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Analysis and Design of Information Management Platform for Engineering Cost*

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***Abstract*—In recent years, the large quantity of data generated by all-pervasive network terminals brings various industries into the age of big data in a leap-type mode. And it is the same for the field of engineering cost. This paper comprehensively uses the current emerging data mining technology and software engineering technology to study the information management platform for engineering applied by aiming at the big data of engineering cost, analyzes and designs the general structure of platform and function modules and explains the technological supports for the platform. The study in this paper has significant exploration meaning and reference value for the scientific management of engineering cost under the conditions of big data.**

Keywords—engineering cost; information management platform; big data

I. INTRODUCTION

In recent years, with the rapid development of network technology, various kinds of network terminals have permeated into the entire space around us. And the large quantity of data generated from such network terminal also brings various industries into the era of big data. It is the same for the field of engineering cost. The field of engineering cost has always been a forgotten field which is easily ignored in the study of big data. However, the current engineering cost field actually has accumulated the useful data of a considerable quantity. How to use such data to guide the engineering cost management is the issue that we should pay close attention to and solve at present and even in a long period in the future.

The engineering cost information in broad sense refers to all the data and information that may be involved in and impact the engineering management activities. Currently, the information acknowledged in the mainstream of industry includes pricing basis, related policies and regulations, price information, bid information, social average production cost, social average profit, index information and indicator information, etc. While the engineering cost information in narrow sense mainly refers to the price of labor force and materials involved with the specific values of engineering cost. The main study object of this paper is to suitably expand on the basis of engineering cost data in narrow sense and take into account the necessary policies, pricing information and other data.

Facing the huge data, if purely relying on manual processing, not only the work efficiency will be low, it will also make mistakes frequently. Relying on the information technology and intelligent data processing technology is the key method for solving this issue. And the construction of scientific and dynamic information management platform for engineering cost on the basis of big data technology can directly transfer technological study into realistic practice so as to truly find the deep meanings of study on engineering cost information.

II. CURRENT SITUATION OF INFORMATION MANAGEMENT PLATFORM FOR ENGINEERING COST

Currently, over 30 provinces have established the engineering cost information websites based on the engineering cost management organization of corresponding administrative levels. And the various engineering cost information including policies and regulations, industrial development, pricing basis, cost information and pricing software has been released on this website which promotes the timeliness and transparency of engineering cost information. The China Engineering Cost Network which is founded and operated by the Ministry of Housing and Urban-Rural Development can guide the information process of engineering cost of different places on the macro level. In addition, the continuous development of the software independently researched and developed by Glodon Software and Sware, etc also provides convenience for the informatization of engineering cost management. Although the network information services provided based on such engineering cost information network provides better real-time data for engineering cost management to a certain extent and can meet part of the demands, there are still following problems:

A. The Standards Are Not Uniform Which Causes Low Sharing Efficiency

In 2013, the Ministry of Housing and Urban-Rural Development issued the Code of Pricing with Bill Quantity of Construction Works as the guidance document for different places to carry out engineering cost activities. And the various local governments also successively issued local construction laws and regulations. Although such construction laws and regulations are all based on GB 50500-2013, there are still differences, especially on the aspect of ration standards. And

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there are also differences in the item coding and classification standards. In addition, different construction units and organizations will also adopt different engineering cost rules and calculation methods which may generate different preliminary budget documents for the same project. The lack of different lists, ration standards and industrial exchange agreements and interface of different places will cause it difficult to share engineering cost information and large quantity of valuable data cannot give play to functions.

B. Postponement of Engineering Cost Data and Information

The engineering cost industry has high requirements on the timeliness of data. However, the industrial information released on various engineering cost information network relatively lags behind. According to information, although basically the information networks of different provinces can timely and update the policy, laws and regulations and industry dynamics, etc, the update of price information and pricing indexes, etc is still slow which may lag behind for a month and a quarter or even a year. The instability of time causes it hard for enterprises and engineering cost personnel to obtain the latest information and that they cannot find out the market trend and the conditions of competitors which are adverse to conduct whole-process real-time accurate cost management.

C. Insufficient Data Mining and Low Value of Data

Although there is large quantity of information collected and released on the cost information networks of different places, most of such information is simple release of price and pricing index, list of typical engineering projects, insufficient deep processing of data and failure of extraction of key and useful information, such as forecast of industrial development trend and vertical and horizontal contrastive analysis among typical engineering. In addition, the accuracy of forecast, bidding and cost control upon website information is relatively low, the reliability is poor and the value is low.

D. Lack of Mainstream Information Integration Platform for Engineering Cost

Currently, various places have established the engineering cost information networks according to their respective conditions and there are also national directive engineering cost information websites. But there lacks a systemic and comprehensive data integration, analysis, mining and processing platform for guiding the practice of engineering management.

III. DESIGN OF INFORMATION MANAGEMENT PLATFORM FOR ENGINEERING COST

A. Design Thought

Relying on the information management platform for engineering cost, the users can obtain reliable engineering cost information and obtain other services related to cost. The information management platform for engineering cost is based on B/S framework and users only need to login this platform through internet without installation of software to get services. The platform shall customize personalized services according to different customer groups at the same time of providing many free services and the economic supports shall be provided through advertisement for investment and customized service fees, etc. According to investigation, in the official website of China Engineering Cost Association, the column of “cost information” is set with four modules including “database of laws and regulations for engineering cost”, “database of Engineering Cost Information”, “national inquiry platform for the market price of building materials” and “national sharing platform for engineering cost achievements (data)”. Thereinto, the last two modules have temporarily not been opened for open beta. The four modules of this website basically can cover all the data types of cost information. This paper relies on this to further design and completes the information management platform for engineering cost.

B. System Framework Design

The system framework design is as shown in following “Fig. 1”.

The framework adopts the thought of layering and divides the system into three layers in details which separately are presentation layer, business logic layer and data layer. And the business logic, systems interface and data control zone are divided through such layering method so as to realize “high cohesion and low coupling”.

The presentation layer takes charge of the interactive process between system and user and providing the user interface of the whole system. The presentation layer is the interface for direct interaction between system and user and is the key for presenting the system interaction and operability and is also the key link which directly determines the user experience. Currently, with the developed network services, the user experience becomes crucial. This paper plans to choose mainstream Bootstrap framework to realize the development of UI interface.

The business logic layer mainly takes charge of handling the business logic process for the part of data involved with the system and directly operating the data layer. The business logic layer is the main part for realization of system functions which takes charge of all the business operation logic at system backstage. And the process from basic addition, deletion and correction to the complex data processing is completely in the charge of this part.

The data layer directly takes charge of maintenance of database and directly operating database and conducting the actions including addition, deletion, correction and inquiry, etc. The data layer mainly provides data support for the business logic layer and takes charge of interaction and operation of data which is the base layer for system operation. Because it directly interacts with database, it has relatively higher requirements on the security of access and operation. In the process of realization of this platform, we comprehensively use traditional relational database MySQL and the non-relational database HBase dedicated for big data process.

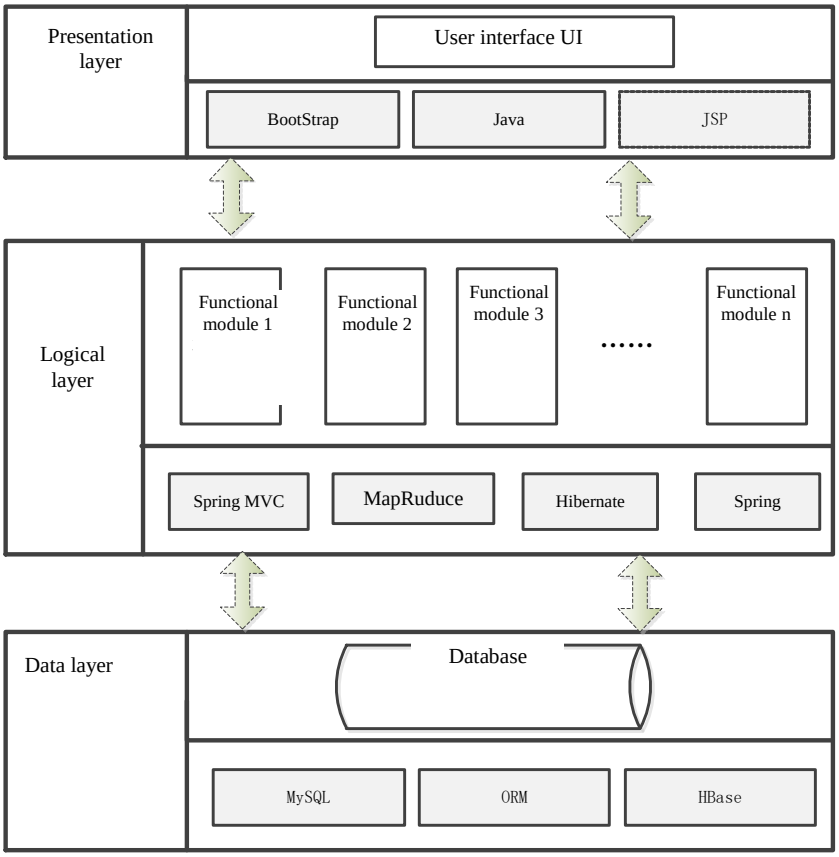

Fig. 1. Figure of system general framework.

C. Design of Functional Modules

According to the overall design and use demands of system, the functional module design of system is as shown in "Fig. 2".

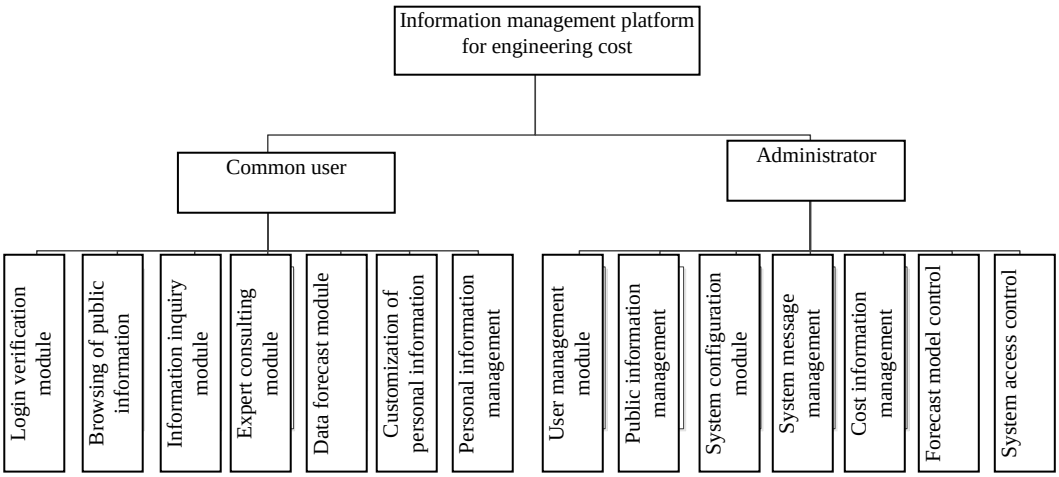

Fig. 2. System functional module diagram.

The system role setting has two categories, including administrator and common user. The administrator possesses the supreme access authority of system and generally only one operator shall be designated to hold the post. The administrator shall take charge of daily system maintenance works. Common user is the main user of system and generally the administrator shall verify their identities and issue the corresponding accounts and passwords.

1) Functional module that common users can access

a) Login verification module: Common users can login the control module and use the accounts and passwords issued by system administrator to login the system. After successful login, the common users can use related functional module.

b) Browsing of public information: Users can check the public information presented in the system according to their demands and interests.

c) Information inquiry module: The system has completed the integration of cost information of different regions all over China. Users can inquire the cost information of related materials by distinguishing the different regions according to demands.

d) Expert consulting module: Users can leave the questions that they want to consult and inquire through the form of message board according to their demands and the related experts will answer such questions with the authorization of administrator and users can continue the actions including addition, deletion, correction and inquiry of their own questions.

e) Personal information customization: Users can continue to customizing and adding the homepage functional modules of themselves. This functional module can bring the users with high freedom degree after module expansion of system in the future.

f) Personal information management: Users can delete and read the system messages and other reminding messages according to demands.

g) Data forecast module: Users can access this module to fully forecast the corresponding cost data in a period in the future according to demands.

2) Administrator functional module

a) User management module: Administrator can manage the access users and the specific management operations include addition, deletion, correction and inquiry and direct correction of user information in database.

b) Public information management: The administrator can regularly manage the system public information according to demands and the specific operations include addition, deletion, correction and inquiry of public information.

c) System permission control: The administrator can develop the access permission of different modules for different users according to demands to realize the precise control of user access.

d) System configuration module: The administrator can continue the management of basic configuration of system according to demands.

e) System message management module: The system can customize and manage the user information pushed to users by system.

f) Cost information management: The system has integrated the cost information of different places for the convenience of cost information inquiry of users. The administrator can manage the region, kind and cost data of cost information according to different message sources.

g) Forecast model management: After the system has completed the integration of different data analysis modules, the system can control the specific model turning on and application conditions and check the statistics.

3) Database design: According to the module design of system and actual application demands, the system database is designed as following four logical base:

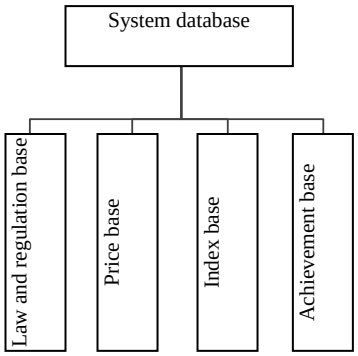

Fig. 3. Logical classification diagram of system database.

As shown in “Fig.3”, the system database is divided into following four types:

Laws and regulations base: according to the classification of national construction law system, it can be divided into laws, administrative construction laws and regulations, local construction laws and regulations. The release and update of part of laws and regulations can be obtained from different government official websites.

Price base: It can meet the demands of different customers according to the setting of region, item types and time options and provide the inquiry of price information including labor force, building material, machinery and rent, etc according to the specialty types of engineering project. Except for disclosure of price including tax and tax exclusive price, etc, it shall also show the price source and the possible future change trends to realize multidimensional classified display and searching.

Index base: it can provide multidimensional and multi-layered index searching, editing and use functions. Fast search the list data within the index according to list characteristics and engineering types, etc. of projects and automatically recommend the index data extent threshold value for single project, unit project, partitioned project and subdivisional project. At the same time, it can also provide the reference value of consumption level of different periods.

Cost achievement sharing base: it includes the typical projects of different periods and different specialties and possess the economic indexes and consumption indexes, etc obtained through techno-economic analysis and cost analysis of such typical projects.

IV. TECHNICAL SUPPORT OF INFORMATION MANAGEMENT PLATFORM FOR ENGINEERING COST

A. Software Technical Support Realized by the Platform

The system adopts layered framework and is designed and developed based on B/S mode. And the development IDS environment selects MyEclipse10 and the database supports to select MySQL 5.1. The realization in details selects java programming language; the leading end is developed by selecting Bootstrap page frame technology; the back-end is realized by adopting current popular lightweight framework JFinal and it also comprehensively uses JSP technique and other component techniques for comprehensive development.

The JFinal framework selected in the study of the platform is open-source which has been widely applied in the open source community since the date of generation and has been broadly applied in practical projects. It has been proved by the broad developers that JFinal can greatly reduce the economic costs and time costs of development in the development and application of large projects. And the code quantity is reduced by about 75% to 90% compared with traditional SSH integration framework (Spring-Struts-Hibernate) for the realization of functions of the same item, therefore it is taken as the main frame of system development.

B. Technical Support from Data Analysis and Mining

The most important function of information management platform for engineering cost is to provide valuable data for users which are manifested as reliability and predictability of data in details. The price, index and other data on the platform are from government, enterprise or individual at first which are messy and extensive and can only become real useful data after scanning and processing.

The platform applies the latest data mining technology which can structure the disordered cost data and realize the mining and visualization of data. The platform plans to select the Least Squares to support Vector Machine and K-means clustering analysis algorithm as data analysis model. The underlying platform selects Hadoop technology and the products developed within its full life circle as technical support. The database selects HBase and the analysis framework selects MapReduce framework. After building the budget model for engineering cost, input the impact factors and output the final price according to different types of engineering projects; and comprehensively apply and select MATLAB, SAS and other software to conduct simulation and checking calculation and conduct visual output to results.

V. CONCLUSION

In general, our national engineering management informatization still needs further development and needs to rely on the strength from government, association, industry and enterprises, etc. to promote the informatization of construction and standardization of data. The construction of information management platform for engineering cost cannot be realized without big data technology. Through this technology, we can accomplish the mining, analysis and processing of cost information to enable data to realize visualization and exchangeability so as to promote the healthy and orderly development of engineering cost of China.

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