Application Practice of Government-level BIM Public Service Management Platform: A Case Study of Shanghai Yangpu District (Postprint)

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Abstract

The BIM Technology Application Public Service Platform of Yangpu District, Shanghai represents the first BIM technology application management platform in the industry to integrate BIM project group management with GIS and cloud computing technologies for government service. The data platform, relying on BIM data from pilot projects within Yangpu District, combines BIM informatization with platform capabilities. With pilot project data as its foundation, an expert platform as supplementary support, and a joint conference platform providing guidance, it not only advances the development and application of BIM technology in Yangpu District, but also offers valuable direction for construction enterprises in their BIM technology adoption.

Full Text

Application of a Government-Level BIM Public Service Management Platform: A Case Study of Yangpu District, Shanghai

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Abstract: The BIM Technology Application Public Service Platform of Shanghai' s Yangpu District represents the first management platform in the BIM industry to integrate BIM project group management with GIS and cloud computing technologies for government applications. Grounded in BIM data from pilot projects within Yangpu District, this digital platform combines BIM informatization with platform services, using pilot project data as its foundation, an expert platform as supplementary support, and a joint conference platform as guidance. The platform not only advances the development and application of BIM technology in Yangpu District but also provides valuable direction for construction enterprises implementing BIM technology.

Keywords: Building Information Modeling (BIM) Technology; Public Service Management; Project Group Management

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BIM technology serves as a data-driven tool for engineering design, construction, and management. It integrates project-related information through parametric models, enabling sharing and transmission throughout the entire project lifecycle—from planning and operation to maintenance. This provides a collaborative foundation for design teams and all construction stakeholders, including building operation units [1]. BIM plays a crucial role in improving production efficiency, reducing costs, and shortening project schedules. It represents a revolutionary and dominant trend in the global construction industry and constitutes an important means for promoting refined urban management in the information age.

In recent years, the construction industry has witnessed rapid information technology development, with BIM technology receiving significant attention from both government and industry stakeholders. Policy guidance and industry support have accelerated the development of BIM-based construction management platforms. Currently, domestic BIM industry platforms primarily focus on single-project construction phase management, enabling digital and information-based project management through construction management platforms integrated with BIM workflows [2-3]. These platforms enhance transparency in project processes, materials, funding, and schedules, thereby improving both management and construction quality [4]. However, a significant gap remains: no BIM technology application management platform exists for comprehensive regional project group management.

The government-level BIM technology application public service platform addresses this gap by using BIM as an information carrier, combined with GIS technology, mobile internet, and IoT technologies, to develop an information management platform. This platform integrates a construction project information database, a project public service platform, and a project supervision service platform, enabling information-based, three-dimensional visualized, and intelligent management of regional construction projects. This foundation lays the groundwork for smart urban application management.

2. Platform Architecture

The BIM Technology Application Public Service Platform leverages IoT, cloud computing, and big data processing technologies to build a comprehensive BIM application management platform. It achieves GIS-BIM integrated project group management, enables monitoring and automatic early warning of major risk sources based on building information models, and supports cost management and benefit analysis from BIM implementation (including benefits from design coordination, schedule control, and cost management).

The platform employs a B/S architecture, requiring no software installation and enabling access through standard web browsers. It consists of front-end and back-end components. The front-end comprises two layers: a GIS-layer cockpit (for project group management) and a BIM layer (for single-project management). The front-end primarily displays the operational status of BIM projects within the region. Government management personnel can view all project data for timely control and oversight. Project participants can consult experts, upload models and documents, and update project data in real time. Experts can promptly address project challenges and provide solutions.

The back-end primarily maintains fundamental data, including user management, project management, expert management, department management, link management, role-based permission management, and system logging.

The platform adopts a five-layer architecture (Figure 1 [Figure 1: see original paper]), from bottom to top: infrastructure layer, data resource layer, platform support layer, business application layer, and user service layer. Each layer' s functions are as follows:

1. **Infrastructure Layer:** Provides the fundamental network facilities required for platform operation.
2. **Data Resource Layer:** Supplies data storage and management capabilities for the platform.
3. **Platform Support Layer:** Provides foundational functional support for platform logic implementation. The model rendering engine enables real-time rendering for user model operations, while the file conversion service facilitates 3D model file conversion and data-model separation. After conversion, model geometric data and attribute data are stored separately.
4. **Business Application Layer:** Delivers various functions to users, including pilot project management, joint conferences, expert platforms, benefit analysis, and BIM+ applications.
5. **User Service Layer:** Enables user access to the platform through web browsers.

3. Platform Functionality

3.1 GIS-Layer Cockpit (Project Group Supervision and Management)

The GIS-layer cockpit module integrates regional GIS maps with BIM models from pilot projects, enabling three-dimensional visualization and project group management.

3.1.1 Regional Project Group Built upon GIS maps, the platform establishes BIM project models. Users can switch between 2D and 3D views and perform operations such as zooming, rotating, and panning to display project information comprehensively, enabling online data management and visualization (Figure 2 [Figure 2: see original paper]). Users can also filter projects through precise or fuzzy searches, with selected projects linking to the model area for focused location. The platform displays construction progress and statistics on quality, safety, and civilized construction events, allowing users to access detailed event information through the BIM layer' s event function module.

3.1.2 Expert Platform The platform establishes a cloud-based expert database, showcasing BIM expert information within the region and enabling online Q&A and communication with experts. Through long-term accumulation, this forms a BIM knowledge base that promotes regional BIM technology application and development.

3.1.3 Benefit Analysis The platform employs a scientific and rational BIM comprehensive evaluation system comprising five major criteria (cost savings, schedule acceleration, quality improvement, safety enhancement, and efficiency gains) and sixteen indicator systems to evaluate BIM applications. The system analyzes benefits generated from BIM implementation (including benefits from design coordination, schedule control, and cost management) and generates corresponding comparative analysis charts, providing intuitive insights into project savings. It conducts statistical analysis on schedule benefits from BIM implementation for project groups or individual projects, generating charts such as actual schedule statistics and comparisons between planned and actual schedules (Figure 3 [Figure 3: see original paper]). The platform also performs cost-benefit analysis, including statistics on actual investment, contract amounts, and actual investment comparisons (Figure 4 [Figure 4: see original paper]).

3.2 BIM Layer (Single-Project Management)

The BIM layer enables single-project management through modules including progress management, quality management, safety management, civilized construction guidelines, remote monitoring mechanisms, and material management. This integration process gradually consolidates engineering information from the decision-making phase through implementation to the usage phase, forming a comprehensive project information model that provides all project participants with real-time access to project dynamics, progress, quality, and safety status.

3.2.1 Progress Management Progress management encompasses schedule planning, progress tracking, progress statistics, and schedule correction functions. BIM model components are classified according to divisional and subdivisional works and associated with construction schedules (importable from Microsoft Project). Created divisional works are categorized into four types:

milestone tasks, general tasks, critical processes, and major risk sources (Figure 5 [Figure 5: see original paper]). For critical processes, users can select from predefined divisional work categories, enabling automatic event triggers upon schedule completion. The system achieves component-level, three-dimensional dynamic construction simulation. Weekly tasks can be distributed to relevant responsible parties through the platform, allowing 随时随地查看相关项目成员和计划的执行情况. Construction personnel can complete tasks individually within the platform, while supervision and construction management units can track progress and implement corrections, ensuring traceability throughout the construction process while effectively guaranteeing project schedules.

3.2.2 Quality Management The platform establishes quality control points for various construction industry sub-sectors, corresponding one-to-one with divisional and subdivisional works. As construction progresses, quality control tasks are pushed to responsible parties through the platform, providing real-time on-site construction guidance. Quality events occurring at construction sites can be recorded and uploaded, with issues linked to corresponding BIM model components to facilitate timely problem resolution, rectification, and future traceability. Over time, this process forms a quality common-problem database, providing references for future construction projects (Figure 6 [Figure 6: see original paper]).

3.2.3 Safety Management The platform establishes a major risk source database for various construction industry sub-sectors, corresponding one-to-one with divisional and subdivisional works. As construction progresses, safety control tasks are pushed to responsible parties through the platform, providing real-time on-site construction guidance. Safety events occurring at construction sites can be recorded and uploaded, with issues linked to corresponding BIM model components to facilitate timely problem resolution, rectification, and future traceability. Over time, this process forms a safety common-problem database, providing references for future construction projects (Figure 7 [Figure 7: see original paper]).

3.2.4 Civilized Construction Management The platform establishes civilized construction measure guidelines for various construction industry sub-sectors, corresponding one-to-one with divisional and subdivisional works. As construction progresses, tasks are pushed to responsible parties through the platform, providing real-time on-site construction guidance. Civilized construction events can be recorded and uploaded, with issues linked to BIM model components for timely resolution, rectification, and future traceability. The platform supports querying and editing of civilized construction-related documents. Over time, this forms a civilized construction common-problem database for future project reference (Figure 8 [Figure 8: see original paper]).

3.2.5 Remote Monitoring The platform integrates BIM models for main structures, surrounding environments, site layouts, retaining structures, and road pipelines to build monitoring models. Monitoring points are associated with their corresponding physical components, with results reflected in real-time within the 3D environment. The system generates various monitoring analysis reports exportable to PDF format for future data review. Monitoring data is automatically pushed to appropriate management personnel according to safety hazard levels (Figure 9 [Figure 9: see original paper]).

3.2.6 Material Management This module provides the following functions:

1. **Material Planning:** Manages online project material information such as equipment specifications, asset codes, planned delivery times, and suppliers, with integration into the BIM model.
2. **Material Traceability:** By binding consumed materials to BIM models, the system enables detailed usage traceability for future material usage tracking.
3. **Material Statistics:** Combined with project progress management, the system records labor, materials, and equipment consumption information, helping users understand material usage throughout the project (Figure 10 [Figure 10: see original paper]).

The Yangpu BIM Technology Application Public Service Platform has completed development and is currently in trial operation. During this phase, BIM data from six pilot projects have been successfully integrated for platform testing. Following formal launch, the remaining twenty pilot projects will be sequentially integrated with the platform.

The establishment of a government-level BIM technology application public service platform enables government construction management departments to timely grasp milestone information and construction status of all projects within their jurisdiction, effectively managing on-site quality, safety, and civilized construction issues. The platform provides schedule comparison analysis to guide construction progress optimization. The system is accessible anytime and anywhere without geographical, platform, terminal, or browser limitations. It requires no software installation and supports over forty file formats, enabling users to quickly open models from various sources. With reliable visualization solutions, the platform facilitates more convenient and efficient information transfer, sharing, collaboration, and communication.

4. Conclusion

The front-end architecture of the BIM Technology Application Public Service Platform primarily comprises the GIS layer and BIM layer. The GIS-layer cockpit enables project group management, allowing users to view BIM pilot projects in Yangpu District and understand the current status and development history of BIM adoption in the region. The BIM layer facilitates detailed project management, including project participants, schedules, models, quality, safety, and civilized construction.

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Note: Figure translations are in progress. See original paper for figures.