Brief Analysis of the Application and Limitation of BIM in Project Life Cycle Management

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Abstract. BIM (building information model) with its advantages of information integration and excellent visualization effect has created considerable economic benefits and significantly improved work efficiency in construction practice. Although BIM is widely regarded as the future of China’s construction industry, there are many obstacles to its application in China. This paper briefly analyzes the application status and main obstacles of BIM in China. At the end of the paper, the author provides some suggestions from different aspects.

1. Introduction
In western countries, the number of BIM construction projects has exceeded that of traditional projects. Although application of BIM in China started late, it has been used to a considerable extent in many complex construction projects. For example, BIM was used to build the Disneyland in Shanghai in 2015 and Joy-City of Xi’an in 2017. In large and complex construction projects, BIM technology shows its tremendous advantages in structural design, team cooperation and conservation of manpower and material resources [1]. Generally, from the design concept of BIM, it has great advantages information exchange and cost saving compared with traditional construction method. However, in China's construction practice, BIM's huge application potential in the whole life cycle of construction has not yet been fully exploited.

For example, in the Xi'an LvDi Center project, due to lack of unified BIM industry standards in China, the communication between different stakeholders in the project has become an intractable problem. In addition, the compatibility between different BIM software is still unsatisfactory. In the projects of Shanghai Central Building and Concert Hall of the Central Conservatory of Music, BIM was only fully utilized in the design stage. Moreover, due to lack of overall management and immature application model in BIM practice, many projects in china have failed to implement information management through the whole life cycle of project, which has wasted BIM's huge potential.

In this article, I will briefly analyze the application status of BIM in China by describing several examples of construction projects, and then discuss main obstacles to its further application. Finally, this article will attempt to propose measures to overcome obstacles and try to put forward some suggestions from multiple perspectives.

2. Findings and discussion

2.1. The application potential of BIM in project lifecycle information management
BIM, which is building information modeling, is a data tool used to design, construct and manage
construction projects. It can integrate the data and information of the building and shares them during the whole life cycle, so that technicians can correctly and quickly understand and process various building information. It also provides the foundation for collaborative work of the design team and all stakeholders involved in all stages. BIM can improve construction efficiency and plays an important role in cost saving and shortening the construction period.

BIM technology is another new technology in construction industry after CAD technology. Its application will also bring revolutionary changes to the construction industry [2]. Compared with CAD technology, BIM technology has the following characteristics: Firstly, BIM is a database formed three-dimensional computer model, which stores the whole process information of a project from design and construction to operation after completion. Secondly, the information of the whole building’s life cycle is interrelated. Any change to the information of the three-dimensional model database will cause the corresponding change of other information associated with the information. Thirdly, BIM supports collaborative work. BIM technology is based on IFC standard, which is an open data standard. It effectively supports data exchange among various application systems in the construction industry and data management in the whole building life cycle.

In fact, the essence of BIM is to achieve information management throughout the whole life cycle of the building, which is of great significance to the construction of the project and the integrated management of the post-operation stages. Zheng’s research [2] shows that BIM has the advantages of integrated management and whole life cycle management in building information system.

However, the current application of BIM in China basically relies on the special needs of clients and BIM is only used in some complex projects. There is still much work to be done to achieve the expected advantages of BIM information integration in the whole life cycle so as to realize further application of BIM.

3. Application status and main limitations of BIM use in China

3.1. Brief analysis of the application status of BIM in China
In China, BIM has been well known and applied to a considerable extent by construction technicians. According to the survey of 《BIM Applied Research Report 2013》 in China Construction Industry, 87% of respondents have heard of BIM and 39% have used BIM [3].

For example, In Tianjin Port International Cruise Terminal Project, facing the changeable construction environment, complex main building form, tense construction period, high safety requirements and many challenging construction requirements involving engineering fields, the builders decided to use BIM to assist their construction of the project. In the whole process of the project, BIM technology was mainly applied in the early stage of functional analysis and structural design of the main building, and the results are very satisfactory. Engineers with different professional backgrounds in the design team quickly completed the communication and completed the design drawings of architectural, structural, mechanical and electrical aspects within nine days. Subsequently, they completed all the construction drawings of the project in two months and received high praise from the client. However, unfortunately, the application of BIM in this project was only limited to the design stage, and it was not used to organize a complete workflow from design to construction and operation.

Similarly, in the German National Pavilion Project of Shanghai World Expo Park, BIM technology is also used by the constructors in this project due to the tight construction period, complex shape and spatial relationship of the main building, and large volume of the building. With the help of BIM technology, Shanghai Modern Architectural Design Group has completed all the complicated design in less than half a year and has been recognized by the German side. However, the limitation of this project is that BIM was only used in the architectural design stage but not in other stages. For example, projects such as Shanghai Central Building, Nanjing South Railway Station and Xi’an exhibition center, have only applied BIM technology on design stage [6]. BIM technology is mainly used for complex building design to improve design efficiency and conflict checking to reduce drawings errors. Its visual analysis makes building information more intuitive, and it can produce component processing drawings to ensure
3.2. Main limitation of BIM use in China

3.2.1. Inadequate application of BIM

Generally speaking, the application of BIM technology in China is mainly used to help the design of complex buildings and model conflict checking of professional engineering and so on. Moreover, according to the research of [1], BIM application in China mainly concentrates on the design stage, and the application in construction is rare and is seldom used in other stages. In terms of the whole life cycle, the application pattern is the designer-driven, not the client-driven.

Designer-driven mode is the earliest application pattern of BIM in construction projects, so it is also widely used in China now. It is dominated by the designer and will not be affected by the client and contractors. This design method is helpful for designers to express their design ideas to customers quickly and intuitively in the fierce market competition. Designer-driven BIM application patterns are usually applied only in the early stages of project design [4]. After the design scheme has been approved by the construction unit, unless the owner specifically requests, the designer will not refine the 3D model that they had established before, nor will it be used for related design analysis, such as structural analysis. Moreover, the application of BIM in the construction and maintenance stages in this pattern is even rarer. Designer-driven BIM application mode accelerates the development of BIM to a certain extent, but it does not apply the main functions of BIM to the whole process of construction projects, and only uses the 3D display function of BIM in initial stage of the project.

In some projects, the main application of BIM is for the contractor. The contractor-driven pattern is an application mode which comes into being with maturity and has wider use of BIM technology in recent years. The application side of BIM is usually for large-scale contractor. There are two main purposes for contractors to adopt BIM technology: assist bidding and assist construction management. Under the pressure of competition, in order to win the bidding of construction projects, contractors use BIM technology to show the feasibility and advantages of their construction schemes, so as to improve their competitiveness. In addition, in the construction process of large and complex construction projects, in order to ensure the smooth progress of construction and to reduce rework, contractors will also use BIM in the construction phase.

BIM technology, combined with simulation technology, has played a positive role in the bidding stage and construction stage of the project. However, in this pattern, the application of BIM is mainly oriented to the bidding and construction stages of the projects. When the project bidding or construction ends, the established BIM model will lose its value. This has lost its original meaning for BIM, which should be applied to the whole life cycle of buildings.

3.2.2. Imperfect BIM industry standards

Although BIM will become the next generation of technology in the construction industry, the promotion of BIM in China has been hampered at the institutional level. Compared with foreign countries, China's existing construction industry standards is imperfect. In addition, there is no specific law to define the legal liability for the use of BIM and to protect the intellectual property rights of BIM users. Therefore, the environment for BIM to be widely promoted in China is not mature enough.

Weimin Zhuang, co-chairman of UIA Vocational Practice Committee, pointed out that "Platform improvement and market awareness are the main shortcomings of BIM development" (2011). At the same time, many China experts in construction area point out that the existing construction industry system, domestic standards and norms are becoming obstacles to promoting BIM, which urgently needs to be broken through.

3.2.3. Lack of integrated management experience for BIM

Because the application of BIM in China is still developing, many projects lack effective collaborative management in the project process, which leads to the difficulty of timely sharing of information among...
different professions and stakeholders at different stages of the project. Because the sharing of project information is the key to ensure that BIM can be applied in information management in the whole life cycle of buildings, the lack of integrated management results in the emergence of "information islands", which eventually leads to the split of BIM application in different stages.

4. Conclusion and suggestion

BIM technology, as the core technology of project whole life cycle management, is bringing unprecedented changes to the construction industry. BIM technology can centralize all kinds of building information through full life cycle by using digital model [2] However, due to inadequate application, imperfect industry standards and lack of integrated management experience limit further application of BIM in China.

Although there are some obstacles to the promotion of BIM in China. From the overall trend, due to the great advantages of BIM in use and efficiency. We are still very optimistic about the development of BIM in China’s construction industry.

In order to promote the application of BIM from partial stage to full life cycle, from some projects to the whole industry, this essay tries to put forward some suggestions based on the main problems of BIM application above.

1. The government should vigorously promote the BIM application pattern led by client in the construction industry. For the construction project, the client will control the execution and management of the whole project. Therefore, client-led BIM applications will be conducive to the implementation of BIM application and management throughout building life cycle. At the same time, construction enterprises should be encouraged to strengthen their cooperation with BIM professionals and train their technicians so as to produce experienced BIM managers.

2. The government and industry should jointly formulate BIM industry standards, issue unified BIM specifications and supporting laws as soon as possible, clarify the division of legal responsibilities for BIM use, and protect intellectual property rights.

3. The academic community should cooperate with the industry to explore BIM management method for the whole building life cycle to adapt to market conditions, and try to improve the management experience through continuous practice.

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