

# A new intelligent construction management platform

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**Abstract.** Focusing on the project construction unit and construction process, through "BIM + GIS" and other advanced technologies, real-time, accurate, real and complete monitoring and management of "human, machine, material, method and environment" and other elements and processes, so as to realize the interconnection, collaborative sharing and comprehensive display of post, project and enterprise data, and build a platform based on BIM Technology and with progress as the main line With economy as the core and project as the carrier, all participants cooperate, multi-level linkage, management pre control, and integrate an efficient digital, online and intelligent new construction management platform to ensure the smooth realization of project quality, safety, progress and cost construction objectives.

**Keywords:** BIM, GIS, Intellectualization.

## 1 Introduction

Basic database refers to a database built to uniquely identify the relatively stable attributes of an object, the main characteristic information of the object and the relationship information between objects. It mainly includes object identification information, main feature information, remarks, attribute collection time, attribute update time, relationship with objects, etc.

The basic database stores the basic attribute data of various basic natural objects[1], monitoring management objects, monitoring stations and related projects required by the system. The main contents include:

Basic information of main facilities of tunnel, pipeline, pump station, high-level pool, valve, gate, box culvert, manhole, drainage well, survey station, etc.

Basic information of safety monitoring points, environmental monitoring points, water and soil conservation monitoring points, metal structure equipment, electromechanical equipment, communication optical fiber, communication network, park and other ancillary facilities of the project.

Basic information of natural persons, superior management units, water users, emergency units and other engineering actors.

Basic information of engineering behavior objects such as machinery, materials, projects, indicators, video monitoring points, gates, water receiving areas, waterworks, water resources zoning, water function zoning, surface water sources, groundwater sources, etc.

Basic information of rivers, lakes, watershed zoning, geological units, roads, railways, geological structures, other pipelines, other tunnels, etc.

### **1.1 Spatial database Safe and practical, advanced and reliable**

Spatial database storage includes basic geographic information data[2], engineering thematic element data, various remote sensing images, DEM data and spatial information related to various objects. It includes basic geographic information and spatial information corresponding to natural objects, related projects, monitoring stations and monitoring management objects.

### **1.2 BIM database**

BIM database stores BIM model data such as tunnel, pipeline, segment, box culvert, pump station, high-level pool, sluice, valve, reservoir, inverted siphon, working well, water diversion outlet, manhole, drainage well, ventilation well and water measuring room.

### **1.3 Monitoring database**

The project monitoring database stores real-time or semi real-time monitoring data[3], including project safety monitoring data, water quantity and quality monitoring data, ecological environment monitoring data, water and soil conservation monitoring data, park monitoring data, etc.

Project safety monitoring data: deformation, horizontal displacement, inclination, water level, flow, internal force, pressure, stress, sediment content, sedimentation, etc. of tunnel, working well, maintenance or leakage drainage well, intake forebay, pump station, high-level water tank, water diversion outlet, etc.

Water quantity and quality monitoring data: hydrological element monitoring, water quality element monitoring, equipment fault monitoring, equipment power supply voltage anomaly monitoring, etc.

Ecological environment monitoring data: water environment monitoring, ambient air monitoring, acoustic environment monitoring, terrestrial ecological environment monitoring and investigation, aquatic ecological environment monitoring and investigation, radioactivity monitoring, environmental accident emergency monitoring, etc.

Monitoring data of water and soil conservation: spoil (stone and slag) yard, borrow (stone and slag) yard and large-scale excavation

Monitoring of water and soil loss influencing factors[4], water and soil loss status, water and soil loss hazards and water and soil conservation measures in (filling) area, construction road and temporary soil (stone and slag) yard.

Park monitoring data: vehicle and personnel access time and positioning data, building electricity, water, gas, etc.

### **1.4 Industrial control database**

Real time status data, dispatching instructions and other industrial control data of automatic control systems such as pump stations, gates and valves[5].

### 1.5 Business shared database

The business sharing database stores the data shared by each business application system to other business systems[6], including business sharing data of engineering project management information system, business sharing data of intelligent dispatching system and engineering maintenance system

Business sharing data, emergency command system business sharing data, etc.

Project management information system business sharing data: project safety, project quality, project progress, project contract management, investment and payment management, material management and other related business data.

Business shared data of intelligent dispatching system: relevant business data such as pump station, gate, valve, reservoir dispatching operation, tunnel and pipeline dispatching.

Auxiliary decision-making business sharing data: project supervision, project evaluation and other data.

Data shared by other business systems: engineering digital archives, Yuehai water OA, training management, hidden danger management, electronic signature and other relevant system data.

### 1.6 Multimedia database

The multimedia database stores documents, pictures, images, sounds, videos, etc. involved in the construction process of multiple projects.

### 1.7 Metabase

Metabase stores database level metadata, dataset level metadata, feature class level metadata and object level metadata related to data resource pool.

## 2 Objectives and ideas

Basic database refers to a database built to uniquely identify the relatively stable attributes of an object, the main characteristic information of the object and the relationship information between objects. It mainly includes object identification information, main feature information, remarks, attribute collection time, attribute update time, relationship with objects, etc.

The basic database stores the basic attribute data of various basic natural objects, monitoring management objects, monitoring stations and related projects required by the system. The main contents include:

Basic information of main facilities of tunnel, pipeline, working well, foundation pit, pump station, high-level pool, valve, gate, box culvert and so on.

Basic information of ancillary facilities such as safety monitoring points, quality inspection points, environmental monitoring points, water and soil conservation monitoring points, metal structure equipment, electromechanical equipment, communication network and so on.

Basic information of project actors such as participating units, natural persons and superior management units.

Basic information of engineering behavior objects such as bid section, work area, machinery, materials, projects, indicators, video monitoring points, gates, etc.

Basic information such as river, watershed zoning, highway, railway, geological structure, other pipelines and other tunnels.

## **2.1 Spatial database**

Spatial database storage includes basic geographic information data, engineering thematic element data, various remote sensing images, DEM data and spatial information related to various objects. It includes basic geographic information and spatial information corresponding to natural objects, related projects, monitoring stations and monitoring management objects. BIM database stores BIM model data such as tunnel, pipeline, segment, box culvert, pump station, high-level pool, sluice, valve, reservoir, inverted siphon, working well, water diversion outlet, manhole, drainage well, ventilation well and water measuring room.

### **(4) Monitoring database**

The project monitoring database stores real-time or semi real-time monitoring data, including construction equipment monitoring data, construction safety monitoring data, project safety monitoring data, project quality detection data, ecological environment monitoring data and water and soil conservation monitoring data.

Digital site safety monitoring data: monitoring data of construction shield machine, gantry crane, mixing plant, elevator, water and electricity, access time and positioning data of vehicles and personnel, etc.

Project safety monitoring data: deformation, horizontal displacement, inclination, water level, flow, internal force, pressure, stress, sediment content, sedimentation, etc. of tunnel, working well, maintenance or leakage drainage well, intake forebay, pump station, high-level water tank, water diversion outlet, etc.

Project quality inspection data: for raw materials, semi-finished products, pours, equipment and facilities, leakage, bending resistance, pullout resistance, strength, thickness, defects, solid content, tensile strength, fracture elongation rate, bonding strength, appearance, coating thickness, hardness, compression permanent deformation, repeated immersion test, low temperature bending, high temperature fluidity, density, density, sag Leveling, surface drying time, application period, constant elongation adhesion, elastic recovery rate, thermal conductivity, compressive strength, apparent density, UT, RT

(X-ray film), MT / Pt, uniformity, continuity and compactness, integrity, sieve analysis, apparent density, moisture content, mud content, mud lump content, soundness, organic matter content, sulfide and sulfate content, etc.

Environmental monitoring data: water environment monitoring, ambient air monitoring, acoustic environment monitoring, terrestrial ecological environment monitoring and investigation, aquatic ecological environment monitoring and investigation, radioactivity monitoring, environmental accident emergency monitoring, etc.

Monitoring data of water and soil conservation: spoil (stone and slag) yard, borrow (stone and slag) yard and large-scale excavation.

Monitoring of water and soil loss influencing factors, water and soil loss status, water and soil loss hazards and water and soil conservation measures in (filling) area, construction road and temporary soil (stone and slag) yard.

## **2.2 Business shared database**

The business sharing database stores the data shared by each business application system to other business systems, including the business sharing data of the engineering project management information system, the business sharing data of the intelligent supervision platform, etc.

Project management information system business sharing data: project safety, project quality, project progress, project contract management, investment and payment management, material management and other related business data.

Business shared data of intelligent supervision platform: business data such as safety management, quality management, digital construction site (personnel management, vehicle and ship management), intelligent evaluation, etc.

Auxiliary decision-making business sharing data: project supervision, project evaluation and other data.

Other auxiliary management systems share data: land acquisition and resettlement, engineering digital archives, Yuehai water OA, training management, hidden danger management, electronic signature and other relevant system data.

## **2.3 Multimedia database**

The multimedia database stores documents, pictures, images, sounds, videos, etc. involved in the construction process of multiple projects.

# **3 Overall architecture design**

High precision 3D topographic and geological simulation. In the construction stage, BIM Technology is applied to conduct high-precision three-dimensional simulation of the topography and geology of water conservancy projects in the Pearl River Delta, so as to provide a more accurate basis for the selection of foundation surface and grouting

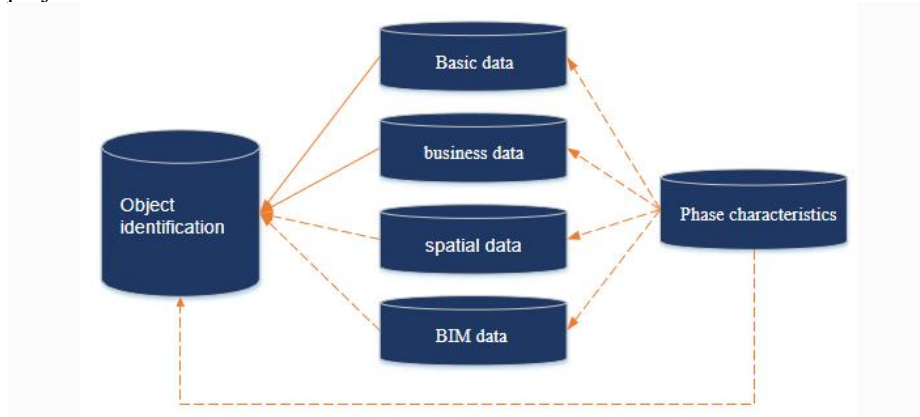
According to. Ensure the effectiveness and scientificity of building layout, geological defect treatment and anti-seepage measures, so as to ensure the rationality of design and the safety of the project.

Change model services. Reflect various changes in the construction process in the BIM model to ensure the real-time and correctness of the model and change information.

Layout and positioning of monitoring equipment. The layout of monitoring equipment is positioned in the BIM model to facilitate the management and maintenance of monitoring equipment in the later stage.

Establish digital delivery standard rules, associate design information with BIM, realize model-based integration, retrieval and extraction of design information, ensure the traceability and effectiveness of document sources such as drawings, instructions

and calculations, and provide design guarantee for the smooth construction of the project.



**Fig. 1.** Data resource model

Ensure that the shape and size of the model and the model construction and the positional relationship between the model construction are accurate, as well as the accuracy of relevant information. The model shall be checked before delivery to ensure that the model accurately reflects the real engineering state.

Ensure that the geometric information and plug-in information of the delivered model shall be effectively transmitted.

Ensure that the contents of drawings and information tables in the deliverables shall be consistent with the information in the model.

Ensure that the delivery model meets the requirements of quantity calculation and construction deepening.

Under the three-dimensional GIS platform, the integration, retrieval and extraction of design information based on model are realized through the interaction between model and design information. The design information is fully expressed in three dimensions through view customization, cutting and measurement tools.

Add non geometric information to all constructions in the BIM completion model, prepare construction codes for all constructions according to the specific situation of the project, and import them into the platform for asset management. Achieve accurate positioning, rapid query, track the whole process of procurement, warehousing, change, maintenance, disposal and scrap, and monitor and manage the whole life cycle of assets.

Provide QR code service: support component to generate QR code, and scan the QR code to dynamically obtain the native and user-defined properties of the component.

Associate the engineering change information with the BIM model to ensure the real-time accuracy of the BIM model. The BIM model is integrated with the additional picture and video information, and the retrieval, query and statistics of change reason, time, quantities, model, information and time are realized by using the color attribute and interaction characteristics of BIM model. Attachment

Management: component objects can add or delete external document links (PDF, word, Excel, etc.).

## 4 Conclusion

Continue to reuse the data resource pool during the construction period, integrate the data resources such as intelligent dispatching system, engineering maintenance system, emergency command system and digital experience system, expand the organization's data resource structure according to the data resource planning during the operation and maintenance period, carry out ETL governance such as data resource coding, data extraction, data cleaning and data loading, extract the target data resources and build the basic database Eight types of databases, including spatial database, BIM database, monitoring database, industrial control database, business sharing database, multimedia database and meta database, develop data services and establish data access strategies to provide data services for intelligent applications during operation and maintenance.

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