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Research on the Construction of Cost Information Base for Construction Enterprise Based on Big Data

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Abstract: With the advent of the era of big data, driven by policy guidance and market demand, construction enterprises are facing an urgent need for information construction and cost system reform. However, the traditional method of project cost management often relies on labor and experience, and there are some problems such as Information Island, insufficient data mining and difficulty in sharing. Therefore, how to use big data technology to build efficient and intelligent construction enterprise engineering cost information database has become an urgent problem to be solved. By analyzing the application direction of big data in project cost management and combining with the current situation of construction enterprise cost information database management, this paper gradually builds the construction cost information database architecture based on big data from four levels of "data-logic-application-management" and gives application suggestions, in order to realize the intelligent accumulation of project cost data for construction enterprises. To improve the level of enterprise digital management provides beneficial reference.

1. Introduction

On September 27, 2024, the National Data Bureau drafted and issued the Opinions on Promoting the Development and Utilization of Enterprise Data Resources (Draft for Comment), proposing to "fully release the value of enterprise data resources and build a digital economy with data as the key element". Based on the new development stage opened by the "14th Five-Year Plan", digital transformation has become an inevitable trend for the entire construction engineering industry[1]. Big data technology, with its powerful data processing and analysis capabilities, is bringing revolutionary changes to unengineered cost management. The essence of digital transformation of engineering cost industry is to use big data technology to enable the whole process management of engineering cost[2], fully excavate the value of historical data, transform the historical data of enterprises into data assets of enterprises, establish a market-based engineering cost information database, in order to achieve fine cost management of construction enterprises, maximize the benefit of engineering investment, and enhance the core competitiveness of enterprises driven by digital innovation.

2. Application of Big Data Technology in Cost Management

Big data is a collection of data beyond the capability of traditional database software tools in terms of acquisition, storage, management and analysis. The core of big data is to use a technical means to store and analyze massive data, improve the processing ability of data, quickly obtain valuable information, and tap the application value contained in the data. For example, complex machine analysis can make reasonable predictions about the cost of the project and control the error within a reasonable range[3]. The application of big data technology in construction enterprise project cost management is mainly reflected in the following four aspects:

(1) Data acquisition and integration: Big data technology realizes efficient and real-time acquisition of engineering cost data through intelligent sensors, Internet of Things and other technologies, and integrates data from different channels and formats into a unified data set, laying the foundation for subsequent analysis.

(2) Data storage and management: Big data technologies such as distributed storage systems and cloud storage meet the storage requirements for massive engineering cost data, with high reliability, high availability, and high scalability.

(3) Data analysis and mining: Big data technology in-depth analysis and mining of engineering cost data, find correlation, regularity and trend, provide decision support for cost management, such as historical data mining guidance for new project estimation and cost control, real-time monitoring and early warning of potential risks over templates.

(4) Information sharing and collaboration: Big data technology builds project cost information databases and platforms, realizes real-time information sharing and collaborative management across enterprises and industries, improves the efficiency and accuracy of cost management, and promotes all-round and multi-angle communication and cooperation among enterprises, governments and other participants.

3. Construction Enterprise Cost Information Base Management Status and Problems

Based on the characteristics of high investment, large volume and long cycle of construction projects, the engineering cost data itself has large quantity, data and data fragmentation, which is conducive to the exploration and application of information technology. With the continuous advancement of the wave of digital transformation, more and more construction enterprises begin to pay attention to the accumulation and sorting of cost data. For example, establish an internal cost database to centrally manage key information such as historical project data, market prices and engineering indicators; Cloud computing technology is used to improve data processing efficiency, dig deep value of data, extract previous project cost indicators to guide new project budget, cost control and process risk management; Establish an integrated platform for cost management, project management and financial management systems to realize data sharing and collaboration, and improve work efficiency and decision-making level. At present, the BIM-based construction cost information database system can obtain accurate information continuously, which is the core of constructing the engineering dynamic information database system, and also provides multi-angle quality services for construction cost management and cost control[4] .

Although advanced technologies such as big data and cloud computing provide strong support for the construction of cost information database, the management of cost information database in construction enterprises still faces many problems in practical application.

(1) The degree of information resource sharing is low. Construction enterprises that have been tested by the market usually have accumulated a considerable scale of cost data resources, but these data often fall into an "island" state because of inconsistent format and standards. The degree of information resource sharing is low, and interconnection has not been realized, which affects the

informationization function of project cost and limits the benefit of construction[5]. Data "silos" not only hinder the smooth flow and sharing of data between different systems and different platforms, but also greatly weaken the availability and potential value of data.

(2) Information collection channels are blocked. At present, some construction enterprises still rely on inefficient and error-prone manual data collection, and the data source is single, and the update mechanism is imperfect, resulting in data information lagging behind the market, affecting the speed and accuracy of corporate decision-making. Therefore, how to improve the efficiency of information collection and broaden the source channels has become a problem that needs to be solved.

(3) The level of information base construction is uneven. At the same time, despite the opportunities provided by big data technology, it is difficult for some enterprises to deeply explore the value of data due to the lack of professional talents and technical means, and the insufficient application of analysis results, wasting resources and hindering data-driven decision-making ability. Therefore, strengthening the ability of data analysis and application, training the team, and deep integration into the business has become the key.

4. Construction Project Cost Information Base of Construction Enterprise

4.1 Construction Principle

The construction of construction cost information database aims to achieve the integration, interoperability and deep utilization of cost data resources. The information base is utilized to achieve comprehensive coverage and complete the elements of collaborative management, thereby providing accurate and efficient project cost information services to all participants of construction enterprises. Concurrently, enhancements are made to the flexibility and scalability of the cost information database, and its content is constantly updated to ensure that the database remains adaptable to the evolving needs of industry development. The main principles of building big data cost information base include the following three aspects:

(1) Data quality and accuracy: The accuracy of cost control is inseparable from the reliability of the data itself. In the process of collecting and uploading massive data, the comprehensiveness, accuracy and effectiveness of the cost data information should be guaranteed. When the data is stored, it is carefully checked to avoid the leakage and loss of key information, and at the same time, the data is deeply mined and analyzed to improve the accuracy and reliability of the data.

(2) Unified standards and systematization: Gathering different types of cost data from within the industry makes the cost control extremely complicated, and the cost objectives of various subjects are inevitably mutual and independent. The information base needs to coordinate and unify the standard system based on the cost data of all elements, for example, in accordance with the different stages and components of the project, such as civil construction, installation, municipal administration, etc. A corresponding data classification and hierarchy structure is established to form a systematic information base.

(3) Dynamic update and real-time: Based on the real-time and volatility of engineering cost information, the information base needs to ensure that the data can reflect the changes in market and project demand in real time. The study timely collects new project data, markets price changes, and other relevant information, and updates it to the information base, in order to achieve dynamic and sustainable development of accurate cost control.

4.2 Service Object

The main service objects of the engineering cost information database of construction enterprises

include construction units, construction units, design units, supervision units, cost consulting units, government departments and industry associations, and material suppliers, and the relationship is shown in Figure 1.

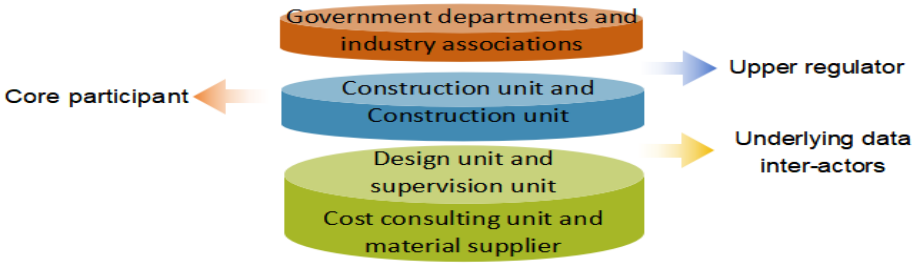

Figure 1: Project cost information management service object and the relationship between all parties

4.3 Information Base Architecture

The construction of engineering cost database is a comprehensive and complex task, which requires comprehensive planning of data collection, in-depth analysis and effective use of data[6]. In this process, it is necessary to extensively collect the cost data of various typical engineering projects, fully explore the potential of the data, and use advanced intelligent algorithm analysis to reveal the inherent law of the cost index, improve the utilization efficiency of the engineering cost data, and meet the diversified needs of all relevant parties in the engineering cost data information services. Based on this, the construction enterprise engineering cost information database architecture is constructed, which covers scene application, logical construction, data input and platform management four levels. The project initiates by analyzing its actual needs, followed by the collection and storage of original data. This data is then subjected to in-depth mining and algorithmic analysis. Through integration of the service requirements and data utilization goals of all stakeholders, it ensures that all components are interconnected, thereby creating an organic whole. Its construction idea is shown in Figure 2.

(1) The data entry layer is the foundation of the entire platform and is responsible for collecting and integrating massive amounts of data from different sources. The database encompasses raw data, which includes the project overview, bill of quantities, and investment estimation indicators. It also features dynamic update data, such as regularly updated market information on project costs, project schedules, and potential design changes within the project. The data input layer is also responsible for tracking data sources, and the original data sources are mainly government and cost industry associations, construction units, design units, construction units, cost consulting units, material suppliers, etc, to ensure the reliability and traceability of data.

(2) Logic building layer is the core of the platform, responsible for data processing, analysis, model building and user-oriented Database configuration. First of all, through data cleaning and preprocessing, the original data is converted into a standard format that can be used for subsequent analysis and application, and then advanced machine learning and artificial intelligence technologies are used to conduct deep learning and analysis of massive data, such as parallel computing iterative algorithms, data mining and other technologies, to conduct deep processing and mining of various types of data in the input layer to extract valuable information. Secondly, build data models, such as data analysis model, monitoring model, data early warning model, etc., which are used to analyze the level of cost indicators, real-time monitoring of project progress and cost, and timely detection of potential problems. Finally, according to the actual business needs of all parties, various cost indicators are configured and information databases are managed, including

standard database, index database, market price information database, etc., to provide powerful data support and decision-making basis for the scene application layer[7].

(3) The scenario application layer is the top layer of the architecture and is responsible for applying the data and analysis results generated by the logical construction layer to actual business scenarios. Including the realization of rapid information retrieval, indicator trend visualization, process control early warning, cost index comparative analysis and other specific services. The application layer maximizes the value of data by translating data and analysis results into actual business operations, and improves the level of intelligence and refinement of project management.

(4) In addition, the information platform management section is responsible for user management, data rights management, Q&A feedback management, information base management, performance statistics and AI large model management, timely collection of user opinions and suggestions, and continuous optimization and improvement of the architecture to ensure the safe and efficient operation of the information platform and the effective use of users.

This architecture shows how a complete cost big data repository starts with data collection, goes through data processing and analysis, and finally applies the results to specific business scenarios to support decision making and optimize business processes.

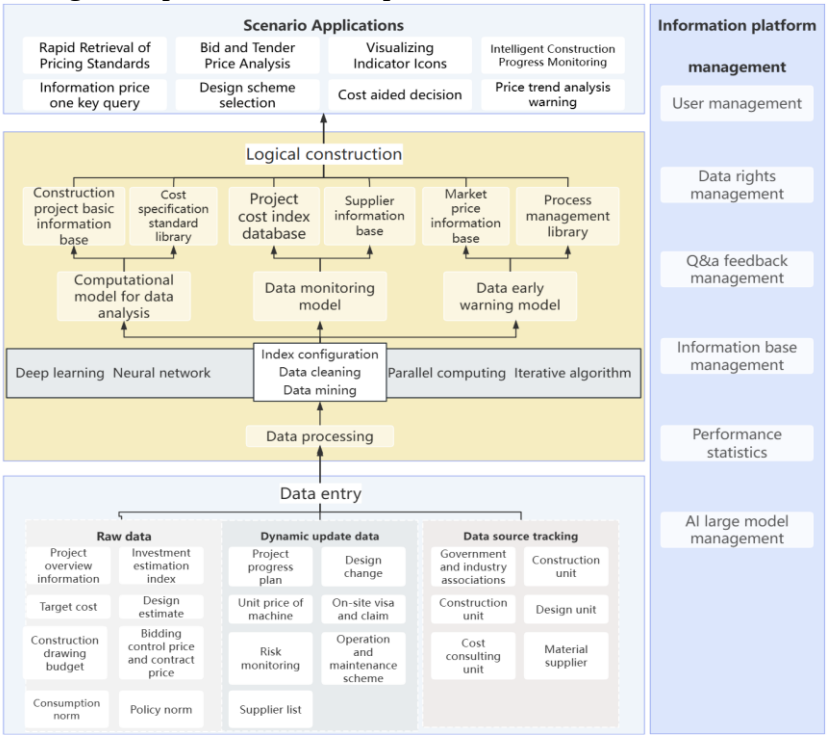

Figure 2: Construction enterprise project cost information base structure

5. Suggestions on the Application of Construction Cost Information Base in Construction Enterprises

In order to improve the level of engineering cost management and enterprise competitiveness, and realize the accurate control of engineering projects, the key lies in the effective use of engineering cost information database. By comprehensively integrating various cost data resources including historical project cost data, market price information, quota standards and cost indicators, systematically sorting and archiving, and building a unified and standardized data resource information database, there are the following suggestions in subsequent application.

(1) Explore the potential value of data and optimize the intelligent analysis model. Utilizing big

data technology, this approach involves implementing correlation analysis and trend prediction of engineering cost data through algorithmic analysis. Additionally, the intelligent analysis model is optimized to support efficient and accurate cost estimation.

(2) Strengthen the dynamic update and maintenance of information base. In order to keep the timeliness and accuracy of the engineering cost information base, enterprises must strengthen the dynamic updating and maintenance of the information base. It involves collecting the latest market data and quota standards on a regular basis, collecting supplier input and output data, and updating the content of the information base in a timely manner. At the same time, an effective data quality management mechanism should be established to verify and review data to ensure the reliability and accuracy of information.

(3) Deepen the application of the whole cycle and process of the cost. Enterprises should actively promote the application of project cost information database in the whole cost management process, realize the full cycle data sharing and collaborative work, and enhance the communication and collaboration between cost management, design and construction, government and cost association. Through the continuous application of multi-participants in the whole cycle, the deep learning ability of the information base is strengthened, more cost data assets are accumulated for enterprises, further help the fine management of cost, and provide an effective reference for future projects.

6. Conclusion

Engineering cost information is an important means of engineering cost reform. Big data technology provides strong technical support for the construction of engineering cost information, making the engineering cost more scientific and reasonable. The construction of database is the most basic work in big data analysis, and also the foundation of the construction of cost management platform. It promotes construction enterprises to establish cost information database, makes cost data analysis realize the leap from "manual statistics" to "intelligent algorithm", and helps enterprises to continuously strengthen the refinement level of cost control and core competitive advantages in the process of cost reform. This strategy promotes the development of the construction cost industry towards a healthier and more orderly path.

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