ability Dimension. After basic information statistics, first consult the experts' views on the five ability dimensions, ask them to tick the satisfactory dimension, explain the reasons for the unsatisfactory dimension, and put forward modification suggestions. The recognition of the five capability dimensions is shown in Table 2.

From the above statistical data, it can be seen that the experts have a high recognition attitude towards the enterprise's organizational change ability, research and development ability, and project management ability, and they are very consistent. One expert put forward different opinions on the dimension of employees' technology application ability, which should be reflected in other ability dimensions. Two experts put forward different opinions on training professional ability. It can be seen that 10 experts basically agree with the capability dimension under the method in this paper, and only think that individual capability dimensions need to be improved, which further proves that the method in this paper has a good effect on the optimal allocation of human resources.

4.2.3. Efficiency of Human Resource Allocation. Taking the efficiency of human resource allocation as the experimental index, the application effects of different methods are compared, and the results are shown in Figure 5.

According to the analysis of Figure 5, the human resource allocation time of the method in this paper is

TABLE 2: Experts' recognition of competency dimensions.

Capability dimension	Number of consenting persons/person	Number of disagreements/person
Technical application ability of employees	9	1
Organizational change capability of enterprises	10	0
Training professional competence	8	2
Research and development capability	10	0
Project management capability	10	0

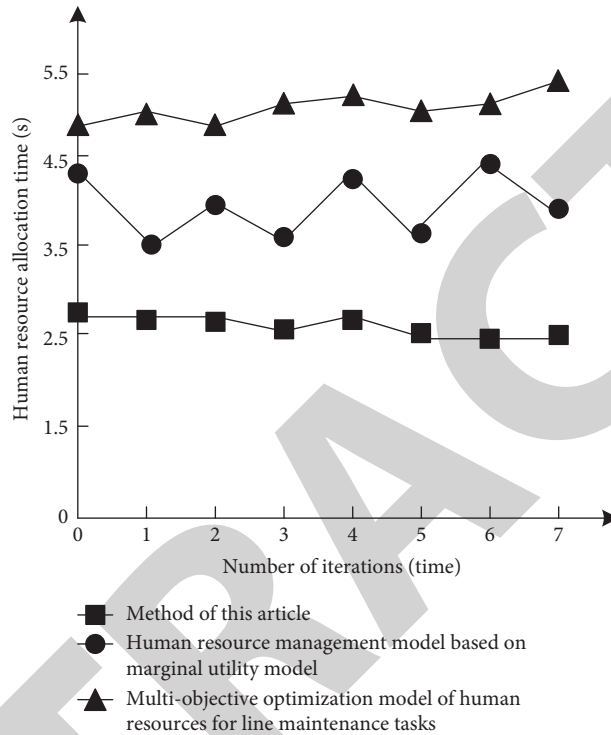


FIGURE 5: Comparison of the efficiency of human resource allocation by different methods.

significantly lower than that of the two traditional methods. The minimum value of human resource allocation time is 2.4 s, and the maximum value is only 2.7 s. In contrast, the human resource allocation time of the human resource management model based on the marginal utility model is long, unstable, and fluctuates greatly. Although the human resource allocation time of the multiobjective human resource optimization model of airline maintenance task is relatively stable, the human resource allocation time is longer. The results show that this method can quickly get the optimal allocation results and improve the allocation efficiency. It is an effective method to solve the problem of optimal allocation of human resources.

4.2.4. Analysis of Corporate Income. The ultimate goal of human resource allocation is to improve the economic benefits of the enterprise and bring more profits to the enterprise. Therefore, compare the economic benefits brought by different resource allocation methods. Figure 6 shows the economic benefits of the enterprise without human resource allocation, and Figure 7 shows

the economic benefits of the enterprise after applying different methods.

According to Figures 6 and 7, the economic benefits of the enterprise have been effectively improved after the human resource allocation optimization using the method in this paper, while the economic benefits of the enterprise have not been significantly improved after the human resource allocation using the traditional method. Therefore, the application value of this method is higher and can bring more considerable economic benefits to enterprises.

To sum up, comparing the two traditional methods, with the support of this method, the effect of enterprise human resource allocation has made progress in multiple dimensions, and the effect of human resource allocation is better. Ten experts basically accepted the capability dimension under this method and only thought that individual capability dimensions needed to be improved, which further proved that the optimal allocation effect of human resources in this method was good. This method can quickly get the optimal allocation results and improve the allocation efficiency. It is an effective method to solve the problem of optimal allocation of human resources. And, the application

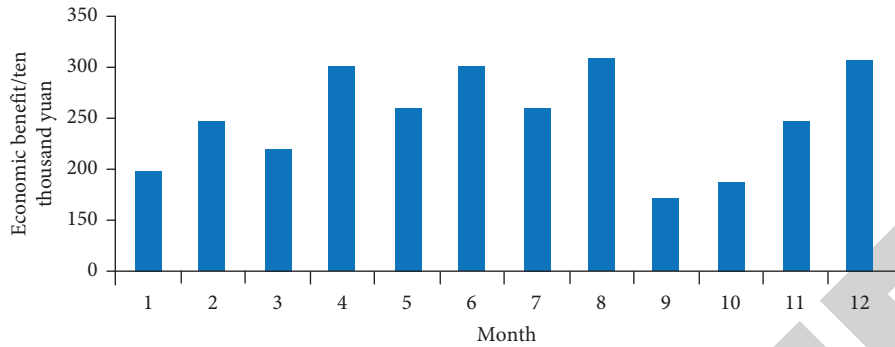


FIGURE 6: The economic benefits of the enterprise without the allocation of human resources.

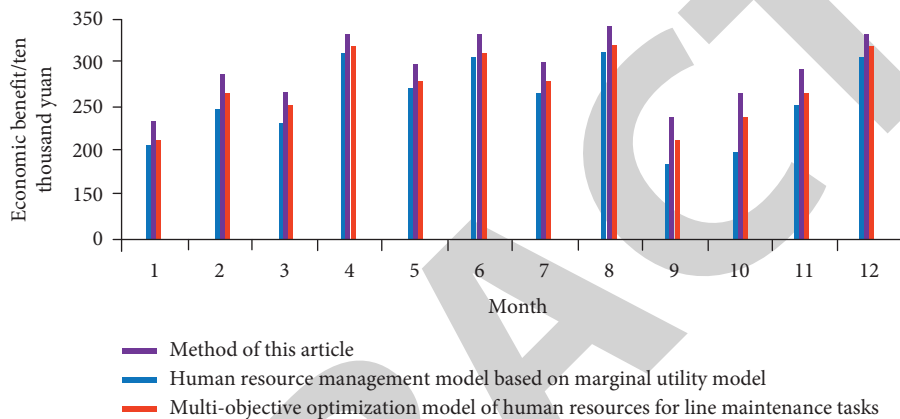


FIGURE 7: Comparison of corporate economic benefits of different methods.

value of this method is higher, which can bring more considerable economic benefits to enterprises.

5. Conclusion

Aiming at the problem that the traditional methods have low efficiency of human resource allocation and cannot effectively improve the economic benefits of enterprises, an optimal allocation method of human resource structure based on the integration of capability maturity model is proposed. The experimental results show that this method effectively improves the economic benefits of enterprises and the efficiency of human resource allocation, which shows that this method has higher application value. The optimal allocation of human resource structure based on the integration of capability maturity model has high application value and can bring more considerable economic benefits to enterprises. The next research work is to mine the membership function value of fuzzy set from the input-output database by using the neural network method, a data mining method in knowledge engineering, according to the close relationship between the input and output of human resources.

Data Availability

The raw data supporting the conclusions of this article will be made available by the author, without undue reservation.

Conflicts of Interest

The author declares no conflicts of interest regarding this work.

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