Research Article

Visualization of the Digital Enterprise Performance Management System Integrating the Simulated Annealing Algorithm

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Received 2 June 2022; Revised 29 July 2022; Accepted 17 August 2022; Published 9 September 2022

Academic Editor: Sagheer Abbas

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Enterprises conduct performance management through performance management systems, which can greatly improve work efficiency and quality. The win-win of human resources and time resources has been realized, making the assessment fair and objective. At present, the application of performance management to digitalization is becoming more and more intense. This paper proposes to use the optimization of the simulated annealing algorithm to help the research of the enterprise performance management system. It is helpful to analyze and solve some negative factors brought by the current traditional enterprise performance management system, so that the employees of the enterprise have higher satisfaction in the performance, and the enterprise can have more far-reaching development goals. In the subsequent survey of employee satisfaction with the enterprise performance management system, the results show that after the implementation of performance management reform, the recognition of performance management by enterprise managers and employees has increased significantly. Among the returned questionnaires, 3360 people expressed great satisfaction, and the proportion increased from 32.69% to 63.62%, almost doubling. A total of 4259 people expressed great satisfaction and satisfaction, the proportion increased from 70.08% to 87.35%. A total of 1021 people expressed dissatisfaction and very dissatisfaction, the proportion dropped from 29.92% to 12.65%. Therefore, this survey result shows that the visual analysis of the digital enterprise performance management system and its application in the operation of the enterprise is very important.

1. Introduction

In today’s society, the market economy is constantly developing under the current situation, and the modes of competition are ever-changing. For the purpose of maintaining an invincible position in the competition, enterprises often continuously update and upgrade technology and equipment to ensure the front-end and advanced nature. Correspondingly, the training personnel should be more familiar with and master the relevant specific knowledge. To a certain extent, the competition focus of enterprises in the current society has turned to technical talents with specific knowledge. For enterprises, talent is a very core competitiveness and an important intangible capital. If an enterprise wants to win in the increasingly fierce competition in modern society, it must create more value as much as possible. To achieve this, enterprises also need to fully mobilize and exert their own human resource advantages. Therefore, performance management is a very important part of the practice activities of human resource management in enterprises, and it is also an important factor closely related to its own success for enterprises.

Performance management refers to decomposing goals according to the company’s development strategy and annual key tasks as the basic tasks, so that performance managers and employees form a systematic relationship in terms of work tasks, target completion, and improvement direction and reach a performance appraisal agreement. It is a management method to carry out performance appraisal according to the established appraisal plan, which plays a role of incentive or reminder and finally realizes the annual work tasks and development goals of the enterprise. Of
course, the role of performance management for enterprises is not limited to this. It plays a very important and basic role in the management of employees’ compensation, training, incentives, career, and other aspects.

The enterprise performance management system plays an important role in the survival and development of the enterprise, and many scholars have carried out corresponding research on it. Among them, Gianni et al. made a content analysis of three management theories in order to study the influencing factors of the enterprise performance management system [1]. Feder and Weienberger suggested that by integrating CSR-related aspects into their management control systems, both formal and informal, companies could direct their CSR-related actions and achieve positive performance outcomes [2]. Dana et al. aimed to provide an overview of literature on management control systems and intellectual capital accounting methods in logistics and to relate these concepts to the sustainability of firm performance [4]. The purpose of the study was to assist companies in designing new performance management systems to improve their performance. The integrated performance management system framework was chosen because of its ability to overcome problems in the company [5]. However, the above research studies cannot be separated from the analysis of the traditional enterprise performance management system. It is impossible to optimize and analyze it in depth, so that the computer algorithm cannot be fully integrated with the enterprise performance management system, and its practicality cannot be too strong.

The use of the simulated annealing algorithm to optimize the enterprise performance management system is a very novel field, which has attracted a large number of scholars to study it. For example, Yilmaz and Yazgan proposed the opportunity for companies to create their own enterprise performance management systems to understand sustainability and competition in the field of training [6]. Mohammed et al. aimed to discuss employees’ attitudes towards enterprise performance management systems to help companies achieve positive performance results [7]. Cui studied the simulated annealing algorithm according to the enterprise performance management system. First, the intelligent recommendation system was mathematically modeled according to association rules. After analyzing the requirements of an enterprise performance management system, techniques were used to divide the system architecture into presentation layer, business logic layer, and data layer [8]. Wanquan and Lixin proposed an enterprise performance management system based on the simulated annealing algorithm for enterprise management, which can help enterprises to manage companies more efficiently [9]. In Fu’s article, the simulated annealing algorithm was used to optimize, analyze, and construct the system of the enterprise performance evaluation system. The adoption of new research methods and viewpoints can promote research on the use of performance information, which was of great significance to the realization of the effectiveness, scientificity, and sustainability of corporate performance management [10]. In the above series of studies, the simulated annealing algorithm is associated with the enterprise performance management system, which makes this method more important in the system analysis of enterprise performance management. However, due to the limitation and singularity of traditional enterprise performance management methods, it is impossible to maximize the application of the simulated annealing algorithm.

The analysis of the performance management system can combine enterprise performance management with computer technology and informatization. Compared with the traditional and single performance appraisal method, computer technology has built a convenient and systematic platform for the performance appraisal of enterprises, which can realize the participation of all employees, thereby improving the efficiency and accuracy of enterprise performance management and appraisal. It can greatly shorten the working time and save the cost and reduce the workload of the human resources department by using the system management method to carry out the performance management of the enterprise. There is no need to spend a lot of energy on managing employees. The performance communication interviews between employees and performance managers are stored and invoked in an information-based way, so that the consistency of goals can be recognized and the sharing of information is enhanced. In the performance appraisal system, the employee’s performance appraisal information is updated monthly, quarterly, and annually. Therefore, all employees can log into the performance appraisal system at any time, and through the system, employees can check their own performance appraisal situation and more clearly their personal work goals. It is necessary for employees to always regard improving their own quality and ability as their own responsibility, to achieve more income with more work, and to promote career development, so that performance managers can also pay attention to employee dynamics in real-time. Team performance can also achieve the goals that need to be achieved, helping performance managers to better perform their duties and responsibilities in their daily work, know people and make good use of them and help them grow. On the basis of using the simulated annealing algorithm, this paper investigates and analyzes the attitude of employees of a company to the performance management system. The results show that with a total number of 330 people, after the implementation of the performance management reform, the recognition of the performance management by the leaders and employees of the enterprise has been greatly improved. These results show that the optimization of performance management has an obvious effect on employee satisfaction, that is, the quality of performance management determines the development of the company. The innovation of this paper is that it optimizes the performance appraisal process, scientifically quantifies the appraisal results, pays more attention to actual performance, is more open and transparent, and improves the objectivity and fairness of performance appraisal. In the performance appraisal system, all the processes are preset in
the computer, so the operational scope for the performance appraiser is very limited. And all the calculation methods of the assessment scores are also calculated automatically by the system, which increases the credibility and accuracy of the performance assessment results and reduces subjectivity.

2. Methods of the Enterprise Performance Management System

2.1. System Requirement. Performance rules are the basis for the design of performance management systems. The power supply enterprise performance management system studied in this paper also designs a set of performance rules, which mainly includes two parts: the scoring part and the evaluation part. The results and score conversion of the assessment evaluation are the same as the internal evaluation [11]. Therefore, the performance management system designed should be able to reflect the assessment process specification and assessment results and be fair and directly applicable to employees’ careers and be able to rank according to the annual assessment results of employees in the system. According to the ranking, the performance grades A, B, C, and D are divided according to the prescribed proportion. The salary distribution of employees whose annual performance grade is D will be affected, and at the same time, it is impossible to promote the position and rank and cannot participate in the selection of expert talents and advanced selection. Therefore, the design of the performance management system should be as comprehensive, fair, and accurate as possible. An example diagram of system assessment objects and assessment modes is shown in Figure 1.

Figure 1 shows the institutional system of performance appraisal management of power supply enterprises. It can be seen that the evaluation system is mainly divided into organizational performance and employee performance, corresponding to three major types of evaluation modes and means: the key performance system, the target task system, and the work point evaluation system [12].

After understanding the problems that may exist in the process of system requirements analysis, in the process of performance system requirements analysis, errors or omissions in similar requirements analysis can be avoided in a targeted manner, and the efficiency of system requirements research and analysis can be improved. An example of the designed structure is shown in Figure 2.

As can be seen from Figure 2, according to the structure of the system requirement analysis, the requirements of the performance management system can be roughly divided into two categories: functional requirements and nonfunctional requirements. Among them, functional requirements include user requirements and business requirements; nonfunctional requirements mainly include system performance requirements, such as system security, response speed, and scalability.

2.2. System Functions. In the functional analysis of the system, this paper shows that it meets the needs of performance management, that is, to achieve all the functions that enterprise performance management needs to include. User requirements are some of the additional requirements that users need for the system to be convenient for their own use in addition to the basic functions that the system solves for the actual work content [13, 14]. Its functional flow diagram is shown in Figure 3.

As can be seen from Figure 3, at the initial stage of the establishment of the performance system, the system administrator first builds the organisational structure, i.e. organisation management, and then the personnel management department builds the user rights management system, i.e. user management. Each department then formulates the corresponding post performance indicators according to the functions of the department, that is, assessment project management. Finally, the personnel in charge of each assessment result will save or organize the assessment results, that is, assessment result management.

2.3. User Management Module. There are many people in the company. For various types of personnel identities, in order to facilitate management, it is necessary to distinguish user identities, such as system administrators, general staff, department heads, and enterprise heads. In this module, it is necessary to realize the setting of system maintenance authority, which is convenient for system administrators to manage and maintain the system. At the same time, for different nodes in the performance management process, it is necessary to set system functions for personnel with
different performance functions to facilitate performance management. The determination of the specific system operation authority should be determined according to the department and identity of the staff member [15]. After determining the status and role of the employee, it is also necessary to back up and track the performance process of the employee according to their performance identity and continuously update the corresponding performance appraisal data and information.

The user management module in the performance appraisal management system can be divided into three sub-functions, mainly including user management, authority management, and role management. Its structure is shown in Figure 4.

As can be seen from Figure 4, in the user management sub-function, when a new employee joins, the user must be defined, including username and password settings. When employee information changes, user-related information can be modified. When employees resign or retire, users can be deleted [16, 17]. In role management, it mainly implements the function of setting user roles and modifying or deleting roles. In rights management, it is necessary to be able to customize the rights of different employee roles and
to be able to modify and delete rights with the change of employee roles. Table 1 shows the correspondence between various identity types and user management rights in power supply enterprises.

It can be seen from Table 1 that the system administrator has the highest authority and can implement functions such as adding and deleting users, role definition, and authority definition. The person in charge of the enterprise can add or delete users and modify user information according to their needs. At this time, the users are mainly responsible for the information related to the heads of various departments. The authority of the department head can modify user information and define roles. At this time, the users are mainly ordinary employees in the responsible department.

2.4. Data Table Design. Combined with the above design analysis, the content of the corresponding modules is distinguished and managed by designing table classes. Combined with the requirements of the system, the table types of the system can be summarized as the user information table and the employee evaluation information table. The detailed design is shown in Tables 2 and 3.

It can be seen from Tables 2 and 3 that through the design of the user information table, the assessment plan table, and the employee evaluation information table, it can help to analyze the overall framework and database modules in the enterprise performance management system.

2.5. Simulated Annealing Algorithm. The simulated annealing algorithm, when applied to an enterprise performance management system, can help the enterprise performance management system to better calculate and record employee information and update it in real-time [18].

In the SA algorithm, the acceptance function is also called the state transition rule, that is, the transition probability or the acceptance probability. And the acceptance probability depends on the temperature and the change of the objective function $\Delta E$.

$$P = \exp\left(-\frac{\Delta E}{T}\right).$$  

Among them, $T$ is the current temperature. Acceptance of non-improved transfer is more likely when the current temperature is high. When the current temperature is low, the possibility of accepting a non-improved transfer is very small, and the search at this time is equivalent to a local search. It can have better accuracy when it is used in the

<table>
<thead>
<tr>
<th>Permission category</th>
<th>Define permissions</th>
<th>Add and delete personnel information</th>
<th>Modify user information</th>
<th>Define roles</th>
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<td>√</td>
<td>√</td>
<td>√</td>
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<td>System administrator</td>
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<td>√</td>
<td>√</td>
<td>√</td>
</tr>
<tr>
<td>CEO</td>
<td>√</td>
<td>√</td>
<td>√</td>
<td>√</td>
</tr>
<tr>
<td>Department head</td>
<td>√</td>
<td>√</td>
<td>√</td>
<td>√</td>
</tr>
<tr>
<td>General staff</td>
<td>√</td>
<td>√</td>
<td>√</td>
<td>√</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
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<th>Field name</th>
<th>Column name</th>
<th>Type of data</th>
<th>Length</th>
</tr>
</thead>
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<td>User ID</td>
<td>ID</td>
<td>INT</td>
<td>8</td>
</tr>
<tr>
<td>2</td>
<td>Username</td>
<td>Name</td>
<td>VARCHAR</td>
<td>16</td>
</tr>
<tr>
<td>3</td>
<td>Password</td>
<td>Password</td>
<td>VARCHAR</td>
<td>20</td>
</tr>
<tr>
<td>4</td>
<td>User type</td>
<td>Type</td>
<td>INT</td>
<td>4</td>
</tr>
<tr>
<td>5</td>
<td>Password question</td>
<td>PSWQ</td>
<td>VARCHAR</td>
<td>20</td>
</tr>
<tr>
<td>6</td>
<td>Password hint</td>
<td>PSWA</td>
<td>VARCHAR</td>
<td>25</td>
</tr>
<tr>
<td>7</td>
<td>Registration time</td>
<td>RGTIME</td>
<td>Date time</td>
<td>16</td>
</tr>
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<table>
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<td>Job number</td>
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<td>INT</td>
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</tr>
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<td>2</td>
<td>Employee's name</td>
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<tr>
<td>3</td>
<td>Department</td>
<td>Department</td>
<td>VARCHAR</td>
<td>25</td>
</tr>
<tr>
<td>4</td>
<td>Position</td>
<td>Position</td>
<td>VARCHAR</td>
<td>25</td>
</tr>
<tr>
<td>5</td>
<td>Overview</td>
<td>Evaluation</td>
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</tr>
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<td>Skill levels</td>
<td>Skills</td>
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<td>7</td>
<td>Rewards and penalties</td>
<td>Inventive</td>
<td>VARCHAR</td>
<td>55</td>
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<tr>
<td>8</td>
<td>Evaluation time</td>
<td>RGTIME</td>
<td>Date time</td>
<td>20</td>
</tr>
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</table>
enterprise performance management system, which helps the system to optimize user modules and function modules and improves the running speed of the interface.

If the initial temperature is very high, the search will be a random local search over a period of time. In the initial stage of the algorithm, all moves are accepted and the main disadvantage of this strategy is the high computational cost. If the initial temperature is very low, the search will be local. Therefore, in the SA algorithm, it is very critical to find a suitable initial temperature. There are two commonly used initial temperature determination methods, namely, the deviation acceptance method and the initial temperature adjustment method [19, 20]. The deviation acceptance method is to calculate the initial temperature \( T_0 \) through preliminary experiments.

\[
T_0 = k\sigma.
\]  

(2)

Among them, \( \sigma \) represents the standard deviation between objective function values.

\[
k = \frac{3}{\ln(p)}, \quad p > 3\sigma.
\]  

(3)

Initial temperature adjustment method: it is accepted by starting with a very high temperature and reducing it rapidly until 60% of the non-improved transfer. This temperature is then used as the initial temperature. The three options of linear, geometric, and logarithmic cooling are shown as follows:

\[
T_i = T_0 - i \cdot \beta,
\]

\[
T_{i+1} = \alpha \cdot T_i,
\]

\[
T_i = \frac{T_0}{\ln(i + 10)}.
\]  

(4)

Among them, \( T_i \) is the temperature at the \( i \)th iteration, \( \beta \) is a specified fixed value, \( T_0 \) is the initial temperature, \( \alpha \in (0, 1) \), and the value of \( \alpha \) is between 0.5 and 0.99, which is the best. By applying the algorithm to the systematic analysis of enterprise performance, it can help the system to optimize and help the enterprise to develop. \( T_i \) is compared to the performance appraisal indicators in the system, and it is cooled by the abovementioned schemes, and finally, the results that help the system to be optimized are obtained.

3. Company Employee’s Survey on the Performance Management System

3.1. Sample Library. A company has 760 leading employees in 11 internal departments, including 73 middle-level and above managers. By using the method of “stratified sampling,” random sampling is carried out according to the two levels of senior managers and middle managers, grass-roots managers and general staff. Among them, the sample number of middle and senior managers is 50, accounting for 68.5% of the total number of middle and senior managers. The sample number of grassroots managers and general staff is 280, accounting for 47.7% of the total number of grassroots managers and general staff. Investigated personnel do not include short-term temporary hires [21].

3.2. Specific Implementation Process. In order to further verify the effectiveness of the performance management system in the one-year trial operation, a questionnaire survey was conducted twice before and after the trial operation. And the surveyed persons were selected by random number generator software. Two young employees under the age of 35 were selected from the enterprise to form a three-person investigation team to refine the division of responsibilities. According to the division of labor, they went to various departments to find the corresponding respondents and distributed a total of 330 questionnaires and informed the specific time of collection. Finally, 330 questionnaires were collected on schedule. The validity was judged, and the effective questionnaires were statistically summarized.

3.3. Statistical Methods. Classification and statistics were made according to the basic situation of the respondents in questions 1–8 of the questionnaire. One person chose one question and one option was counted once. In the end, 50 middle and senior managers had 800 choices in the evaluation of the current performance management questions 1–16, and 280 lower-level managers and general staff had 4480 choices.

4. Questionnaire Statistical Results

4.1. Results of the First Survey. Figure 5 shows the overall satisfaction of middle and senior managers and grassroots personnel in the first survey.

As shown in Figure 5(a), in terms of organizational management and performance management, 32,116 middle and senior managers were very satisfied, accounting for 43.25%. 337 people were relatively satisfied, accounting for 42.13%. 74 people were dissatisfied, accounting for 9.25%. 43 people were very dissatisfied, accounting for 5.38%. As shown in Figure 5(b), 1,380 people were very satisfied with the selection of grassroots managers and general staff, accounting for 30.80%. 1637 people were satisfied, accounting for 36.57%. 1079 people were dissatisfied, accounting for 24.08%. 384 people were very dissatisfied, accounting for 8.57%.

4.2. Results of the Second Survey. After the trial operation of the performance management system, the satisfaction of the leaders and employees of the enterprise is shown in Figure 6.

As can be seen from Figure 6(a), middle and senior managers selected 346 people who were very satisfied, accounting for 43.25%, 337 people who were relatively satisfied, accounting for 42.13%, 74 people who were dissatisfied, accounting for 9.25%, and 43 people who were very dissatisfied, accounting for 5.38%. As can be seen from
Figure 6(b), 1,380 people were very satisfied with the selection of grassroots managers and general staff, accounting for 30.80%. 1,637 people were satisfied, accounting for 36.54%. 1,079 people were dissatisfied, accounting for 24.08%. 384 people were very dissatisfied, accounting for 8.57%.

The results show that after the implementation of the performance management reform, the recognition of the performance management by the leaders and employees of the enterprise has been greatly improved. Among the returned questionnaires, 3,360 people were very satisfied, and the proportion increased from 32.69% to 63.62%, an increase of nearly 1 times. A total of 4,259 people were very satisfied and satisfied, and the proportion increased from 70.08% to 87.35%. A total of 1,021 people were dissatisfied or very dissatisfied, and the proportion dropped from 29.92% to 12.65%.

It can be seen intuitively from the above series of graphs that through continuous reform and optimization, a correct performance management concept is established from top to bottom. Personalized customized performance indicator system is boldly promoted with a scientific layout. By actively implementing the enterprise performance management system and insisting on the full disclosure of evaluation
and results application, the recognition of the reformed and optimized performance management has been greatly improved by all the leaders and employees of the company. In particular, the acceptance of the company’s implementation of performance management has been significantly improved by middle and senior managers. Similarly, the resistance of grass-roots managers and general staff to the company’s implementation of performance management has also dropped significantly [22].

5. Conclusion

The use of the performance management system can not only save a lot of time in the human resources department but also eliminate the need for corrections due to departmental or employee operational errors. The power supply enterprise performance management system designed in this paper has relatively complete functions, including every content required in performance management. The requirements for system implementation include management departments and users, management performance results, management assessments, and projects. At the beginning of this paper, the framework and outline design of the software are described, and the second step is to design each module and database. Among them, the simulated annealing algorithm plays an important role in the analysis of the system. When it comes to the survey of user modules and employee satisfaction, the algorithm has been systematically optimized. And through the satisfaction survey of the company’s employees, a visual analysis of the enterprise performance management system is carried out. In this way, employees can understand and be truly convinced of the gap between their own work performance and performance appraisal goals and make effective performance improvements. In the long run, employees have also received relatively complete and scientific career management guidance, which has improved the “three senses” of employee contract awareness, responsibility awareness, and self-improvement awareness. Through point-to-face and in-depth advancement, a scientific and reasonable performance management system will significantly improve the vitality of the workforce and the efficiency of human resources.

Data Availability

The data used to support the findings of this study are available from the corresponding author upon request.

Conflicts of Interest

The authors declare that there are no conflicts of interest.

References


