Research on the methods of BIM reliability prediction with the construction schedule in the application of project of Chushandian reservoir

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Abstract: With the development of BIM (building information model), based on the existing construction management theory, combined with the idea of intelligent construction, fully integrating BIM and 4D technology, we can realize the optimization of construction schedule and real-time perception and control of the actual progress of construction. In this paper, the design model is built on the basis of 3D digital technology and CATIA software as the carrier. In the SQL Server database management system as the platform, with the use of information management platform data, the 4D BIM model has been formed, and the schedule control system has been applied in the Chushandian reservoir project, preliminarily implemented schedule monitoring target. Chushandian project application shows that to achieve the progress of data entry, the use of human-computer interaction realized the dynamic simulation of the progress of the interactive query and other data. The comparison of schedule deviation can be achieved by entering the schedule and actual progress into the network database; through the analysis of abnormal records, and the formulation of measures, the realization of schedule can be ensured.

1. Introduction

In modern project management, how to make a reasonable construction plan, accurately grasp the construction schedule and optimize the use of various types of construction resources, to shorten the duration, reduce costs, improve quality and achieve safe production, has become the consensus of construction management personnel. Construction schedule is one of the key indexes of engineering project management, which directly affects the investment benefit of the project. If the project schedule goal can be controlled well, it will improve the quality of the project, and reduce the efficiency and effect of the project cost and other related target factors. Otherwise, the project target is invalidated, and it even has a great adverse effect on the economic and social benefits of the project. In the implementation of the project schedule, the actual duration of each part of the project and the planned duration cannot be exactly the same. With the progress of the project, a variety of factors such as environmental changes and changes in organizational measures can often make the implementation delays and the cost increase, so we need to adjust the proposed schedule and correct deviations timely, and control the actual progress of the project.
2. The Concept and meaning status of 4D BIM

2.1 The concept of 4D BIM
The concept of 4D BIM originates from the integration of building product models and construction process, in other words, inserting the time (progress) dimension into the 3D building information model to form a 4D model.

2.2 The Meaning of 4D BIM
The application of 4D BIM management method is helpful to innovate and enrich the theory and method of construction schedule management and solve the problems of "information island" and information exchange failure in construction information. And it also provides a new research perspective to solve the information problem in construction schedule management. The problems in construction information management of construction industry are outstanding, and the demand of construction industry informationization is very strong. The strength of 4D technology is that it can help managers obtain on-site construction information in time, carry out effective management of information in the construction process, improve the timeliness of progress information and provide new theories and methods for the problems in the process of schedule management.

3. The Technical Route for The Design of 4D BIM Progress Control System
In the design of 4D Progress Monitoring System, including design model creation, progress model division to late progress acquisition, virtual construction, anomaly recording and other information integration. This research technology route is as follows:

Based on three-dimensional digital technology, using CATIA Software as the carrier, creating the design model, according to the schedule and project needs, the design model is divided into a progress model, which is the first step of the 4D Progress Monitoring System.

Catia Composer Player, as the main development platform and display platform of the system, its main advantage is that when the product changes do not have to be recreated, it can greatly save time and save the cost of rework, and it can convey product information through 3D animation and the creation of interactive product documents better. The two-time development of Catia Composer Player is an extension of its software capabilities that can better serve project requirements and customize proprietary interactive project menus.

Database technology is an important part of modern information science and technology, and it is the core of computer data processing and information management system. Database technology studies and solves the problem of effectively organizing and storing a large amount of data in the process of computer information processing, reduces data storage redundancy, enables data sharing, ensures data security, and efficiently retrieves data and processes data in database systems. This project mainly takes the Sql Server Database Management System as the platform.

The platform’s information including using Information management platform data, quality information, security information, and integrated status index information, Forms, pie charts, and histogram diagrams formed by the information can be used directly for the 4D Progress Monitoring System, resulting in a 4D BIM model. The technical route is shown in Figure 1.
Figure 1 Technology Roadmap

4. The Application of 4D BIM Progress Control System Implementation Scheme in Export Shop

Henan Province Mountain Store Reservoir whose total construction duration lasts 48 months is one of the 172 major water conservancy projects recently deployed by the State Council. The concrete dam section has to go through three flood seasons. In the flood season, the dam body should have the function of retaining water, so it has to reach the specific watermark in the flood season, which requires higher progress. In order to ensure that the node target, annual target and overall goal are realized on schedule, the 4D Progress Monitoring System is used in the concrete dam section to monitor the progress in a visual way by means of advanced management theory and management method, and to improve the field fine management level and promote the realization of the progress goal.

4.1 Specific Development Processes

After the completion of the project structure, we have to analyze the system, combine the flow chart, the implement the development plan. The specific development processes are:

(1) Based on the existing floor plan, using the three-dimensional design software CATIA of the French company Dassault, the three-dimensional model is constructed, and parameterized and templated modeling is used in the modeling process to quickly implement the model update when the design changes.

(2) According to the schedule, the plan is decomposed. The design model is transferred into a progress model, which is shown in Figure 2 (uniform seam) and figure 3 (uneven seam), and each building name has a specific identifier. The progress model is divided into three parts: the dam section type, the dam section number, the layer number, which contributes to distinguishing each progress model easily. The type of dam section includes connecting the dam section, the overflow dam section, the bottom hole Dam section, the Non-overflow dam section, the Power Station Dam section and so on. Each dam section is divided into different dam section number, and each dam section number is divided into different layer number. The layer number is the most basic unit.

Among them:
4D: 4D Progress Monitoring System;
DBMS: Database Management System;
IMS: Information Management System.
(3) Writes all progress model names as a field to the database, and then establishes additional fields, such as scheduled start time, actual start time, construction order, pile or elevation, quality information, security information, exception logging and so on.

(4) After the above basic work is completed, the CATIA model is imported into CATIA Composer, and the CATIA Composer player is developed for the second time. Its corresponding Composer player ActiveX plug-in, which not only gets rid of the CATIA design platform, can be independently embedded development, but also has a fully functional API interface, combined with the Microsoft Visual Studio2013 development platform and can meet almost all the functional needs. This step is the main work of achieving the 4D progress monitoring system. The ideas of the development of main functions and the functions mainly include: BIM function, Progress input and query function, Progress lag analysis function, Virtual construction function.

(5) Debug the program. After the above steps are completed, the program is debugged to ensure that all functions are completed successfully. Before putting the programmed program into actual operation, testing it by means of manual or compiler and correcting the process of grammatical errors and logical errors is an essential step to ensure the correctness of the computer information system. After the native debugging is complete, it is necessary to debug on other computers to ensure proper operation on all systems, and debugging needs to be repeated.

(6) Publish the program. After the program debugging is completed, the program will be published, and each participating can try the application. In the trial application process, the problems encountered in the operation are collected, after which the program will be debugged and release again. These processes have to be repeated until the program can be used on all computers.

4.2 Feature Introduction
After successful login, enter the main interface, as shown in Figure 4, which is also divided into four parts, including toolbars, menu bars, status bars and model areas. The menu bar contains a total of six functional areas: Dam segment viewing, cutting view, process video, plan progress, actual progress and drawing retrieval. The model area can display the building outline, size, and poured dam blocks.
5. Application Validation and Research Prospect

5.1 Application Validation
Based on 4D Progress Monitoring System of BIM three-dimensional model, integrating BIM information, progress information, progress monitoring and other modules, using personalized human machine intersection, the Mountain Shop Reservoir project has achieved successful application in Henan Province. 4D Progress Monitoring System has achieved the traceability of all information, strengthened the dynamic control of the site construction process, realized the visual management of the progress, brought economic benefits to the project, and saved the time cost. Generally, it played an important role in the construction of the project.

5.2 Research Prospect
According to different project requirements, the personalization requirements of the information management system and 4D Progress Monitoring System are usually different. However, its theory is a cross-research which is around engineering technology, computer technology, Internet technology, digital technology and other different disciplines. Therefore, In addition to the functions described above, it is also possible to realize dynamic management of construction resources, real-time cost monitoring, etc., to provide intelligent decision support for the project.

This study realizes some functions of the 4D progress monitoring system, but there are still limitations and shortcomings, as follows:
(1) At present, there is lots of BIM software on the market, and the 4D Progress monitoring system based on BIM does not form a unified specification or data interface, and the models cannot be fully referenced by each other. Therefore, the 4D progress monitoring system is more suitable for the situation based on CATIA modeling.
(2) Information management system and 4D Progress management system cannot be fully integrated. The former is based on B/S structure, and the latter is based on C/S structure. If the two can be combined into one system, not only the data can be seamlessly connected, and field managers do not have to be entangled in multiple systems, so that field managers can focus more on on-site management.
(3) In the future, except improving the project progress management system gradually, we can also add cost data to BIM model at the same time, and form the 5D management on the basis of 4D management.
(4) IOT. (Internet of Things) functions like video surveillance, hazard source early warning and acceptance management can be added to the system.
(5) The standardization of the current 4D Progress Monitoring System is not high enough, so the code usually needs to be rewritten in a new project. In the future, modules and interface used commonly can be standardized to shorten the system development cycle and response project.
objectives rapidly.

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