Construction of Power Transmission and Transformation Project Cost Information Platform Based on Big Data Analysis

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Abstract. With the reform of China's power system, power transmission and transformation project (hereinafter referred to as PTATP) are gradually developing in the direction of integration, informatization, large-scale and systematization. Therefore, the traditional project cost can no longer meet the needs of the society, which requires the project cost based on BD (hereinafter referred to as BD) technology. Through the information platform (hereinafter referred to as IPF), we can collect a lot of information, including policies and regulations database, talent and machine price information database, project cost index database, industry information database, etc., which will provide important support for project cost. Project cost informatization will solve the problems of low information sharing rate, low information value and high information cost, which will more scientifically complete the cost of PTATP. Based on BD technology, we can collect, sort out and analyze the cost information data of PTATP, which will fully explore the data value. Firstly, this paper analyzes the main algorithms needed for project cost. Finally, this paper constructs a PTATP cost IPF based on BD analysis, which will provide accurate countermeasures.

Keywords: Big Data Analysis, Power Transmission and Transformation Project, Project Cost, Information Platform

1. Introduction

With the continuous improvement of China's power grid system, the state has more strict requirements for the whole process cost management of PTATP, which requires the construction of a standardized, scientific whole process cost management system [1]. By constructing the bank wide effective comparison, we can meet the economy of PTATP construction, which is the evaluation of the whole construction process, production and operation, economic benefits and comprehensive impact [2]. In the era of information explosion, engineering cost information must solve the shortcomings of large volume and long period, which requires rich dynamic information. Therefore, the project cost information management is of great significance to the development of the whole cost industry, which needs the help of information technology to assist the project cost information management [3-6]. BD technology improves the level of information technology, which also reduces the cost of informatization. Through
BD technology, we can provide an open software development platform, which can obtain flexible computing power, storage capacity and other infrastructure services [7]. Therefore, the construction of project cost IPF based on BD technology has many advantages, which can promote the construction of project cost information [8].

2. Engineering cost application algorithm

2.1. Big data analysis technology

Data mining technology is widely used in databases with massive data. The operation process is shown in Figure 1.

![Figure 1. Operation process of big data analysis technology](image)

2.2. K-means algorithm

K-means algorithm is an algorithm for classifying given samples, which can measure their classification distance. In this way, we can find the nearest distance. Each work of K-means algorithm is independent of each other, which can be processed in each iterative task [9]. Cluster similarity is calculated by using a "central object" obtained by the mean value of objects in each cluster. The general description of the objective function is shown in Formula 1.

\[
J_m(U, P) = \sum_{k=1}^{c} \sum_{i=1}^{m} \mu_{ik}^m d(x_i, p_k)
\]  

Among them, \( (x_i, p_k) \) is the distance and \( m \) is the weighted index. According to the clustering criterion, when \( J_m(U, P) \) is the minimum, the clustering effect is the best. Therefore, the membership degree of \( J_m(U, P) \) is shown in formula 2.

\[
\mu_{ik} = \left[ \sum_{j=1}^{c} \left( \frac{d_{ik}}{d_{jk}} \right)^{\frac{1}{m-1}} \right]^{-1}, \exists d_{ik} \neq 0, 1 \leq i \leq n \\
\mu_{ik} = 1, \exists d_{ik} = 0, k = 1 \\
\mu_{ik} = 0, \exists d_{ik} \neq 0, k \neq i
\]
2.3. Grey prediction model

Grey system theory is a method to study the modeling of uncertain systems, small samples and poor information. Through the processing of some known information, we can find useful information. The grey prediction model is widely used in industry, agriculture, economy and other fields [10]. The grey prediction model can remove the old data in the data series and constantly supplement new data. The continuous addition of new data to the grey prediction model can meet the requirements of self-study. By continuously removing the old data, the model can reduce the storage space, which makes the operation convenient. The time response of GM (1,1) model is shown in formula 3. GM (1,1) model is shown in Formula 4.

\[
\hat{x}^{(1)}(k) = x^{(0)}(1) - \frac{u}{\alpha} e^{-\alpha(k-1)} + \frac{u}{\alpha} \left(1 - e^\alpha\right)
\]

\[
\hat{x}^{(0)}(k) = \left(1 - e^\alpha\right)x^{(0)}(1) - \frac{u}{\alpha} e^{-\alpha(k-1)}
\]

2.4. Fuzzy comprehensive evaluation

Using fuzzy comprehensive evaluation (hereinafter referred to as FCE) method, comprehensive evaluation is a method integrated with the application of fuzzy mathematics, which can quantify the indexes that are not easy to quantify [11]. Therefore, the FCE method is used to improve the accuracy of evaluation. In this paper, the FCE method is used to evaluate the whole process cost management of PTATP. By using the fuzzy evaluation criteria, we can change the qualitative evaluation into quantitative evaluation, which can finally obtain the comprehensive evaluation results in line with the evaluation level of the whole process cost management level of the PTATP [12]. The final evaluation effect value of each evaluation object, as shown in formula 5.

\[
S = \left[w_1, w_2, ..., w_n\right]^T
\]

where

\[
\begin{bmatrix}
  r_{11} & r_{12} & ... & r_{1n} \\
  r_{21} & r_{22} & ... & r_{2n} \\
  ... & ... & ... & ... \\
  r_{n1} & r_{n2} & ... & r_{nn}
\end{bmatrix}
\]

3. Advantages of construction of project cost platform

3.1. Auxiliary engineering decision

The project cost platform can effectively assist the decision-making department of PTATP in project decision-making and project management. Through the project model, the project cost platform realizes the effective integration of different projects of PTATP, which can reflect the diversification of material information data. Through the project cost platform, some problems we can find are presented in advance, which can play a great auxiliary role in the design planning and management of the project decision-making department. At the same time, the project cost platform provides an effective platform for the construction and operation effect of PTATPs. According to the data and operation effect reflected in the model, the project cost platform can promote the scientificity and effectiveness of decision-making.

3.2. Implement complex operations

The project cost platform can realize complex calculation. For PTATPs with complex structure, a variety of cost management will be designed, including project excavation volume, concrete volume, regional block measurement and calculation, etc. Therefore, the amount of calculation brought by complex projects is very huge, and part of the data can only be estimated. Through the project cost platform, we can effectively split and calculate the layout of different high-grade concrete and PTATP power facility.
system, which can realize the accuracy and effectiveness of the design layout. At the same time, we can fully and accurately measure the cost of icing, current consumption and load of power transmission and transformation lines. Through the project cost platform, we can accurately count the quantities, which will reduce the deviation caused by human factors. By improving the evaluation quality, we can accurately estimate the project cost. Through the project cost platform, we can effectively realize the cost management and automatic cost calculation of PTATP, which will avoid possible omissions and errors in manual operation. At the same time, the project cost platform ensures the integrity and accuracy of the bidding bill of quantities and other cost management achievement documents.

4. Architecture based on BD platform
Based on BD technology, this paper constructs the project cost information management platform, and the system architecture design is shown in Figure 2.

![Figure 2. Architecture of the platform](image)

5. Conclusion
BD technology is an advanced information technology means. Through the IPF, we can centralize and share scattered resources, which will improve the efficiency of resource utilization. Through the construction of PTATP cost IPF, we can realize the optimal allocation and efficient utilization of
resources, which can build a standardized, scientific and standardized whole process cost management system.

References
[1] Li Xiaoqian, Niu Bo. Project cost information and information management [J]. Journal of Xi'an University of Posts and telecommunications, 2012,17 (S1): 34-37.
[2] Wu Renda. Preliminary discussion on the construction of an international project cost information service platform of a company [J]. Hydropower station design, 2020,36 (01): 41-45.
[3] Liang Jinyong. Analysis of Shanxi highway engineering cost management informatization [J]. China transportation informatization, 2020 (08): 29-31.
[4] Shi Yu. Analysis on the informatization construction of project cost management at the present stage [J]. Modern economic information, 2015 (10): 127.
[5] Li Wei, Xiong Jiena. Exploration of construction project cost information management and application practice [J]. Value engineering, 2015,34 (26): 22-24.
[6] Zhang Yuquan. How to do a good job in cost information management of construction projects by cost management departments [J]. Construction economy, 2011 (06): 75-77.
[7] Chen Hongyan. Research on the construction of cost analysis IPF for PTATP [J]. Industrial technology and economy, 2016,35 (04): 101-108.
[8] Mo Dan. Concept of "three IPFs" in project management [J]. China Construction, 2014 (06): 78-79.
[9] Zhu Xisheng, Zhang Runtao. Research on construction planning of project cost IPF [J]. Journal of engineering management, 2018,32 (06): 35-39.
[10] Xiao Hanwen. Research on cost information resource sharing of port engineering bidding under the background of BD [J]. Ship materials and market, 2019 (03): 54-55.
[11] Hu Xianchun. Discussion on the construction and application of real estate cost consulting IPF [J]. Journal of Guangdong water resources and electric power vocational and technical college, 2019,17 (01): 35-38 + 63.
[12] LV ruiruirui. Down to earth informatization outlines the new picture of smart Chuzhou [J]. China construction informatization, 2019 (13): 26-27.
[13] Liu Hongzhi. Research on application mode of power project cost management based on BIM [J]. Shaanxi electric power, 2016,44 (11): 66-71.
[14] Li Jian. Research and implementation of cost management IPF [J]. Highway transportation technology, 2017,13 (02): 308-311.