Civil Engineering Based on Big Data and BIM Technology

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Abstract. In the modern information society with the rapid development of science and technology, human beings are producing massive data every moment. Big data technology, which is born of massive data, has become the trend of the times and has a great impact on the reform of all walks of life. At the same time, the civil engineering industry has experienced a slowdown in growth and a shift to intensive growth of quality and efficiency under the new economic normal. The civil engineering industry relies on information technology to get out of the growth dilemma, and big data and BIM Technology are the key to realize civil engineering informatization. Therefore, the research on BIM engineering management platform of big data is carried out, It is helpful to solve the problems of missing building parameters, incomplete and inaccurate information expression and difficult to improve the operation and maintenance of the project. In this paper, through the method of literature review and research, in view of the impact of big data and BIM Technology on Civil Engineering, we come to a conclusion that to build a BIM Technology team, we need a professional BIM project manager, three BIM modeling engineers and one BIM coordinator.

Keywords: Big Data Technology; BIM Technology; Civil Engineering; Literature Review

1. Introduction
With the advent of the information age and the rapid development of the Internet, the growth rate of data volume is accelerating significantly. Massive data makes people confused, so the concept of big data is put forward. As one of the pillars of our national economy, civil engineering plays an important role in the rapid development of our economy. It involves many aspects such as building structure, architectural design and building materials. There are many upstream and downstream industries, involving a wide range and large scale. A large amount of data has been created, which has potential big data characteristics. The basic technologies to improve the level of manufacturing informatization include BIM Technology. The collaborative application of BIM Technology and large-scale data technology in manufacturing industry is the inevitable trend of information development, which is characterized by data, Internet and cloud computing.

Based on the above reasons, many experts put forward their views. Fan Zhu said that "big data has opened a major era transformation. Big data will bring great changes, change our way of life, work and thinking, and change our business model. Moreover, the better application of big data technology in civil engineering will presume the vigorous development of civil engineering construction industry..."
Wang Chun et al. Aimed at the defect of data exchange and management mainly through files in current BIM applications, aiming at the creation of complete BIM, constructed an integrated BIM framework for the whole life cycle of buildings, discussed the key technologies involved in the architecture, and finally verified them in their prototype system bimdis through an example [2]. Naidu believes that in the process of civil engineering construction, misunderstanding of quality standards and components, ambiguity of quality defects, and neglect of continuous improvement of quality management, BIM model based on 4D can simulate specific or whole process design errors, reduce uncertainty and improve quality level [3]; Although the suggestions of these experts and scholars have made some achievements, they have not been used in practice.

Through reading a large number of literature on big data, construction industry data and BIM, this paper analyzes and studies the big data theory and BIM model data interaction technology, through the data mining and storage development practice of a large number of building materials big data existing on the world wide web, practices and discusses the computer simulation research of BIM model and visualization platform, This paper summarizes the technologies and methods of building materials data mining and BIM visualization, and carries out the preliminary research and case verification of BIM project management platform combined with big data.

2. Method

2.1. Association Analysis of Big Data and Building Data

The theoretical characteristics of big data are: large amount of data, rapid growth of data, diversity of data dimensions, low value density of data, close and reliable connection between data and reality. From the five different characteristics of the data itself, the big data is refined. Similar to big data, the construction industry is also an aggregation of a large amount of data[4].

With the rapid growth of data, the construction industry is a traditional industry with a long history. The ancient and modern architectural materials, architectural paradigms and architectural records contain a large number of paper-based data. With the development of the information age, the electronic construction of the original paper data, as well as the application of emerging information technology, In particular, BIM Technology, remote sensing measurement technology and virtual reality interaction technology have brought about the rapid increase of information data in the construction industry [5].

2.2. Concept of BIM

BIM can be called building information model, or exactly building information modeling. It is based on the design concept of three-dimensional model and presents and manages all relevant information of the project with the project model as the carrier. In this way, different time and different types of information of the project are reflected respectively through different models on the time axis, and management, coordination, sharing and transmission are carried out in the whole life cycle of the project such as project planning, construction, operation and maintenance, so that the technical personnel at each stage can make the most correct understanding and efficient situation response to the building information. It provides a collaborative platform for Party A, design, construction, supervision, property management and other parties involved in the construction, which plays an important role in the production efficiency, cost control and reduction of construction period. In architecture, BIM software company has defined a set of basic building object classes that can be added, modified or extended for users. An object class can create any number of object entities of different shapes based on parameters and relationships with other objects. How an object changes itself when its environment changes is called an object's behavior. The system provides object classes that predefine walls, slabs, or roofs based on their relationships with other objects. BIM design application allows users to mix 3D modeling objects with 2D drawn sections, allowing users to determine the 3D detail level while drawing complete drawings. BIM is a digital expression of the physical and functional characteristics of a facility (construction project); at the same time, BIM is the
sharing of knowledge resources, which provides reliable basis for the decision-making of the whole process from the proposal of scheme concept to the demolition of the entity through the analysis of relevant equipment information; in each stage of the construction life cycle, different stakeholders use upload, Download the update and modification information of BIM Technology, which can reflect and support their respective responsibilities and work together.

2.3. BIM Based Data Extraction Method for Quality Control Civil Engineering

BIM is based on 3D model. In the whole life cycle of civil engineering construction engineering, BIM continuously expands the attributes of each component (geometric attribute, technical information, product information, construction information, maintenance information, etc.), and outputs various reports (such as progress report, engineering quantity report, material use table, etc.) to form BIM report data. In addition, BIM can also support the project preparation stage documents (decision-making and project approval documents, construction land documents, survey and design documents, bidding and contract documents, commencement documents) stored in CAD drawings, office documents, pictures, compressed packages and other formats, construction documents (construction management documents, construction technical documents, construction materials data, construction records, construction test records and inspection reports, construction quality) External data such as quantity acceptance records, completion acceptance data), as built drawings, project completion documents (completion acceptance documents, Completion Final Accounts documents, completion documents, completion summary documents) and other external data are associated with components [7]. BIM component attribute information, BIM report data and external information jointly realize the complete description of engineering object. BIM model integrates multi-dimensional information data to form a reliable information data collection source. As the object of big data analysis, BIM model data must be transformed into BIM quality management big data, that is, BIM data extraction is needed.

2.4. Text Data Clustering

Cluster analysis is a statistical analysis method to study the classification of samples or indicators. The text content is transformed into matrix, and each phrase is given corresponding weight. After text data cleaning and text segmentation, the text data is replaced by feature phrases, and then these feature phrases are clustered into concepts based on domain ontology, that is, concept set based on domain ontology is formed. It is the basis of clustering algorithm [8]. TF-IDF is used to evaluate the importance of a phrase to a text set or a text file in a corpus.

The mathematical representation of TF-IDF is[9]:

\[ TF = \frac{t}{d} \]  

\[ IDF = \log\left(\frac{n}{m}\right) \]  

\[ TF \times IDF = \frac{t}{d} \times \log\left(\frac{n}{m}\right) \]  

In the formula, T represents the frequency of the phrase t in a text D; D is the total number of phrases in text D; n is the total amount of text; m is the number of times the phrase t appears in each text of n [10].

3. Experiment

3.1. Literature Review and Research:
Consult the relevant information of BIM Technology and its application research at home and abroad, understand the current theoretical research status and application situation, and summarize the existing problems based on the actual investigation. It includes BIM Technology and IFC Standard, BIM application system, application of cloud computing in construction field, application of ontology technology in construction field and IFD content construction, BIM data management and organization method, BIM web service modeling method and IDM standard. In addition, according to the situation of BIM application system in specific field, as well as the utilization and demand of other kinds of systems, the results of literature research are supplemented and improved according to the actual situation.

4. Discussion

4.1. Construction of BIM Team for Construction Quality of Civil Engineering Project

Table 1. BIM Team Positions and The Number of People Required for Team Building

| Serial number | post                        | Number of people |
|---------------|-----------------------------|------------------|
| 1             | BIM Project Manager         | 1                |
| 2             | BIM building director       | 3                |
| 3             | Head of BIM structure       | 3                |
| 4             | BIM installation director   | 3                |
| 5             | BIM Coordinator             | 1                |

A BIM team was set up in the project department, and a professional BIM project manager was responsible for the overall deployment and coordination of BIM work of the project. Implement process control and application in-depth assessment for BIM team members. There are 3 BIM modeling engineers in each discipline, and the BIM construction director carries out modeling and information input for engineering construction, and guides the engineering construction and application docking. BIM structural director carries out modeling and information input for engineering structure engineering, and guides engineering construction and application docking. BIM installation director carries out professional engineering (mechanical and electrical, plumbing) modeling and information input to guide engineering construction and application docking. And a BIM coordinator to collect the data of the whole process of BIM application, and assist the BIM principal in relevant work. Among them, three professional modeling engineers are technicians with good BIM modeling level and have relevant project work experience. The technical personnel of each profession use BIM Technology to guide the construction of workers on site.

4.2. Case analysis of Civil Engineering Safety Accidents in China Based on Big Data Technology

Heinrich put forward in the factors of safety accidents in civil engineering that people's unsafe behavior accounts for nearly 90%, the unsafe state of things only accounts for less than 8%, and force majeure only accounts for 2%.

Figure 1. Distribution of Civil Engineering Safety Accident Causes

It can be seen from Figure 2 that 52% of the accidents caused by human unsafe behaviors are...
completely caused by human unsafe behaviors, and 36% are caused by the joint action of human unsafe behaviors and external objective conditions. This is very similar to Heinrich's conclusion. Therefore, in the civil engineering construction safety based on big data technology, the proportion of human factors is still the largest.

4.3. BIM Based Civil Engineering Information Management System Framework

Figure 2. BIM Based Engineering Information Management System Framework

Compared with the traditional civil engineering information management, the BIM based engineering information management system framework emphasizes the relationship among organization, application, process and integration. These four elements are interrelated and influence each other, forming six edges in the tetrahedron model. For example, in BIM based engineering information management, the selection of application software needs to consider whether it is compatible with the integration platform used; whether the output data of application software meets the requirements of specific process (sub model); whether the integration platform supports the definition of process (sub model view). These associations are not prominent in the traditional engineering information management, mainly because the traditional engineering information management takes the document as the main carrier of data exchange, while the BIM based engineering information management takes the information model as the main carrier of data exchange.

4.4. Management Objectives of Civil Engineering Construction Organization Based on Big Data

X project in Shanghai is selected as an example. As a large-scale and high-tech key project in Shanghai, X project often meets with high difficulty in construction, and it is difficult for enterprises to organize and coordinate the construction. Therefore, in order to ensure the quality of the project, we need to pay enough attention to the construction organization and management.

Table 2. Project Scale and Project Success Rate

| Number of people | 10  | 12  | 30  | 40  | 260 | 500 |
|------------------|-----|-----|-----|-----|-----|-----|
| time/month       | 8   | 9   | 12  | 20  | 24  | 40  |
| Project success rate | 60% | 35% | 27% | 17% | 10% | 0   |

Table 2 shows the relationship between project scale and project success rate, in which
management and technical personnel play an important role. Therefore, in the construction of civil engineering projects, the management organization must be lean and efficient, which can play a unified command and scientific management effect. The management personnel can be carefully selected and optimized in the establishment of organizational positions, and the construction organization can be guided by scientific methods to ensure that the construction work can be completed quickly, orderly and smoothly, to create high-quality projects with high-quality, and to cultivate a high-quality team with technical and management talents.

5. Conclusion
In recent years, the application of BIM Technology in enterprises has been popularized to a certain extent, and a large number of application points have been developed and matured in the aspects of engineering quantity calculation, collaborative management, deepening design, virtual construction, resource planning, engineering archives and information integration. Entering the era of big data, BIM Technology will thoroughly solve the current situation of low ability of engineering basic data collection and collation in the construction industry. The perfect combination of Bim and enterprise information management system will bring greater value to enterprises. As the future development trend of construction industry, BIM Technology has a comprehensive and revolutionary impact on the whole construction industry. Several key technologies closely linked with Bim in the future are discussed. The feasibility and necessity of Bim and big data in civil engineering are elaborated, which provides ideas for the future development of civil engineering based on BIM and big data.

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