

Application of GIS and BIM Integration Technology in Construction Management

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Abstract. With the development of smart city, the concept of smart development is integrated into the construction management, so as to promote the smart development of construction and improve the efficiency of construction management. This paper discusses the application prospect of GIS-BIM integration technology in construction schedule management, site material management and safety management of construction personnel. At the same time, it looks into the application trend of GIS-BIM integration technology and global wide area network, Internet of things, virtual reality and other emerging technologies in the integration of building construction management, so as to promote the intelligent and visual management development of GIS-BIM integration technology in building construction management.

1. Introduction

With the rise of the concept of smart city, the construction and management of modern cities have gradually become the focus of social attention^[1]. The planning, investigation, design, construction and operation stages of a building project are all highly dynamic processes. The fusion and integration of various technologies will be the inevitable path^[1]. Building Information Modeling (BIM) and geographic information System (GIS) integration technology in construction management is a new and rapid development trend. GIS focuses on low-density spatial geographic information data of a larger range, while BIM focuses on high-density spatial component data of the building environment itself of a smaller range. The integration of GIS and BIM can provide more detailed and comprehensive data information of integrated human environmental activity space. Therefore, GIS-BIM integration technology is very suitable for managing the needs of the various stages of the building life cycle in most cities, which is more conducive to people's application in engineering practice. Promoting the application of GIS-BIM integration technology in building engineering will bring about further breakthroughs in the exchange of effective information between people and processes.



2. GIS and BIM integration technology summary

2.1. development status of GIS and BIM integration technology

BIM is to visualize the real information of a building by using a digital 3D model based on relevant information data of a building project^[2]. The application of BIM technology in the management of construction projects has very important value and is an inevitable trend of the development of the construction industry^[3]. GIS technology is an advanced mapping technology commonly used in the construction industry at present. With the support of computer software and hardware systems, this technology has completed the management of all environmental information with spatial attributes in construction projects^[4]. With the development of GIS, complex spatial analysis and 3d spatial query can be carried out. As a decision support system, GIS can help users to explain and solve practical problems in various fields. GIS systems can be integrated with the database operations and statistical analysis of other different systems for visual display in maps. One of the key steps in the implementation of the smart city project is to create a 3d digital city model. These 3d models are crucial to the realization of smart city projects, and the integration of GIS and BIM technology is the key technology to realize the 3d digital city model, so the GIS-BIM technology will be conducive to the research and development of dynamic smart city.

Large amount of data, incompatible format, non-unified coordinate system, and lack of standard specification are the major defects between BIM and GIS system., although GIS - BIM technology development has a lot of difficulties, the domestic and foreign researchers tried various ways to overcome the GIS and every weakness of BIM technology, can be widely used in stability and feasibility of technology and research. Nagel^[5] et al. proposed a method to transition from KML graphic model to BIM through CityGML. Amirebrahimi^[6] et al. proposed to integrate BIM into GIS using data model. Liu Xin et al^[7]. studied the integration solution of BIM and GIS, and determined the data model of BIM and GIS integration. Guo Ruiyang^[8] BIM model is studied and the fusion of 3 dgis technology research and its implementation, and through the SUPERMAP secondary development platform of BIM model and the integration of GIS, the main interface of the system in the platform, working space management, asset grouping query and dynamic update, indoor and outdoor three-dimensional coordinates querying, spatial distance measurement and area measurement, object style Settings, indoor roaming, spatial analysis, the best path analysis and multiple functions such as indoor navigation demo. Zhang wensheng^[9] et al. studied the integration technology between BIM and 3D GIS and its application in railway bridge construction. The whole process of the integration technology of BIM and 3D GIS is described in detail, and the technology is applied to the practical application of railway bridge construction. Cheng fangyuan^[10] et al. studied the research and application of integrated GIS/BIM digital management of highway tunnels, and realized the technical integration of gs-bim and its application in tunnel engineering through the infrastructure Smart Service System (iS3) proposed by tongji university. At the same time, with the development of technology, software that can directly read mainstream BIM formats has also been launched in 2019.

To sum up, gis-bim integration technology has been able to perform complex spatial analysis functions. Construction projects become more complex and site Spaces become more compact as the construction process requires more construction activities to be arranged at the same time. In this case, space management becomes more and more important during construction. Traditional construction methods can no longer meet the needs of complex construction management. Introduction of BIM and GIS technology to realize the visualization of construction management, through the establishment of visual model, based on the BIM building information model for the construction flow of information, cost, material and building component attributes analysis, and using GIS in building external environment information integration and management advantages, to ensure reasonable spatial layout, the buildings which implements the course of construction, the real-time and visualization of regulation^[11].

2.2. functions of gis-bim integration technology

As shown in figure 1, both GIS technology and BIM technology have their respective functions and characteristics, and they also have their own advantages and disadvantages. The main reason for the integration of GIS and BIM is that the two technologies can provide complementary information and become a more powerful tool, which can bring more convenient and perfect methods to engineering practice.

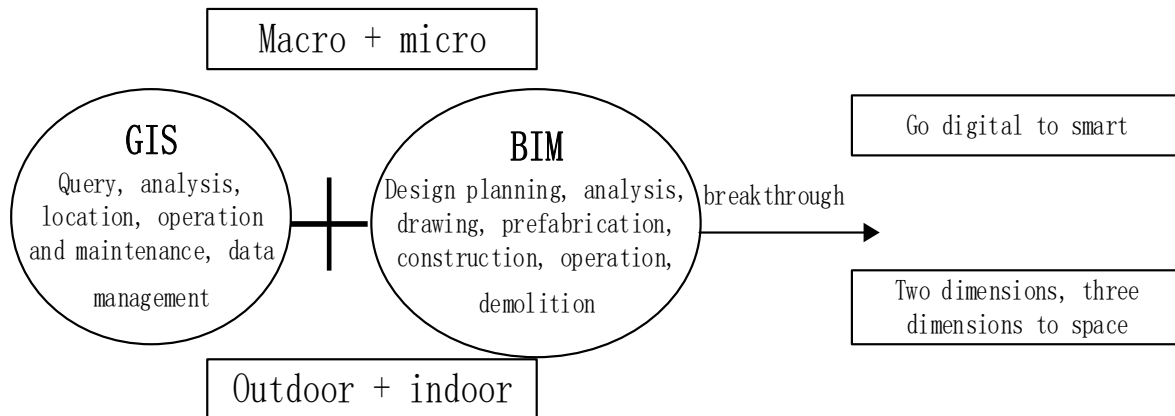


Figure 1 development of building application technology

2.3. development of construction technology

As shown in FIG. 2, the application technology of architectural engineering projects develops from 2D CAD to 3D BIM and further towards spatial GIS and BIM technology. Traditional software such as AutoCAD is generally based on two-dimensional graphic design. In order to realize the full digital requirements, architectural applications are no longer as simple as using CAD software to complete architectural projects or engineering projects. The 3d parametric design of BIM adopts professional 3d design tools, real-time 3d visualization, and more advanced collaborative design of models. According to the models, construction details and progress diagrams are automatically created to support analysis and simulation design tools. With the development of smart city, the design of BIM based on single buildings will gradually be further developed and improved, and the gis-bim three-dimensional space technology in line with the development of smart city will gradually become an important technology for people to study and develop.

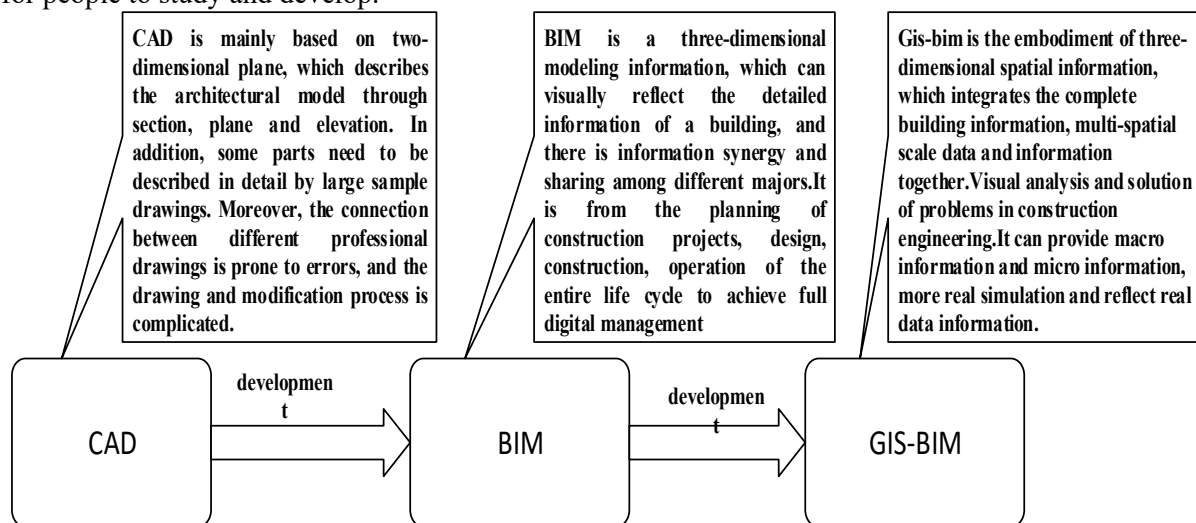


Figure 2 development of building application technology

3. Application of GIS and BIM technology in construction management

In the construction stage, there are many participants, large amount of information, complex management and other characteristics. GIS and BIM integration technology is applied in construction engineering in different aspects, affecting the construction process. The construction site is the main area for construction activities.

3.1. construction schedule management

Construction schedule directly affects the speed, cost and quality of construction. The construction schedule is determined by the key circuit to determine the duration of the whole project and the start and end time of the activity. The construction schedule is influenced by time, space, technology, management, resources and other factors. Construction schedule can plan and schedule construction activities to help the engineer complete the project on time and within budget.

GIS and BIM technology can be used for the overall management of people, materials and machines of multiple single buildings in the construction process. As shown in figure 3 GIS and BIM technology can be combined with information construction information and space environment to simulate the multiple construction progress at the same time, also can monitor the material in order do not match with the construction progress, the scene of the large material handling and mechanical equipment put conflict in real time contrast, monitoring, to ensure the accuracy of construction progress control. The application of GIS and BIM in construction management can monitor and regulate construction progress in real time, coordinate various links and personnel work, reasonably allocate resources, evaluate and predict construction progress, so as to reduce labor losses, unreasonable methods, repetitive work and inter-departmental conflicts, material waste and increase the utilization rate of machinery and equipment.

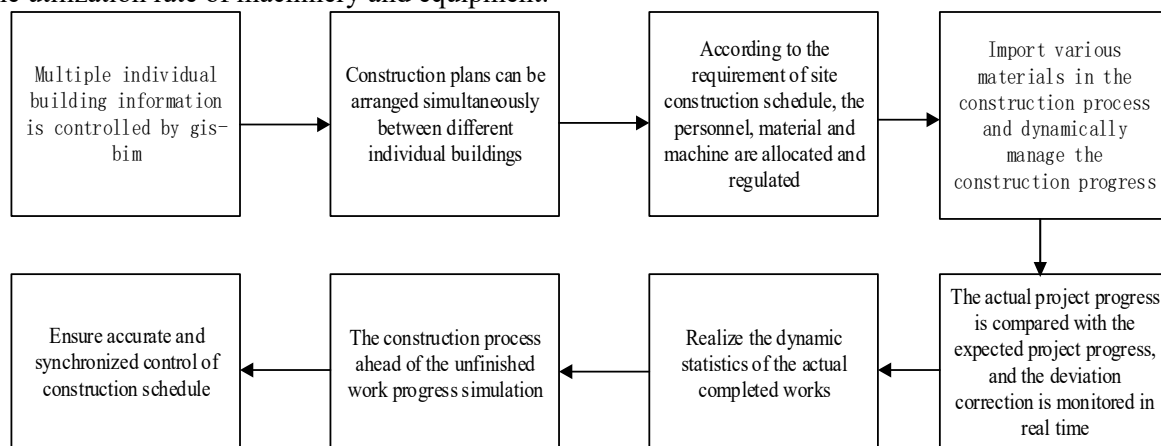


FIG. 3gs-bim technology management in construction schedule

3.2. construction schedule management

Site material management mainly includes the storage, use, handling, disposal, waste removal and other activities on site after delivery of goods. Site material management is an integrated process. The implementation of a comprehensive material management plan helps achieve more predictable project results, reduce costs, improve productivity and quality, and provide a safer work environment.

Through the GIS and BIM integration technology, the site material stacking position, stacking quantity and handling route can be uniformly optimized and arranged through data analysis. Meanwhile, the materials can be uniformly allocated according to the needs of different single buildings to ensure that the construction process is not affected by the shortage of materials. The gis-bim integration technology can also analyze the climatic and environmental problems at the construction site to ensure the safe storage of materials. As shown in figure 4, GIS and BIM technology can carry out comprehensive planning management of site materials, saving costs from management fees, hoisting costs, production costs, equipment costs and other aspects. The application

of gis-bim technology in material management helps achieve more predictable project outcomes, reduce costs, improve productivity and quality, and provide a safer work environment.

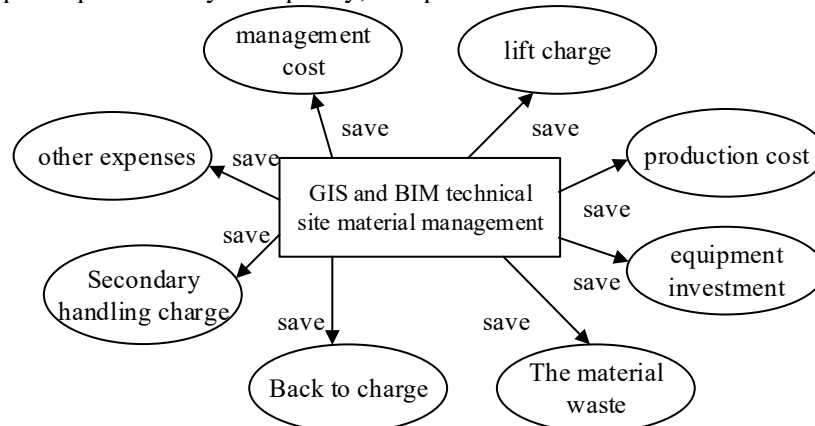


Figure 4 GIS-BIM technical site material management objectives

3.3. construction schedule management

Through the GIS and BIM integration technology, the construction site personnel can be accurately positioned. In the process of construction, people can give warning in advance through the "four mouth" and "five adjacent" dangerous areas, so as to predict and control the dangerous behaviors of construction personnel in advance. GIS and BIM technology can reasonably arrange and control the construction environment on the site, and it can timely find the danger and propose the treatment plan through data analysis of the environmental problems on the site. The GIS-BIM technology adopts the information-based dynamic supervision means to realize the scientific supervision of construction safety, effectively eliminate the safety hazards, so as to improve the safety of construction projects.

4. The combination of GIS and BIM technology and other information technology is applied in construction management

4.1. GIS-BIM and World Wide Web(WEB)

In the traditional construction mode, the transfer of management information between construction teams is slow and inefficient. The GIS and BIM +WEB technology can integrate all the data information of the construction process, coordinate the management of the information of the construction process and realize the data sharing, so as to realize real-time data visualization. Through GIS and BIM+WEB technology, the construction process can be operated cooperatively, so as to achieve the common goal of the development, utilization and sharing of the construction process information. Bim-gis +WEB technology can also analyze and simulate the feasibility scheme in the construction, and take the best choice before the construction. At the same time, it can effectively manage the infrastructure and facilities in the building in terms of follow-up maintenance, service and delivery, greatly reducing the waste of resources, thus carrying out quality control and thus improving the quality of life of residents.

4.2. GIS and BIM technology and The Internet of Things (IOT)

The Internet of things is a network of interconnected things. It is used for the collection, analysis and management of multi-source information, automated monitoring and early warning. GIS and BIM+IOT technology can carry out real-time monitoring, positioning and data analysis of the construction site, such as equipment monitoring, material testing, climate and environment monitoring, noise monitoring, dust monitoring and personnel distribution. GIS and BIM+IOT technology can sense and predict construction personnel to give early warning before or when the situation occurs, thus preventing situations that may lead to safety accidents and waste of time. Gis-bim +IOT

technology can provide rapid and accurate feedback and analysis of construction site data, thus significantly improving efficiency, productivity and worker safety.

4.3. GIS and BIM technology and Virtual Reality (VR)

With the rapid development and maturity of VR technology, the application scope of VR technology has become more and more extensive, and it has been applied in construction engineering and related fields. GIS and BIM+VR technology supports visual simulation of building construction, such as visualization of site construction progress, visualization of construction drawings, visualization of optimal construction route, visualization of construction personnel, visualization of on-site material demand, etc. It can monitor and analyze the construction process, such as construction progress monitoring, safety hazard monitoring, project quality testing. GIS and BIM+VR technology enables users to be completely immersed in 1:1 simulated reality scenarios, and enables them to assess the constructibility of construction projects and identify time and space conflicts in construction, thus saving material costs and reasonably arranging the number of workers needed for the projects. The GIS and BIM +VR technology can clearly display the construction process, browse and analyze each part of the model, and accurately obtain the amount of materials needed for each part, so as to intuitively simulate the construction work and avoid material waste at the site.

5. conclusion and suggestion

5.1. conclusion

The construction management of a building needs to consider a variety of factors, which needs to be analyzed and visualized from both macro and micro perspectives. This problem can be solved by the combination of BIM and GIS. GIS and BIM technology has significant benefits for management methods and coordination mechanisms such as construction quality management, schedule management and time reduction, cost reduction and control, health, safety and environmental performance improvement, information management and coordination among various departments. According to the research in this paper, the application of gis-bim integration technology in construction management has the following new breakthroughs and developments : (1) through the application of gis-bim technology in construction management, the informatization, automation and wisdom development of construction management can be improved. (2) it breaks through the limitation of single building management of BIM technology and integrates multiple building construction management into a whole system. (3) integrate geographic information data into construction management, so as to realize fine management of construction management. (4) the application of gis-bim technology in construction management can save construction cost, improve project safety, build collaborative management and realize rapid data sharing.

5.2. suggestion

The development of GIS and BIM integration technology in construction management is the trend of future development of construction management, but GIS and BIM integration technology is still facing challenges in its extensive application in construction. The following Suggestions are proposed for some problems:

(1) The standards and specifications of GIS and BIM integration technology are not unified, and the standardized construction cannot be realized. In view of this problem, the country should vigorously promote the application of gis-bim integration technology in construction management, summarize a lot of practical experience and introduce a series of policies to formulate relevant norms, so as to realize the standardized and intelligent development of GIS and BIM technology in construction management.

(2) There are few researches on the application of GIS and BIM in construction management in China, and there are no relevant majors set up in domestic universities to cultivate professional talents. In view of this problem, the country should issue corresponding policies to support and develop the

application and development of GIS and BIM in construction management. Construction enterprises should set up relevant positions for recruitment according to the development trend in the future to increase the demand for talents. Colleges and universities should also vigorously train professional talents according to the needs of social development.

(3) To promote the application of GIS and BIM integration technology in construction management, it is also necessary to speed up the compatibility of professional software formats, and vigorously develop the construction management platform construction and promotion.

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