Research on Application of BIM+GIS Technology in Building Life Cycle

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Abstract. Based on a project, the application of BIM+GIS technology in the whole life cycle of the project building is studied. Selecting the image data based on the fusion of UAV tilt photography and panoramic data, a controllable data management platform is established. In the planning and design stage, the use of technology can reduce the frequency of exploration, check the project for design errors, reduce the number of rework of the project, improve work efficiency. In the construction phase, funding for large-scale projects through image data, using BIM Technology to simulate construction progress, collision check, etc. Reduce the waste of resources; in the operation and maintenance phase, through the management of the information data of the BIM model, so as to provide data support for the maintenance and other work in the later stage of the project.

1. Introduction
BIM refers to building information modeling, it can be understood as the information model of the project from design, construction, operation and management to demolition of the whole life cycle. It's also a big database, which contains all the physical and functional information of the project. GIS is a geographic information system, which is used to manage and display spatial reference information. Its main advantage lies in the function of large-scale geographic feature modeling and spatial analysis[1]. The integrated application of BIM and GIS can enhance the management ability of large-scale public facilities. With the rapid development of Internet technology, the integrated application of BIM and GIS based on Internet and mobile communication technology will change the application mode of technology and develop towards the direction of information technology. In order to meet the requirements of BIM technology and GIS technology at different stages of the building life cycle. On the basis of fully considering the different advantages and disadvantages of BIM technology and GIS technology, this paper analyzes the application of the combination of BIM and GIS from four aspects: planning and design, construction, operation and maintenance[2].

2. Project overview
The construction area of a theater project is 36000 square meters, with seven floors above ground and two floors underground, and a complex internal steel structure. Many problems will be encountered in the design, construction, operation and maintenance management of construction projects. For example, in the design, while meeting the requirements of green buildings, the lighting, ventilation and air conditioning insides the theater should meet the requirements of ergonomics. In the process of construction, the management of construction personnel and the construction of steel structure of building curtain wall are very difficult, so it is very important to arrange personnel reasonably. It is very difficult to maintain and manage the building in the later stage of operation and maintenance. The design
of the project is complex and difficult to build, therefore it is particularly important to use BIM and GIS technology.

3. Platform management and technical route
After the combination of BIM technology and GIS technology, the model database can be managed and applied by using three-dimensional image information. According to the characteristics of the project, the flight plan is made, the project area datas are collected by UAV, the panoramic datas are processed by using 720 cloud platform, and the three-dimensional real scene model is generated after the fusion of tilt photography data and panoramic data, which is compared with BIM model for analysis, so as to carry out the application of the project life cycle management.

4. Application of BIM+GIS technology in the whole life cycle of buildings

4.1. Application in the planning stage
During the project planning phase, engineering feasibility studies are often required to determine the project's project. Then after a series of preparatory work, the feasibility and reliability of the project and the surrounding environment is analyzed to determine the functionality of planning land, traffic planning rationality. Analyze and explore the impact of socio-economic development and overall coordination and aesthetics and other factors, and then implement the project.

4.1.1. Real-scene modeling. In the early stage of the design, planning land was determined through the analysis of the surrounding environment (figure 2). Secondly, the tilt photography technology is used to collect architectural information and the panoramic data is collected by drone. A real-world 3D model is quickly generated by drone tilt photography under Context Capital (figure 3). After the model is established, panoramic data is introduced and integrated with it. According to its geographic information, the model can be directly used as 3D terrain data and site model in the design stage, giving a real environment of building construction to designers, and at the same time, checking the building planning and adjusting the details, completing site planning, city simulation, scenario comparison, light analysis and so on. Finally, coordinates, distance, surfaces, volume measurements are carried out, and the information exploration is carried out.

Figure 1. Platform Technology Roadmap
4.1.2. Road simulation. In the early stage of design, through the use of Visim road simulation, analysis of the road environment around the Grand Theatre, and find the best way: City Road, Fudong Road (as shown in the red line logo), for the construction materials to enter the site to set aside time, and through road simulation, you can be timely analysis of road conditions information. Through the vehicle input time flow map information, to avoid peak material entry.

4.2. Application in the design stage

The application of this project in the design stage is mainly reflected in the design analysis of building structure. The project can be visualized in the course of the design phase by combining tilt photography with panoramic data with the BIM and GIS technology. The main applications of the project in the planning and design stage include road simulation acoustic environment analysis, fire simulation, evacuation simulation, VR fire escape, collision checks, plot out and so on.

4.2.1. Indoor and outdoor acoustic environment analysis. This project simulates and analyzes the indoor and outdoor acoustic environment of the sound pressure level distribution map at the site height of 1.5m. Preset according to the main conditions of noise such as surrounding roads, the preset is made, and the noise environment closest to the completed project is obtained through computer simulation to reflect the real situation of noise after the completion of the project. According to the requirements of the two types of building standards, the sound functional areas simulated by the software and analyzed by the results are judged to be up to standard. Through the rational planning of outdoor garden layout, it can finally meet the evaluation of green buildings.

4.2.2. Fire safety simulation. Building fire safety is one of the application fields of BIM technology combined with GIS technology[3]. The application of this project in fire escape simulation is divided into three aspects:

- smoke spread analysis;
- evacuation simulation;
the application of VR fire escape simulation.

In order to effectively reflect the smoke spread and the temperature analysis in the process of fire, the fire spread of the theater project was modeled and analyzed. Through the data of heat release rate, temperature and pyrotechnic monitoring, it is concluded that the indoor temperature changes from low to high and subsequently to low with the passage of time. The conclusion that the height of smoke spread changes with time. Through modeling and analysis, the conditions of fire spread effect and the conditions of slowing down or stopping the spread can be obtained, which provides data and theoretical support for formulating the response strategy of building fire spread.

In the application of building fire safety, BIM technology can provide fire rescue personnel with internal information of the building. GIS technology can conduct corresponding spatial structure analysis based on BIM three-dimensional information model, such as safe route selection for personnel escape (Figure 5). The evacuation simulation is used to understand the situation of the people inside the building through the visualization method, and the evacuation passage is optimized for the places that are prone to congestion. The combined application of BIM technology and GIS technology, to a certain extent, has changed the thinking mode of firefighters, that is, the transformation from two-dimensional to three-dimensional, so that firefighters can quickly get familiar with the internal space structure of the building, more efficient rescue process, save rescue time.

VR technology is used to simulate fire escape (Figure 6). When a fire breaks out in a theater, different parameters such as the location of the fire source, the size of the crowd in the scene, and the emergency evacuation exit are set. By setting different fire sources and evacuation channels, the behavior characteristics of different personnel structures will produce different evacuation reactions and effects. Through VR simulation, people's safety awareness can be enhanced so that they can calmly face emergencies and escape from the scene in an orderly manner.

![Three-dimensional diagram of simulated architecture](image1)

![VR simulation of fire escape](image2)

4.2.3. Collision check and net height analysis. Collision inspection of civil engineering, electromechanical and equipment is an important manifestation of the application value of BIM technology in the architectural design stage. This project applies BIM visualization technology to carry...
out three-dimensional collision detection and indoor clearance height analysis. Through the collision
detection report and the collision position and information provided by clearance height analysis, the
pipeline is comprehensively optimized to avoid spatial conflicts and reduce possible errors in the
construction process of the project, so as to reduce losses.

4.2.4. Revit plotting. Compared with the traditional two-dimensional model, the three-dimensional
effect formed by BIM model can more comprehensively display the design effect and simulate the real
situation of buildings. The civil engineering, electromechanical and steel structure parts of the project
are based on Revit and assisted by Tekla to establish the model. Visualization of the construction is
carried out by using Revit drawing, and the inspection and design modification of the construction is
carried out by using two and three dimensional linkage, so as to find and solve issues in time.

4.3. Application in the construction stage
BIM+GIS technology in the construction process function mainly reflects in the analysis of the
construction schedule, construction site layout, schedule allocation for large-scale projects, three-
dimensional visual disclosure and safety civilization construction guidance, through the use of BIM +
GIS technology can not only ensure the engineering quality in construction process, reduce the project
cost can also improve the efficiency of the project.

4.3.1. Construction schedule control based on BIM+GIS. In the process of construction, the
construction progress is extremely important, along with the whole life cycle of the whole project. The
construction schedule mainly includes: the compilation of the construction progress plan, the
optimization of the construction progress plan, and the control of the construction progress. Based on
the three-dimensional model, the progress allocation of large-scale projects is realized by comparing the
data extracted by UAV tilt photography with the three-dimensional information model. Progress
tracking is a difficult aspect of the construction industry at present. BIM+GIS technology is used to
control the progress of the project combined with the generated 3D panoramic model. The staff can use
the real scene information and model information to control the construction progress in order to arrange
the follow-up resources and evaluate the end time of the work. It greatly improves the management
ability of the project, and can provide strong data support for the later construction project.

4.3.2. Construction site layout based on BIM+GIS. With the continuous improvement of construction
technology, the requirements for the layout of the construction site are more and more strict. By using
BIM+GIS technology, the characteristics of BIM technology can be effectively utilized to reasonably
adjust the layout of the three-dimensional construction site. The construction site layout should be
reasonably adjusted according to the use specifications and construction requirements of the project, so
as to shorten the construction period and achieve the goal of maximizing the benefits of the project.

In the construction of three-dimensional site layout, the layout of temporary facilities, the layout of
large machinery is very important. In this project, the data collection of the actual construction site can
be carried out by using the three-dimensional real scene model formed by the fusion of UAV tilt
photography and panoramic data. Using Revit and other software to build the construction three-
dimensional site model. According to the principles and methods of operational research, the reasonable
transportation route of materials can be effectively calculated, thus the road layout of the construction
site can be carried out. The construction of facilities in the office area should follow the principles of
economy, practicality and reducing safety. Facilities such as water and electricity should be arranged as
short as possible.

The technical process of construction 3D site layout based on BIM+GIS:
- Three-dimensional terrain modeling, using the data collected by UAV tilt photography and
  panoramic image data, then imported into Contextcapture to build the site model, so as to
determine the planning land.
• According to the planned land, the layout of the construction site can be carried out, and the progress of the site layout can be obtained in time through the use of UAV to monitor the project site layout.

4.3.3. Inspection of 5D progress based on BIM+GIS. Since the Grand Theatre is a large-scale project, the progress and cost of the theatre cannot be effectively controlled. Using the data of UAV tilt photography and combining with BIM5D, the progress and cost of the construction project can be monitored in time, and it is convenient to count the components and materials on the site. And the material list is generated automatically through the three-dimensional information model, which can reduce the consumption of personnel and materials, and improve the management efficiency of the project at the same time.

4.3.4. 3D visualization disclosure. With the continuous development and progress of BIM technology, the traditional two-dimensional construction drawing technology has been unable to meet the needs of the present stage, so the three-dimensional construction technology disclosure technology arises at the historic moment. Three-dimensional visual construction disclosure includes the disclosure of three-dimensional model technology, the disclosure of BIM model drawings, and the disclosure of construction technology. Using BIM+GIS technology to make electronic scheme sand table simulation, the resulting simulation video can not only make visual communication, but also improve the efficiency of communication and save time and cost.

Through the use of BIM-FILM platform, the use of three-dimensional simulation technology in order to intuitively show the construction process, we can watch the animation after the completion of the construction, so that the effect of technical disclosure to achieve a satisfactory state. BIM+GIS technology cooperates with other different software to integrate all kinds of complicated construction and virtual construction into one system effectively with the help of platform. So that the participants can further control the project and build a safe and green building information model.

4.4. Application in operation and maintenance stage

4.4.1. Main functions of the intelligent operation and maintenance system based on GIS+BIM. Intelligent operation and maintenance management system based on GIS+BIM includes real-time monitoring and alarm of the internal and external environment, structure, equipment running state and traffic of the building, management of equipment, security hidden danger, inspection and maintenance, and emergency the command and dispatch for emergencies. In the interior decoration and internal management and monitoring of buildings, remote operation and maintenance can carry out operation and maintenance supervision on environmental monitoring, equipment operation status monitoring, equipment maintenance and maintenance management, patrol inspection management, emergency system command and management[4].

4.4.2. Application of GIS+BIM in the operation and maintenance stage. In operational management model has been built in combination with the local terrain, design the most convenient disasters escape routes, and in the path set fire waterproof gate, installation testing and alarm, it merges into the whole hydraulic structure in intelligent management system, strengthen the daily monitoring maintenance[5], visual efficiently enables participants to participate in the project of comprehensive information query and management, implement the control point coordinates and elevation annotation, model management, model building multi-view expression function, improve the whole and governance engineering the elaborating management level of each part[6]. It can supervise the operation of construction personnel in the construction of the inside of the building, deal with the problems encountered in construction in real time, so as to reduce the waste of construction time and reduce the cost of expenditure.
4.4.3. Problems encountered in remote operation and maintenance. There are a lot of problems that we encounter in the implementation and there are three main ones.

- **Open on demand.** Each time it is used, it is opened and closed frequently. Due to the limited technical level of the personnel on duty in some enterprises, professional operation and maintenance engineers are required to handle the fault remotely almost every night, which causes the operation and maintenance department to be very inconsistent.

- **Management of manufacturers’ engineers.** The engineer of the manufacturer has great variability, so the file of OTP format is saved in the hands of the personnel on duty, which also increases a lot of workloads for the personnel on duty. Although the operation and maintenance department put forward the plan of management by the manufacturer and signing the responsibility letter, safety responsibility can not be transferred with a paper of responsibility. The operation and maintenance department should overcome the difficulties, do a good job in the management of the manufacturer’s engineers, and minimize the safety risks.

- **Release the default route.** This strategy will block the communication of WeChat, and the fault handling often requires communication and coordination, so this strategy makes the communication difficult, so it is suggested using this strategy, supporting the construction of instant messaging tools within the enterprise, in order to alleviate the conflict. Remote operation and maintenance are not a monster, and good use can improve the efficiency of operation and maintenance. With the severe network security situation, remote operation and maintenance, after all, increases the risk of infiltration.

5. Conclusion

With the progress and development of BIM technology in China, the traditional project management pattern will be gradually replaced by digital information management mode. In the future development, we need to use new technologies to change. BIM + GIS technology can not only effectively control the process of whole life cycle, and shorten the construction period can be achieved the purpose of saving resources, achieve finally everything, people can do its role. In the whole life cycle stages of planning, designs, construction, operation and maintenance, the ultimate goal will be to create the maximum value for the owners, so a platform, a model and a framework will be the key. BIM+GIS technology is not only a tool, but also a carrier of our model information concentration. With the emergence of the epidemic new infrastructure terms are also explaining to us the future direction of development, information technology will take us to a new era.

Acknowledgments

This paper was supported by Tianjin University Renai College Special projects of Natural Science (XX20007) "Research on the influence mechanism of collaborative governance of construction supply chain under BIM+IPD mode", and 2020 Tianjin University Students Innovation and entrepreneurship training program (202014038029) “Innovative application of oblique photography and panoramic data fusion”.

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