Research on Construction of Integrated Management Platform for Whole Process Engineering Consulting based on BIM Technology
-- Taking Urban Rail Transit Project as an Example

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Abstract. With the continuous development of whole-process engineering consulting mode, problems such as information island and information fault make it difficult to give full play to the advantages of whole-process engineering consulting integration and collaborative management of urban rail transit projects. In this paper, using a semi-structured interview process to identify the urban rail transit project engineering consulting BIM integrated management requirements, based on BIM integrated management requirements, to build the urban rail transit project based on BIM technology process engineering consulting integrated management platform, and platform to establish a model and safeguard measures, for the whole process of engineering consulting unit to solve urban rail transit project integration and collaborative management problems to provide the reference.

Keywords: semi-structured interview; whole-process engineering consultation; BIM; urban rail transit project.

1. Introduction

Urban rail transit projects belong to the government investment projects, with high investment and complex engineering technology, contractors, coordinate management difficulty is high, the more widely effect, etc [1], and the whole process of engineering consulting is about construction project organization, management, economy and technology, the whole life cycle of the engineering consulting services, with the advantages of integrated and collaborative management, and the government is to guide the government investment project takes the lead to participate in the whole process of engineering consultancy, therefore in the urban rail transit project in the whole process of engineering consulting have more advantages than the traditional engineering consulting.

However, since China began to popularize the whole-process engineering consulting model in 2017, a series of problems have been exposed in the continuous application of whole-process engineering consulting. Whole-process engineering consulting is not a traditional fragmented and phased consulting service, but a collection of professional personnel with clear objectives, which provides comprehensive consulting services through unified planning, division of labor, coordination and management, and communication and integration [2]. Therefore, there are many participants and management elements involved in the whole process of engineering consultation, and a large amount of complex information brings great challenges to information collection, sorting, transmission and sharing during the implementation of construction projects[3]. Due to the relative independence of each stage of urban rail transit project construction and the decentralization of various management contents, the efficiency and level of construction project management are seriously reduced [4], making it difficult to give full play to the advantages of engineering consulting integration and collaborative management in the whole process of urban rail transit projects.

The emergence of BIM can effectively solve the problems existing in the integration and collaborative management of engineering consultation in the whole process of urban rail transit projects, and improve the information management level of the construction industry [5]. However, at present, the application of BIM in the whole-process engineering consultation of urban rail transit

projects mostly focuses on the "fragmented" application of cost management, schedule management, safety management, etc., without considering the interrelationship between the management processes and the integrated management of the project participants [6]. Therefore, in this paper, based on the above research, through semi-structured interview process analysis of urban rail transit project engineering consulting BIM integrated management requirements, according to identify the BIM integrated management requirements, building the urban rail transit project based on BIM technology process engineering consulting integrated management platform, and build mode and safeguard measures is given.

2. BIM Integrated Management Information Demand Analysis based on Semi-Structured Interview

This section based on semi-structured interview method to the whole process of urban rail transit project engineering consulting BIM integrated management information needs analysis, understand the whole process of urban rail transit project engineering consulting services in the application of BIM are present situation, problems and the whole process of BIM integration application in the engineering consultation, the content of the whole process for urban rail transit project engineering consulting BIM integrated management platform to build research foundation.

2.1 Interview Method

Based on the purpose of the interview in this section, a semi-structured interview method is adopted in the design of the interview, and field one-to-one interview and telephone interview are adopted to conduct the interview. The question design of the interview is divided into three levels. Following the logic of "situational lead-in -- core interview -- in-depth interview", the cognition and understanding of the interviewees on "integrated management of BIM in the whole process of urban rail transit project engineering consultation" are explored [7]. The interview time of each interviewee is about 40 minutes, and individual in-depth conversation lasts for 1 hour. During the interview, according to the interview outline and the answers of interviewees, the optional questions are modified in time.

2.2 The Interview Sample

Interview samples to involved in urban rail transit project relevant government departments, consulting relevant staff, engineering design, construction and evaluation experts as the research object, the standards of selection interview object is: familiar with BIM technology and urban rail transit projects and participated in the whole process of actual engineering consulting projects, with the whole process of engineering consulting industry and BIM experts to give priority to. Most of the urban rail transit projects are mainly invested by the government, and have the characteristics of great difficulty in construction, wide professional involvement, multiple project participants, multiple risk factors, complex geological environment, and large workload of coordinating all parties[8]. State of government investment project is promoting the application of engineering consulting, whole process and whole process engineering consulting with urban rail transit project have the same large and professional players involved and coordinate larger workload, both with integrated management requirements, so this article is based on both the common characteristics and needs, to the whole process of urban rail transit project engineering consulting interview BIM integrated management requirements analysis.

The specific interview samples are mainly selected from the following perspectives: select the owner unit (government department), consulting unit, design unit, contractor and personnel of BIM research institute involved in the urban rail transit project; In the selection of posts, it also takes full account of the certain representativeness, as well as the leadership post, scientific research post and business post; In the choice of education level, choose undergraduate course, master, doctor the professional personnel of different record of formal schooling. This paper selects 80 interview samples that meet the requirements nationwide. For some interviewees, the interview outline is

informed to the interviewee by email before the interview, so as to obtain the permission of the interviewee and make him/her prepared.

Table 1. Basic characteristics of interview samples

The sample classification	category	The number
The unit type	Owner units and government departments	3
	Engineering consulting unit	6
	Survey and design unit	4
	Construction contractor	3
	BIM research institute	4
Jobs	Leadership post	8
	Business post	10
	The scientific research work	2
The identity or status of an entire process of consultation	The owner party	6
	Whole process engineering consulting unit	1
	BIM consultant	9
	Professional consulting engineer	4
The degree of education	Doctoral candidate	3
	Master	6
	undergraduate	11

2.3 Methods of Collecting and Analyzing Interview Data

The interview data collection method is mainly based on the interview recording, supplemented by the notes recorded in the interview. At the beginning of the interview, the opinions of the interviewees were solicited to ensure that the recording was only used for this study. After obtaining the consent of the interviewees, the interview data were recorded by recording. During the interview, the answers, responses and questions of the interviewees are briefly recorded, and the interview strategies are adjusted timely according to the questions. After the interview, combined with the interview notes, transcribed the interview content into a transcript word by word, listened to the recording repeatedly and proofread it, and formed a transcript of the interview data for subsequent analysis.

The analysis methods of the interview data are classified analysis and content analysis. Due to the interview outline of this study is in the preliminary design on the basis of literature analysis, so the first generic analysis and then USES content analysis for each word by word, line by reading the content of the main themes, from the original interview data to find out the information units of "useful" classify generalization, eventually form the interview results[9].

2.4 Interview Results

By sorting out the interview data (table 2), the results are as follows :(1) the whole process engineering consultation of urban rail transit project is obviously phased, and there are some problems in the construction process, such as the disunity of project implementation process, the decentralization of project participants, and the inconsistency of project objectives. (2) the whole-process engineering consulting units of urban rail transit project coordinate to ensure the whole-process information integration and sharing of the project becomes the core concern, and the whole-process information integration of the project is the basis for realizing the information sharing. (3) the establishment of BIM project management platform can effectively avoid the problems of information loss and information island caused by piecewise management of urban rail transit projects, and realize the transition from scattered data call to integrated management of the whole life cycle.

Table 2. list of BIM integrated management information requirements

Phase	BIM integrated information requirements
Decision-making stage	Surrounding geographical environment information; cultural environment information; building appearance and function information; investment estimation information; project feasibility study.
The design phase	Engineering survey data information; professional design information; building performance analysis information; project indicators information; design budget information, model error collision information; building internal vertical height; building space layout information.
Contracting stage	BIM model automatic calculation; bidding control price information; based on BIM quick inquiry.
In the implementation stage	Construction site layout plan; construction scheme simulation information; construction process simulation information; construction progress control information; construction cost control information; quality and safety management information; material management information; contract and data management information.
Stage of completion	Construction process data; project completion acceptance information; project completion settlement information.
Operation stages	Building equipment information; building space information; building assets information; building emergency simulation; energy data information.

By summarizing and analyzing the BIM integrated management information needs of the whole-process engineering consultation of urban rail transit projects listed above, the BIM integrated management information needs can be divided into four categories: target inheritance, organization integration, process integration and information integration. Therefore, on this basis and based on BIM technology, this paper constructs a whole-process engineering consulting integrated management platform of urban rail transit project process integration, integration of all participants, target integration and information integration.

3. Construction of the Whole Process Consulting Integrated Management Platform based on BIM Technology

3.1 Construction Ideas

Process of urban rail transit project based on BIM technology engineering consultancy to construct integrated management platform based on BIM model for urban rail transit project participants exchanges and communication of information carrier, through the BIM integrated management platform, effective integrated information model of the project participants, data exchange and transmission of information, realize the whole process of urban rail transit project engineering consulting the process of integration management, target management, organization integration, information integration management four big integrated management objectives.

3.2 Architecture Design

In the architecture of BIM integrated management platform, according to the different functional requirements of the BIM management platform, the hierarchy of the platform frame is divided into four layers, which are the basic data layer, model layer, functional module layer and user layer from top to bottom.
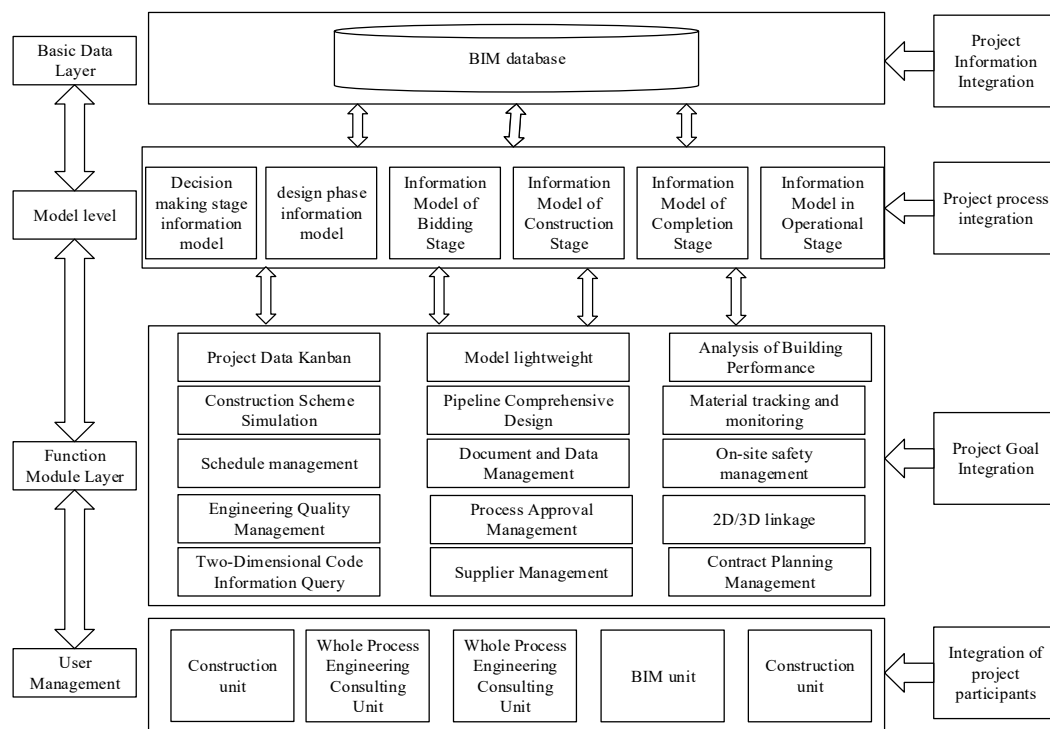
Fig. 1 Overall design framework of BIM integrated management platform

3.2.1 Data Layer

The basic data layer mainly integrates all the information of all stages, majors and project management elements of the whole-process engineering consulting projects into the project BIM database established with the whole-process engineering consulting institutions as the leading role. The establishment of BIM central database should start from the beginning of the project. With the continuous development of the construction project, it will gradually be enriched to form a large project database. In the whole life cycle of a construction project, all participants in the whole process of engineering consultation can download the database information at any time in each stage. BIM central database information is generally divided into three categories: structured information, unstructured data and management process data.

3.2.2 Model Layer

The model layer integrates the project information data through BIM technology to generate the data model. The model layer is based on the BIM data integration management platform and connects with the underlying resource layer through the core layer to realize the integration and application of reading and extracting engineering data. According to the different stages and applications in the whole process of the project, the corresponding stages and application models are generated. Phase model refers to the model of each stage of the project, such as the design stage model, implementation stage model, operation and maintenance stage model, etc., and application model refers to the application model of a certain stage, such as cost management model, schedule management model, etc[10].

3.2.3 Functional Module Layer

The functional module layer is composed of the functional application of BIM software in the whole process of engineering consulting integrated management. All participants of the whole-process engineering consulting shall obtain all kinds of model information from the building information model layer according to the integrated management requirements, and carry out analysis and processing through the corresponding BIM software to achieve the corresponding functional application. Project participants can also re-input the new information obtained from analysis and processing into the BIM database, so as to realize efficient integration and sharing of data and make full use of information.

3.2.4 The User Layer

The BIM project management platform integrates the project participants and sets up different ports, which are divided into construction unit, general consultant, design, bidding, supervision, cost, construction and supplier. The consultant can access all the information of the system, inquire, add, modify and delete the information of design, bidding, supervision, cost, construction and supplier, and maintain most of the information of the system. The owner may review and approve the information of each participant of the project. Other participants will delegate the authority of the platform, and each participant will assign relevant personnel to carry out daily maintenance and management.

3.3 Establish a Pattern

The establishment of the integrated management platform of BIM generally adopts three modes, the first is by buying more mature commercial software, secondary development, to meet the need of practical application software in general these goods to the function of the platform of a child is given priority to, to two or morethings implement other platform function, such as visionbank da, DE, tea, software; The second is to develop a proprietary BIM platform according to the actual situation of the project, which is usually developed by a professional software company. It can basically meet the various target control requirements of the project, and can also be used in other projects after appropriate improvements, such as GRANID platform developed by German GIB company. The third is the combination of purchasing commodity software and self-development, integrating multiple dedicated platforms, which can also meet the needs of project target control. No matter which mode is adopted by the whole process engineering consulting unit of urban rail transit project, it needs to combine the actual situation of the project and its own comprehensive ability, including its personnel composition, financial strength and the knowledge accumulation degree of the company in the whole process consulting field. Based on the analysis of the status quo of the application of BIM technology in urban rail transit projects and the architecture of this platform, this paper recommends to adopt the platform establishment mode combining the third commodity software purchase and self-development.

3.4 Safeguard Measures

The whole process of the successful implementation of engineering consulting project management information integration platform, not only should have a set of advanced and applicable project information management software and reliable performance of computer hardware platform, more importantly should establish a set of corresponding to the work of a computer means, scientific and reasonable transportation construction project information management platform system. In the narrow sense, it refers to the software platform, while in the broad sense, it is the guarantee system composed of BIM application management system, training system and software and hardware configuration.

3.4.1 Establish BIM Application Management System

In the construction process of engineering projects, the whole-process engineering consulting institutions need to supervise and implement the application of BIM on the whole. And urge all parties to submit BIM application results and maintain the information model. So in order to ensure the information management mode based on BIM in the whole process of engineering consulting project smooth implementation, the need to establish the corresponding BIM application management system, for BIM information management for effective management and inspection, and combine BIM applications and incentive system, we should institutionally ensure that BIM model information maintenance and update, in order to realize the effective integration of the whole process of engineering consulting project information management. The established BIM application management system shall at least include project implementation management system, performance appraisal system, data maintenance system, software and hardware management system, etc.

3.4.2 Determine Hardware and Software Configuration

When the construction project determines to use BIM technology for project integrated management, the first thing to be considered is the configuration of hardware and software. Only under the guarantee of software and hardware conditions can the application of BIM technology be realized. Based on the latest BIM series software and hardware requirements, this paper proposes to adopt Autodesk series software and luban series software as the main software of BIM modeling application, select Pathfinder and Fuzor as the safety evacuation simulation and animation simulation software, and luban cloud platform as the supporting conditions of BIM information sharing platform.

Table 3. BIM software and hardware configuration table

The name of the software	The software USES
Revit 2016	Build model; CAD drawing output.
Navisworks2016	Space collision detection; project progress simulation; construction animation simulation.
AutoCAD2014	2d drawing processing
Luban Trans Revit	BIM model output and transformation
Luban steel	Quantity statistics
Fuzor 2017	Assist design; annotation measurement; roaming animation.
Luban MC	Multi-project centralized management; view; statistics and analysis.
Luban BE	Fast query data; component attributes; etc.
Office2013	doc
MS project	scheduling
Modeling workstation	CPUi7, 8G memory, 1TB hard disk, DirectX 11 support and Shader Model 3 graphics card.

4. Summary

BIM technology is no longer a simple building information model, but can bring new power for transformation and upgrading of the whole process engineering consultation of urban rail transit projects. Based on BIM technology, the integrated management platform for the whole process engineering consultation of urban rail transit projects can more effectively realize the four integrated management objectives of urban rail transit projects, which are target inheritance, organization integration, process integration and information integration. The application of BIM integrated management platform in the whole-process engineering consultation of urban rail transit projects can effectively solve the problems of "information fault" and "information island" in the whole-process engineering consultation, give full play to the advantages of the integrated management of whole-process engineering consultation, and improve the efficiency of the whole-process engineering consultation of urban rail transit projects.

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