Design of Enterprise Human Resources Decision Support System based on Data Mining

Jian Li (✉ zhanghappy56@hotmail.com)

Qilu Normal University

Research Article

Keywords: data mining, human resources, decision support system

Posted Date: September 27th, 2021

DOI: <https://doi.org/10.21203/rs.3.rs-805084/v1>

License: © ⓘ This work is licensed under a Creative Commons Attribution 4.0 International License.

[Read Full License](#)

Abstract

The management and development of human resources have become one of the core contents of enterprise operation and management. At first, it can only be used as an auxiliary tool in human resources business management, then it can develop various personnel transaction processing subsystems with relatively independent modules and perfect functions, and then realize the integration of various subsystems, Form a relatively complete set of human resource information management system. In recent years, with the rapid development of data mining technology, more and more enterprises begin to pay attention to the completion of various decision-making activities in management through the assistance of computer information systems. This paper designs an enterprise human resources decision support system based on data mining, which can more effectively support human resources management business informatization, data standardization, intelligent decision analysis, optimize human resources business process, improve human resources management business efficiency, provide more effective decision support for enterprise management and promote enterprise development.

1. Introduction

In enterprise management, human resources, also known as human capital, is the core resource of enterprise strategic management. It has become more and more important. The competition among enterprises is reflected in the competition for human resources. With the development of science and technology, human resources have become an important resource for enterprises to compete with each other. Many enterprises can quickly grasp the dynamics of talents because of their advanced human resources management system, which saves a lot of time and capital investment for enterprises to select and hire talents. On the whole, the research and development of the human resources decision-making system at home and abroad is less, and the start time is late, so great efforts need to be made to improve the human resources decision-making system. The human resources decision-making system can be operated from the moment when employees are recruited, and conduct a systematic and comprehensive investigation and Analysis on employees' pre-job training, skills, salary, and other issues, which can help the company better manage employees. In addition, the system can avoid incompatibility due to the discrete data stored in the system, make the human resource management move towards standardization, digitization, and networking faster, and improve the overall image of the company[1].

Human resources decision system, based on human resources data mining, provides decision support for enterprise development from basic analysis, professional analysis, multi-level and multi-dimensional analysis of efficiency and effectiveness, which will be of great significance, which is embodied in the following three aspects.

(1) The enterprise management can more scientifically and effectively obtain the internal human resources status of the enterprise, valuable operation reference data, and human resources indicators of external industries in real-time, and analyze them in combination with the business decision-making

model, to obtain effective decision-making early warning and reference information and make business decisions.

(2) Human resource managers can more accurately and effectively comprehensively manage the enterprise employee information, master the enterprise employee information status in real-time, and can quickly and accurately count and generate all kinds of human resource decision-making and analysis reports, to further improve and optimize the enterprise's internal human resource management.

(3) Through the collection, data filtering, mining, and analysis of industry human resources data, the human resources index reference library of industry benchmark enterprises is constructed as the reference standard for enterprises to make decisions. The HR data center is composed of internal HR business data and external related data; The data mining and analysis provides fast and correct reference support for enterprise decision-making, which promotes the continuous improvement of human resources business, forms a good closed-loop, and then promotes the development of enterprises.

2. Data Mining Technology

2.1. Overview of data mining

Data mining is a new technology rising in the 1990s for decision support. People usually regard data mining technology as the most important step in the process of knowledge discovery in a database. The so-called data mining is a nontrivial process to obtain people's unknown, novel, effective, potentially useful, and ultimately understandable information and knowledge patterns from a large number of incomplete, noisy, and fuzzy random data. Its main tasks are association analysis, cluster analysis, classification, prediction, time series pattern, and deviation analysis. In short, data mining is to extract or "mine" knowledge from a large amount of data, but not all information discovery tasks are data mining. Data mining is divided into three processes: data preparation, data mining, conclusion expression, and interpretation, as shown in Fig. 1:

2.2. Several common classification algorithms of data mining

The construction methods of classifiers mainly include the following: decision tree classification method, mathematical statistics method, artificial intelligence, neural network method, and so on. According to the different research directions of classification algorithms, they can be divided into the following categories: decision tree classification algorithm, association rules, Bayesian classification, neural network, k-nearest neighbor algorithm, genetic algorithm, rough set, and so on. Decision trees and association rules are typically artificial intelligence methods[2].

2.2.1. Decision tree classification algorithm

The decision tree classification algorithm is a widely used data mining classification algorithm, including ID3 and C4.5 algorithms. For a given data set, how to generate a classifier quickly and effectively is a big problem, and one of the more feasible is the decision tree algorithm. The decision tree method is widely used. It mainly analyzes and infers classification rules from a group of unordered and irregular cases, and uses the way of the decision tree as the form of expression. The main idea of the decision tree classification algorithm is to compare attribute values recursively from top to bottom at the internal nodes of the tree. The specific trend mainly depends on different attribute values, and finally, get a conclusion at the leaf nodes.

The decision tree generation algorithm uses information gain to select the attributes that can make the samples best classified. The information gain is calculated as follows:

If there are n messages and the probability distribution is $p = \{p_1, p_2, \dots, p_n\}$, the expected information of the sample S is:

$$I(S) = I(p) = - \sum_{i=1}^n p_i \log_2 p_i$$

1

For a given sample $s_j \in S$, the total number of samples is S_j , S_j is divided into m subsets according to the class attribute value. The number of samples in each subset is s_j ($1 \leq j \leq m$), and its probability distribution is

$$p = (S_{j1} / S_j, S_{j2} / S_j, \dots, S_{jm} / S_j)$$

2

According to the formula, the expected information of sample s_j is $I(s_j) = I(p)$.

2.2.2. Association rules

Association rules are the most common methods of data mining. The goal of association rules is to find some internal relationship between all objects. The basic methods of association rules mining can be described by the following methods:

Let the database $D = \{t_1, t_2, \dots, t_n\}$ be composed of some transactions with only unique identification, $I = \{i_1, i_2, \dots, i_m\}$ be a set of items, and each transaction t_i ($i = 1, 2, \dots, n$) corresponds to each subset on I .

Definition 1

let $I_1 \subseteq I \in I$, the support value of (itemset) I on data set D refers to the proportion of items containing I in D , as shown in the following formula

$$\text{sup port}(I_1) = \frac{\|\{t \in D \mid I_1 \subseteq t\}\|}{\|D\|}$$

3

Definition 2

for item set I and database set D , T is a nonempty subset of I not less than in support, that is, all item sets that meet people's preset minimum support are called frequent itemsets or large itemsets. In the frequent itemset, we extract all frequent itemsets that are not contained by other items. These special item sets are called maximum frequent itemsets or we call them maximum large itemsets.

2.2.3. Bayesian classification

Bayesian classification is based on Bayesian theorem, which is: H is a certain assumption, $P(H)$ is a priori probability, $P(X|H)$ is the probability of X under the condition that H is established, then the posterior probability $P(H|X)$ is:

$$P(H|X) = \frac{P(X|H)P(H)}{P(X)}$$

4

The principle of Bayesian classification is to calculate the posterior probability through the prior probability of an object and Bayesian theorem, that is, the probability that the object belongs to a certain class, and select the class with the maximum posterior probability as the class to which the object belongs.

3. Demand Analysis Of Human Resource Decision System

3.1. Business requirements

In business decision-making, human resources are the main strategic resources of enterprises. Human resources management plays an important role in enterprise strategy and decision support. In operation, the enterprise supports the work of each business department through the effective management of

human resources and provides strategic decision support for realizing the overall business objectives of the enterprise[3]. As shown in Fig. 2, human resource strategy and decision-making are an important part of enterprise business strategy and decision-making. Human resource decision analysis, as the main support of human resource strategy, the requirements of enterprise decision-making on human resources, in turn, constantly adjust and optimize the development of human resource management. Human resources decision analysis carries out in-depth mining and analysis from the perspectives of talent planning, talent basic data, professional management of human resources, and efficiency and effectiveness of human resources, to provide support for enterprise strategy and decision-making.

3.2. Functional requirements

(1) HR business management function requirements

The data generated by basic human resource business management, such as enterprise organization structure information, personnel basic information, organization information, position information, education information, and personnel change information, is an important part of enterprise human resource data. To obtain this data, it is necessary to informatization, process, and Standardized management. Therefore, the realization of the human resource business management function module is the basic requirement of the system.

Figure 3 is a use case diagram of HR organization structure management. HR users have use cases for organization unit management, job management, position management, job level management, cost center management, salary range management, and location management. Each organization management use case includes functions such as adding, querying, updating, and deleting.

(2) HR decision tree function requirements

By mining and analyzing human resource data, a human resource decision tree model is generated. Under the condition of setting conditions and data reference basis, the decision management user can make decision analysis and calculation by using the decision tree classification algorithm and show the internal correlation and logical law of human resource data in the form of the decision tree. Through the decision tree, it can provide more scientific and efficient decision support for enterprises, such as human resources decision-making, market decision-making, product decision-making, internationalization decision-making, etc.

The realization requirements of enterprise human resources decision support are shown in Fig. 4. The enterprise sets decision analysis requirements, sets enterprise decision direction and objectives, calculates the decision tree through systematic comprehensive decision analysis, outputs human resources decision tree, displays early warning information and enterprise decision-support information, and provides effective support for enterprise business decision-making.

(3) Human resources Web data dynamic mining function requirements

Web data dynamic mining requires dynamically and effectively collect industry human resources-related data and benchmark industry human resources index data through web data mining technology, screen, classify and store the data, and establish an enterprise decision-making reference human resources index database.

Through web data mining technology, collect industry human resources-related data of various industries and various analysis dimensions from the Internet, such as the key index data regularly or irregularly published on the Internet by some benchmark listed enterprises, and then filter and filter these data by referring to the defined decision dictionary and semantic rules to obtain effective decision reference data, These data are stored in the database to form the knowledge reference base of human resources decision-making indicators. Figure 5 shows the web data mining process of industrial human resources.

4. Overall System Design

From the perspective of demand analysis and practical application, the implementation function modules mainly include the design of functional modules such as internal human resources business data management, external data import, industry human resources benchmarking data maintenance, decision analysis report model, human resources decision tree model and web data mining analysis.

4.1. system technical framework design

(1) Software architecture

Figure 6 shows the software architecture of the enterprise human resources decision-making system. The system constructs a human resources data center by maintaining and managing the internal human resources business management data and status data, and importing other system data, such as enterprise sales, generation, and other data, using online analytical processing, data analysis, and mining and other technologies, Re extract the data used for decision-making, conduct comprehensive analysis through the corresponding decision theoretical model and decision tree algorithm, and obtain valuable data through web data mining and analysis, to provide effective support for decision managers.

The software architecture of the human resources decision system is mainly composed of data source, data dictionary, data warehouse, decision theoretical model, industry data standard, decision analysis report, decision tree algorithm model, and decision-maker user management interface. From the standard input of data, combined with industry standards and the decision demand model, after calculation through relevant algorithms, the decision report analysis results, early warning, and decision information are presented to users through the decision-maker user management interface. The specific functions of

each component are described as follows[4]. Decision support systems are applied in a number of areas including blockchain, crowdsourcing, security, and many others [5–9].

Decision data source: provides internal and external analysis data of the enterprise, mainly from internal human resources business management data, and other ERP systems, such as relevant data of finance, sales and production systems, web mining data, and system interface input. This part needs to build the human resource business management module, realize the integration interface with other external systems, the direct input interface of external data users, and the web data mining function, continuously accumulate all kinds of relevant data into human resource data, and improve the scientificity, effectiveness, and timeliness of data mining analysis.

Decision data dictionary: data type standard library, which establishes data items, data structure, and logical standards to meet the needs of user report statistics and analysis, to make the decision results more scientific and effective.

Decision data warehouse: stores industry-standard reference data after screening and standard specification. The data warehouse is a collection of all types of data that provide support in the decision-making process of enterprises.

Decision report model: the collection of all report models created according to the actual business requirements, defines the enterprise decision information requirements from multiple levels and dimensions and constructs the decision analysis report model.

Decision theoretical model: to achieve the enterprise objectives, the theoretical models required for prediction, early warning, judgment, and decision-making provided by human resources management are required. Combined with the report model and the input data, after the set decision inference conditions are met, the system outputs decision early warning information.

Industry decision-making standards: we should collect a large number of standard reference values of various industries in some periods or reference values of industry benchmarks to obtain comparable and more reasonable analysis reference information, to make enterprise decision-making more targeted.

Decision-maker interface: management desktop and cockpit of enterprise managers. Real-time display of various reports, analysis results, early warning information, decision information, and decision support for managers.

(2) System network topology

The network topology of the enterprise human resources decision system is shown in Fig. 7. The overall system needs four servers, namely HR business server, decision analysis server, web data mining server, and data storage server. The HR business server mainly processes HR business operations; The decision

of human resource data and generates

decision analysis reports, and decision trees; The web data mining server mainly completes the mining of Internet data and stores the mined data to the database server: the database server is used to store all human resources business data, other relevant decision-making data imported by ERP system, external input data and human resources index reference data of relevant industries. In addition, the system adopts a B / S structure, which has the characteristics of distribution and strong interaction, to realize the real-time update and sharing of human resources business data. Decision-makers and users can query information anytime and anywhere, obtain the latest data in real-time, and improve the timeliness of decision-making information.

4.2. System function structure design

The design of enterprise human resources decision system is mainly divided into four functional modules: human resources business management function module, human resources data management function module, decision analysis report management function module, human resources decision tree model, and web data mining analysis module. Each functional module contains several sub-functional modules. The overall functional architecture design of the system is shown in Fig. 8.

(1) HR business management module

This part mainly includes three resource modules: enterprise organization structure management, personnel information management, and personnel event management, to realize the daily business management of enterprise human resources and the update and maintenance of basic human resources data. Human resources business data is the main data source basis for decision analysis and the main component of human resources data for decision analysis, Master the internal status data of the enterprise in real-time.

(2) HR data management module

This part mainly realizes the preprocessing of internal HR status data, and further extracts and filters various personnel status data needed in decision analysis based on HR daily business data. This part realizes the functions of direct data generation, interface maintenance, and import.

(3) Decision analysis report module

This part mainly realizes the decision-making analysis function of internal human resource data of the enterprise, and statistically analyzes the human resource status of the enterprise. It is divided into three types of analysis reports: basic decision-making analysis, professional decision-making analysis, efficiency, and efficiency decision-making analysis.

From Fig. 9, we can see that after the global use of data mining algorithm, the growth stability of human resources is better than that used in this scope.

5. Conclusion

This paper mainly expounds on the design of enterprise human resources decision-making systems based on data mining. Firstly, the complete requirements of the system are studied and analyzed in detail, and then the overall functional architecture of the system is designed on this basis. It realizes the daily business of human resources, such as organizational structure management. Through the standardized management of human resources business processes, it establishes human resources standard data center and sharing center to provide basic data guarantee for data analysis. Further, extract the data needed in the decision analysis operation, and the system realizes the maintenance function of the analysis data. By designing three types of reports based on the human resources decision cockpit, you can analyze the current situation of internal human resources from different dimensions, understand the current situation and make more effective decisions.

Declarations

Conflict of interest

The authors declare no conflict of interest.

References

1. Wang Xueli, strategic human resource management - employment model and key decision-making [M]. China Development Press, 2016: 58-61
2. Yu Feng. Research on Intelligent Technology of human resources decision support system [J]. China management informatization, 2011-12: 14 (24)
3. Wang communication. Big data human resource management [M]. China personnel publishing house, 2016: 1-50
4. Ouyang Shiyong, Zhang Feng, application of decision support system in modern human resource management [J]. Management and wealth BCM, 2009: 5-71
5. H. Xiaolong, Z. Huiqi, Z. LUNCHAO, S. Nazir, D. Jun, and A. S. Khan, "Soft computing and decision support system for software process improvement- a systematic literature review," *Scientific Programming*, 2021.
6. H. Xiao, S. Nazir, H. Li, H. U. Khan, and C. Li, "Decision support system to risk stratification in the acute coronary syndrome using fuzzy logic," *Scientific Programming*, 2021.

7. Y. Meng, S. Nazir, J. Guo, and I. Uddin, "A decision support system for the uses of Lightweight blockchain designs for P2P computing," *Peer-to-Peer Networking and Applications*, 2021.
8. S. Nazir, S. Shahzad, S. Mahfooz, and M. N. Jan, "Fuzzy logic based decision support system for component security evaluation," *International Arab Journal of Information and Technology*, vol. 15, no. 2, pp. 224-231.
9. Y. Huang, S. Nazir, J. Wu, F. H. Khoso, F. Ali, and H. U. Khan, "An efficient decision support system for the selection of appropriate crowd in Crowdsourcing " *Complexity*, 2021
10. Huang yin'an. Application of data mining in human resource management [D]. South China University of technology
11. Hu Haowen, Wei Jun, Hu Tao. Application of fuzzy data mining algorithm in human resource management [J]. Computer and digital engineering, 2002, 030 (005): 25-28,40
12. Gao min. research on human resources assessment management system based on data mining [D]. University of Electronic Science and technology, 2014
13. Chen Xiaoying. Application of data mining technology in human resource management system [D]. Wuhan University of technology
14. Hai Yan, Zhang bingbo. University human resources data mining system based on Apriori algorithm [J]. Journal of North China University of water resources and hydropower (NATURAL SCIENCE EDITION), 2008, 29 (6): 57-59 + 104
15. Qi Haosheng, ou yangqun. Application of data mining technology in enterprise human resource management [J]. Enterprise economics, 2012 (01): 78-80
16. Gao Ruiting. Analysis of influencing factors of human resource flow based on big data mining [J]. Science and technology and economy guide, 2018, v.26; No.649(23):7-8+17.
17. Hai Yan, Zhang bingbo. University human resources data mining system based on Apriori algorithm [J]. Journal of North China Institute of water resources and hydropower, 2008, 29 (6): 57-59 + 104
18. Xia Fang. Analysis and design of human resource management system based on data mining technology [D]. Xiamen University, 2015
19. Gao min. research on human resource assessment management system based on data mining [D]. University of Electronic Science and technology, 2016
20. Gu Junhua, Li ruting, Zhang Yajuan, et al. Improved frequent itemset mining algorithm and its application [J]. Computer application and software, 2019, 036 (009): 260-269
21. He Huijing. An algorithm for mining frequent itemsets based on undirected graph [J]. 2009
22. Li Min. Enterprise management information system. Human resources optimal allocation technology and its algorithm implementation [J]. Enterprise management information system
23. Dong Jinchen, Lei Jingsheng. Analysis of abnormal power consumption behavior of distribution network based on community characteristics [J]. Electrotechnics and electrics, 2019, No. 253 (01): 18-23

Figures

Figure 1

data mining flow chart

Figure 2

business demand model of enterprise human resource decision system

Figure 3
human resources organization structure management use case diagram

Figure 4
enterprise decision support requirements

Figure 5

industry human resources Web data mining requirements

Figure 6

software architecture of enterprise human resources decision system

Figure 7

network topology of enterprise human resources decision system

Figure 8

overall function structure of the system

Figure 9

Human resource management based on decision system data mining (a) Observed human mobility and theoretical prediction (a) global recorded human resource mining algorithm calculated from real data and simulation using first-order, second-order and adaptive memory models (b) recorded human resource mining algorithm within this scope.