Design of Human Resource Performance Appraisal System Integrating Big Data Technology

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Abstract. As an enterprise HRM (Human Resources Management), how to realize the scientific and rational management of the enterprise with the help of BD (big data) technology, and how to mine the information that is beneficial to the decision-making of the enterprise from a large amount of data has become an important issue at present. This paper studies and designs HR (Human Resources) performance appraisal system with BD technology. The advanced nature, maintainability and expansibility of the system should be considered as much as possible in the design. This system adopts B/S structure and ASP.NET three-tier architecture mode. Aiming at a large number of uncertain management factors in HRM, this paper puts forward an HR information management model based on DT (Decision Tree) algorithm. Aiming at the shortcomings that the logical expression of ID3 algorithm is not clear enough and easy to understand, this paper puts forward a new idea of building a tree. In the process of tree building, when the proportion of objects in the subset belonging to the same class exceeds a certain probability, the growth of the tree is stopped, and the node is marked as a leaf node of most classes. After system testing, the correctness of the target system is verified.

Keywords. Big data, Human resources, Performance appraisal

1. Introduction

Effective performance management system design will become the top priority of enterprise managers. Performance appraisal is usually carried out independently by various departments and departments of enterprises, with scattered performance data, difficult tracking of the appraisal process and lack of effective supervision over the fulfillment of the appraisal results. With the development of modern information technology, data mining is applied in different fields, thus realizing the effective mining of a large amount of information. Creatively put forward using computer technology and information technology to support, optimize and improve the performance appraisal of enterprises [1]. Therefore, it is necessary to develop HR (Human Resources) performance appraisal system with advanced technology, open system and easy expansion, so as to realize informationization and automation of enterprise performance appraisal management, reduce work cost, improve work efficiency, improve management level and tap work potential.

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In terms of assessment methods, foreign countries mostly use target management method and 360°assessment method when evaluating individuals, and KPI (Key Performance Indicator) and BSC (Balanced Scorecard) are mostly used for organizational assessment. Although China has made some progress in performance appraisal through these years' efforts, these theories are mainly used in the evaluation of employees in enterprises, and they are rarely used in the evaluation of employees in enterprises [2-3]. Some well-known large enterprises adopt their own unique methods according to the actual situation of the company while adopting internationally renowned performance evaluation methods, and have received good results [4-5]. Therefore, in the assessment, we should not only limit ourselves to the explicit evaluation of skills and knowledge, but also comprehensively consider the hidden characteristics such as motivation, quality, self-cognition, role orientation and values. In the specific operation, we should use a 360° all-round performance appraisal method, which mainly adopts a top-down way, and its purpose is to provide multi-faceted and comprehensive information on the work performance of employee affairs managers.

As an enterprise HRM (Human Resources Management), how to realize the scientific and rational management of the enterprise with the help of BD (big data) technology, and how to mine the information that is beneficial to the decision-making of the enterprise from a large amount of data has become an important issue at present. Through the establishment of assessment BD platform, the assessment data of all departments and departments in the hospital can be gathered and analyzed and predicted [6]. Dynamically update assessment methods and indicators. In this paper, BD technology is integrated to study and design HR performance appraisal system. On the one hand, it can provide great support for realizing the strategic objectives of the organization; On the other hand, it can also deepen employees' in-depth understanding of their responsibilities and work objectives. In addition, the results of performance appraisal are usually an important basis to support relevant personnel decisions, such as rank promotion, labor relations change, salary increase, bonus and so on.

2. Research Method

2.1. Overall Design of HR Performance Appraisal System

Performance appraisal refers to an enterprise or organization's all-round evaluation of the work process and results of the assessed according to its own personnel management needs. In addition to the assessment results, performance appraisal should also use the assessment results to guide employees to carry out follow-up work. HR performance appraisal is one of the key tasks in enterprise personnel management. Through the appraisal of employees, enterprise leaders can have a deeper understanding of HR allocation in various departments, workload arrangement and the work situation of front-line employees, so that enterprise leaders can formulate corresponding management measures at an appropriate time to solve the problems of employees in their work.

Effective performance management can guide all departments and employees to constantly improve their behaviors, give full play to their subjective initiative, improve their work performance, and comprehensively improve the operating efficiency and service level of enterprises. Using data management and application based on computer information technology, we can find out valuable information from massive data, use BD method to drive the transformation of business management mode, and provide in-

depth service for customer selection and risk management, product design and precision marketing, resource allocation and structural adjustment, from organization to internal management, all of which are data-driven and data-supported decision-making methods [7-8]. The application and rise of BD technology is of epoch-making significance to the development of the global economy. The "demand-driven" turns to "data-driven", which will provide lasting vitality and exuberant creativity for economic development and become a brand-new power engine for the global economy to achieve leap-forward development.

The systematic development of HR performance appraisal system is to meet the actual needs of digital construction and management of enterprises, realize the diversification of employees' evaluation subjects, the refinement of evaluation contents, the informationization of evaluation methods and the objectification of evaluation results, and ensure the fairness, objectivity and efficiency of the implementation process of evaluation work. Accordingly, the development goal of this system is to properly define all kinds of user functions, complete the entry, modification and inquiry of personal information and the submission of performance information to relevant employees by each evaluation subject, and complete various common functions such as calculation, inquiry and printing of performance appraisal results of each employee: randomly assign evaluation numbers to employees participating in the evaluation to ensure the objectivity of evaluation data.

Among all the contents of performance appraisal, the most important one is the design of appraisal indicators, which is directly related to the quality of performance appraisal and the fairness of results. In the process of designing performance indicators, certain principles and methods need to be followed:

(1) Goal orientation. The design of assessment indicators should be clear and specific, and the post objectives that may be assessed should be set and decomposed as soon as possible.

(2) Scientific. The formulation of performance appraisal system should be based on scientific theory.

(3) Systematic. The setting of assessment indicators needs to be carried out from different angles, including horizontal relationship and vertical relationship. From the perspective of horizontal relationship, different assessment indicators can reflect the relationship of appraisers from different sides.

(4) Openness In the process of index design, we should try our best to make it open, so that it can be adjusted appropriately according to the changes of enterprises and meet the requirements of environmental changes.

The rapid development of BD technology has brought a historic opportunity to HR performance appraisal. Using BD technology in HR performance appraisal will break through the traditional employee appraisal method, which will not only realize the new concept that employees pay attention to their daily life and their work performance; It is also an effective way to test employees and improve the quality of assessment and evaluation. In the design process of HR performance appraisal system, the actual needs of employee performance appraisal in the previous enterprises are taken as the research content, and the analysis and design are carried out.

The advanced nature, maintainability and expansibility of the system should be considered as much as possible in the design. This system adopts B/S structure and

ASP.NET three-tier architecture mode. According to the analysis of different users, the structure of HR performance appraisal system is designed as shown in Figure 1:
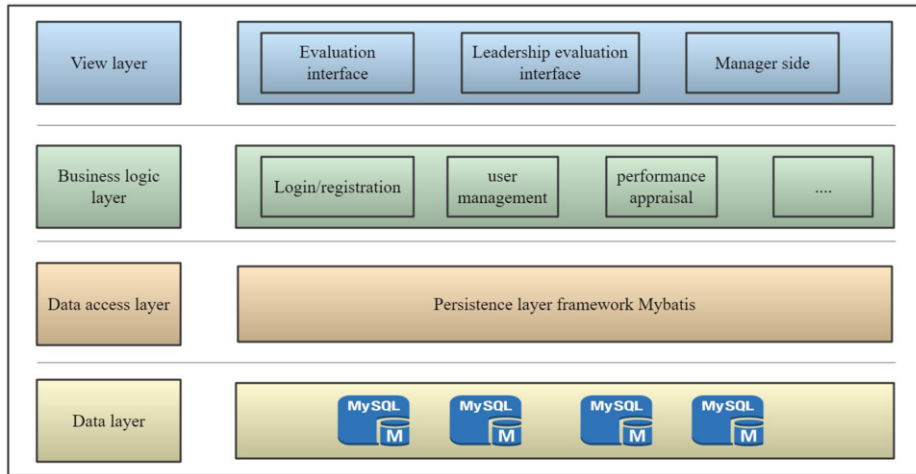

Figure 1. Structure of HR performance appraisal system.

HR performance appraisal system, which mainly includes Evaluation interface, Leadership evaluation interface and Manager side; Different evaluation users have different permissions to log in to the system and get different page views. In the process of system design, in order to optimize decision-making, some specific plans must be made in advance [9]. For example, the system is analyzed in detail to define the role of the system and clarify the functions that all kinds of users should undertake in the system.

The business logic layer mainly judges and executes the user's request. When the application layer receives the user's request, it will transmit it to the business logic layer, which will be responsible for judging and processing the logic in the request, and at the same time, it will be responsible for transmitting the data operation request to the data access layer to realize the whole data request. The data access layer is responsible for processing the user's data request, operating the related data in the database through ADO.NET, and feeding back the processed data results to the user interface. Through the three-tier division, the processing efficiency of the system is greatly improved, and the three-tier division also ensures the data security of the system.

According to the results of demand analysis, the target system has three main functional modules, namely, general user module, department leader module and administrator module. Figure 2 shows the whole functional module structure of the system.
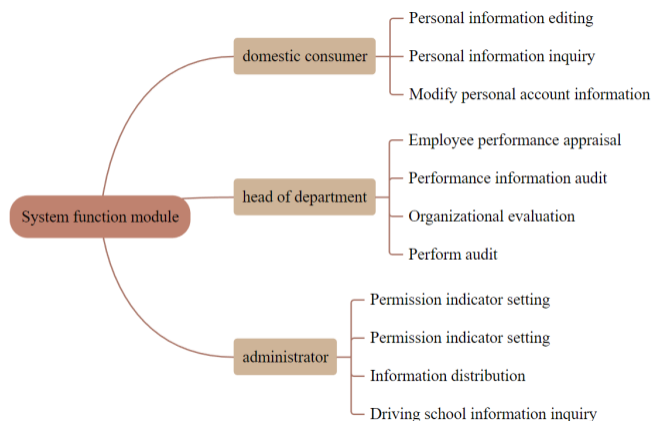
Figure 2. System function module structure.

Ordinary users, that is, ordinary users, do not have special rights, and can only perform some ordinary operations, that is, the management of users' own personal information, including editing, querying and modifying their own information. Department leaders log in to the target system by inputting their own account information and carry out related operations. In addition to ordinary users and department leaders, there is also an important user type, that is, the administrator, who has the greatest authority among all users. It mainly includes system maintenance and information management.

2.2. Key Technology Realization

In the commercial field, BD analysis can enable enterprises to grasp the market dynamics in real time, provide decision support for them to formulate more accurate and effective marketing strategies, and promote enterprises to provide more timely and personalized services to consumers. The high capacity, complexity and variability of BD determine that it also has the characteristics of complexity, uncertainty and non-universality. Only by collecting relevant data legally, carefully screening, analyzing in detail and thinking deeply, and applying it to concrete practice, can we give full play to the value and function of BD and truly realize "BD application".

Knowledge discovery is a complex process of identifying effective, novel, potentially useful and ultimately understandable patterns from data sets [10]. Data mining is the process of extracting hidden, unknown but potentially useful information and knowledge from a large number of incomplete, noisy, fuzzy and random practical application data [11]. Data mining can be described as an effective method to explore and analyze many enterprise data, reveal potentially useful, unknown or verified known laws, and further model them. Aiming at a large number of uncertain management factors in HRM, this paper puts forward an HR information management model based on DT(Decision Tree) algorithm.

HRM subsystem includes personnel file, system management, query, training and assessment, salary and other functions. Therefore, combined with the actual needs of enterprises, this paper divides the system into two subsystems: personnel management and data mining management, which are independent applications. In terms of client selection, users can access the system and mine data only by installing a web browser,

which brings great convenience to users and improves the practicability of the system. In this regard, the specific architecture of the HR information management model is shown in Figure 3.
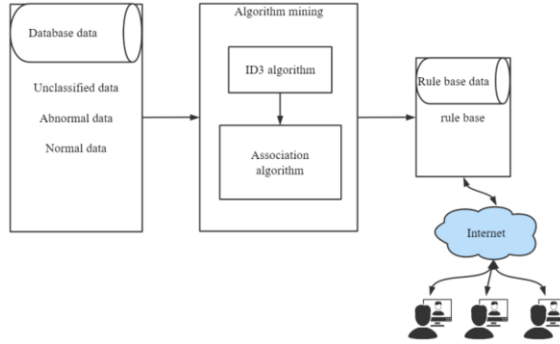

Figure 3. HR information management model.

DT is a tree structure mainly used for classification. It is a classifier represented by a tree structure and is generated by a large number of training samples. In the tree structure. Each different node is the judgment of attributes, and the nodes of leaves in the whole tree structure become the final result of classification. As a typical algorithm in DT, the principle of ID3 algorithm is to measure the best splitting index quality of nodes by using information increment value.

The core idea of ID3 algorithm is to select the classification attributes of DT nodes at all levels by calculating the information gain of attributes, so that when each non-leaf node is tested, the maximum category information about the tested sample can be obtained. Aiming at the shortcoming that the logical expression of ID3 algorithm is not clear enough and easy to understand [12], this paper puts forward a new idea of building a tree.

Suppose a candidate attribute A has n different attribute values, and the corresponding probabilities are $p_1, \cdots p_{n-1}, p_n$, and attribute A is split to generate n data subsets $\{s_1, \cdots s_{n-1}, s_n\}$. According to the principle of information entropy, the information entropy $E(s_i)$ of each child node is calculated respectively, and the information entropy of selecting attribute A as split attribute is obtained as follows:

$$E\left(\frac{A}{S}\right) = \sum_{i=1}^{n} p_i * E(s_i) \tag{1}$$

In order to prevent DT from over-fitting, DT must be pruned. By pruning, we can get rid of those branches that are not helpful to DT classification because of data noise, and then we can generate a more concise and accurate DT.

Given the data sample set S, the number of samples T, and the category set to which the samples belong to C, suppose there are $\{c_1, \cdots c_{m-1}, c_m\}$, suppose a candidate attribute A has n different attribute values, and the corresponding probabilities are $p_1, \cdots p_{n-1}, p_n$, and take attribute A as the split attribute to split and generate n data subsets $\{s_1, \cdots s_{n-1}, s_n\}$.

$$E\left(\frac{A}{S}\right) = \left(1 + \frac{n}{T}\right)\sum_{i=1}^{n} p_i * E(s_i) \qquad (2)$$

The split attribute is selected to minimize the value of $E\left(\dfrac{A}{S}\right)$.

In the process of building trees, we set the stopping conditions of trees in advance. When the proportion of objects in the subset belonging to the same class exceeds a certain probability, we stop the growth of trees and mark the node as a leaf node of most classes.

3. Result Analysis

The last step before the system is developed and delivered to users is to verify the system, which is what we usually call system testing. System testing is a complex system engineering, and there can be different methods from different angles. The goal of software testing is to find out as many errors as possible in the system at the lowest cost. There are two main testing methods for software, namely, black box testing and white box testing.

To verify the effect of the improved algorithm, this paper compares the algorithms before the improvement, and compares the execution time of the algorithms under different support conditions. As shown in Figure 4.
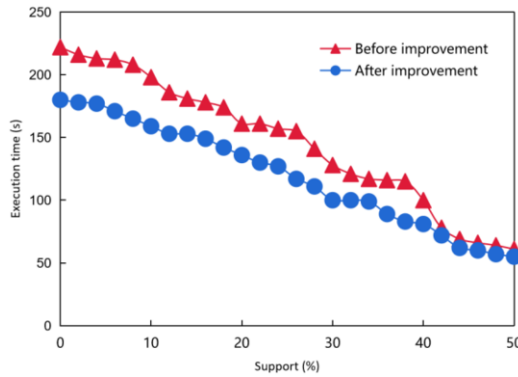

Figure 4. Execution time of the algorithm.

When the support is small, the time gap between the two algorithms is large, but the time required by the algorithm before improvement is the most, and the time required by the algorithm after improvement is the least, which shows that the execution efficiency of the algorithm before and after improvement is relatively high. With the increase of support, the execution time of the algorithm is decreasing and approaching, because when the support is large, the size of the transaction database changes less times, and the algorithm ends early.

Performance testing refers to testing the performance of the target system, mainly including the reliability, stability, throughput and concurrency of the system. Concurrent performance testing is emphasized in the performance appraisal system testing. Control the response time of the system within 5 seconds, and test the maximum number of user concurrency that the system can support within 5 seconds.

When performing the performance test in 4 M bandwidth, we can observe the CPU occupancy, which has reached 100%, as shown in Figure 5.
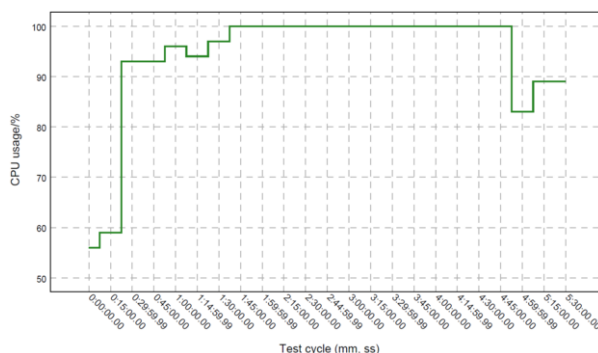

Figure 5. Utilization rate of CPU.

Therefore, in this environment, the constraint factor of concurrency is not the network bandwidth, but the hardware configuration of the system. Network bandwidth can be increased appropriately, but it can't be increased recklessly; At the same time, we can also improve the bottleneck problem by transmitting compressed packets. Through system test, the correctness of the target system is verified.

4. Conclusion

With the development of modern information technology, data mining is applied in different fields, thus realizing the effective mining of a large amount of information. Creatively put forward to support, optimize and improve the performance appraisal of enterprises with computer technology and information technology. In this paper, BD technology is integrated to study and design HR performance appraisal system. On the one hand, it can provide great support for realizing the strategic objectives of the organization; On the other hand, it can also deepen employees' in-depth understanding of their responsibilities and work objectives. Through system test, the correctness of the target system is verified.

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