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Research on Construction Contract under BIM Conditions

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Abstract: After analyzing the development status of Building Information Modeling (BIM) technical standards and BIM contracts in China and abroad, this study notes that the establishment of the engineering contract system which is suited to China's BIM standard would help to clarify each party's legal responsibilities, ensure the delivery and payment standards and enhance all parties coordination so as to promote the application and implementation of BIM technology. As for the choice of the model of the contract, BIM technology is ought to be implemented through adding attachments to the contract and maintaining the existing contract system.

Key words: Building information modeling, engineering contract, integrated project delivery, standards

INTRODUCTION

Building Information Modeling (BIM) technology is used to design, build and operate the projects by creating and using the digital models. It helps integrate all kinds of construction information throughout the whole life cycle of building. BIM could not only improve the efficiency of project construction and operation but it is also conducive to the coordination and supervision of project construction and operation activities. Therefore, the comprehensive application of BIM in China would bring huge economic and social benefits for the development of the construction industry. The design and even the whole project quality and efficiency could be improved.

On the basis of BIM standard which is suited to China's project management practices, this study studies the establishment of the corresponding contract system to the standard by focusing on solving the core technology problems of construction project information carrier development (He, 2010). It would help realize the full information-based construction project life cycle including consulting, project support of survey and design, construction, procurement and subcontracting contract management, provide the basis for the project application of BIM by the project members, safeguard the legitimate rights and interests of each party and enhance the level of project management.

DEVELOPMENT OF BIM

Situation of the development of China's BIM standard: The application of BIM in China's construction industry has already started. Therefore, there is an urgent need for the standardized study of BIM so that the related industrial chains in the construction industry could share

the application of BIM. At present, relevant agencies are stepping up efforts to develop the BIM standard which adapts to the demands of Chinese legal system and management. On the basis of the Outline of the National Long-term Science and Technology Development Plan (2006~2020) issued by the Ministry of Science and Technology and the requirements of "the eleventh five-year" advanced manufacturing and automation technology development planning, BIM, as an important project, has been included in the national Ministry of Science and Technology's "the eleventh five-year" key research project which is Research and Application of Key Information-based Technology in Construction Industry.

In 2007, China Institute of Building Standard Design and Research proposed Building Objects Digital Standard (JG/T198-2007); in 2012, the Ministry of Housing and Urban-Rural Construction revised the construction standards to develop five BIM related standards, including Uniform Standard for the Application of Architectural Engineering Information Model, Storage Standard for Architectural Engineering Information Model, Delivery Standard for Architectural Engineering Design Information Model, Classification and Coding Standard for Architectural Engineering Design Information Model and Application Standard for Manufacturing Industry Engineering Design Information Model.

BIM standard in the international engineering field: At the international level, BIM technology in US, Europe, Japan and China Hongkong region has been widely used in various types of real estate development projects. The United States started the promotion and application of BIM technology at a very early time and the popularity

and application of it are at a higher degree. The government or the owners would ask for adapting the uniform BIM standard for the projects and even some states have passed laws to mandate that all the large public construction projects within the state must adapt BIM technology.

At present, the BIM standards adapted in the United States include NBIMS (United States National Building Information Modeling Standard), COBIE (Construction Operations Building Information Exchange) standard and IFC (Industry Foundation Class) standard, etc. Although different state governments or project owners would choose different standards but the premise is that the relative parties would agree with the use of the uniform standard which could guarantee the maximum benefits for the relative parties. NIBS (National Institute of Building Sciences) released in 2007 the first edition of the first part of BIM standard.

On April 16th of 2010, the United States issued a BIM Project Implementation Guide Version 2. This version points out that the integrated application of the BIM technology in construction project, not only could improve the specific project process but also could enhance the synergy degree between projects.

ENGINEERING CONTRACT BASED ON BIM STANDARD

The study on the construction project contract system in China which is suitable to the BIM technology, is still in blank field. The existing laws, regulations and the contract model lack relevant provisions for cooperative design and the information versions of all parties involved in the construction project could not cooperate with each other. Because there is no legal status of electronic information and electronic versions could not be filed, all these result in duplication of information gathering work. And the information version, update, maintenance of each participant could not cooperate with each other. Therefore, the project management efficiency has been hovering at a low level, because the engineering change disputes frequently occur (Han *et al.*, 2010).

In the United States, in order to facilitate the promotion of BIM and the acceptance of the parties, when BIM is adapted in a project, the standard contract is also used for the BIM project. At the same time, it won't change and rebuild the previous widely used contract but it just illustrates BIM in the form of contract appendix and edits and includes the necessary information of the above content.

American Institute of Architects (AIA) published a few copies of the contract annex which includes the

improved model contract. This model contract introduces the implementation methods of BIM in the project in detail. The Consensus DOCS 301 BIM Addendum which is released by the contractor group of the United States is also a BIM model contract. It is stipulated that in the model contract that in the mature project contract, there should be a written BIM project implementation plan as a special reference, so that the team members could participate in the planning and implementation process. The set of the BIM requirements in terms and conditions of the contract would ensure that all members of the project team would implement BIM as per the project planning at the legal level.

In November of 2009, the UK launched the first edition of "AEC (UK) BIM Standard". It is a practical BIM standard used in building design and construction in the UK. In April of 2010, the UK launched a standard which is called "AEC (UK) BIM Standard for Autodesk Revit", the first edition. The standard was jointly prepared by the experts from more than a dozen companies in the UK construction industry and it is used to guide and support the industry standard for all the construction project building process, in which BIM (Revit platform) is applied in the British construction industry. At the same time, the BIM standard has been compatible with the Fédération Internationale Des Ingénieurs Conseils (FIDIC) contract system.

SIGNIFICANCE OF CHINA'S BIM STANDARD CONTRACT SYSTEM CONSTRUCTION

The contract system which is suited to the BIM technology discussed in this study is based on the corresponding technical standards in the country or industry associations. The existing architectural industry systems in China are not unified and lack a complete BIM application standard, coupled with the unknown BIM legal responsibility limits in the industry which lead to an immature environment for the promotion and application of BIM in the construction industry. The uniform and collaborative project contract would provide guarantee for the parties involved when BIM is applied in the project, through the following aspects.

Realizing information overall management for the whole project life to solve the "collaborative" dilemma in the BIM application: Collaborative design is missing in the process of BIM application. Especially in the operation of the project, overall information management is missing in different stages, different professions and parties involved in the project (Cheng, 2011). However, the relative BIM software involves with different professions

and thus the concept and technology of BIM provide a new platform for collaborative design. In addition, whether the design is cooperative or not is essential for the full realization of the value of BIM.

With the support of the BIM standard, the complete system, in which the consulting, design, construction contract are the main parts and procurement, subcontracting contracts are also included, would provide regulations for the use, delivery and management of the construction project electronic information documents. It would make electronic document data become available resources and realize the information-based data resources and knowledge-based information resources. At the same time, the contract system would further clarify the cooperative responsibilities of the designers at different design stages so as to avoid mistakes, oversight, clash, lack or the increase of a number of later design changes. In this way, it would save the construction cost and improve the efficiency of project management (He and Qian, 2012).

Clarifying the legal and contract responsibilities of project participants in the application of BIM technology:

Because the BIM needs corresponding software as the carrier and tool of information, building information is to be constantly accumulated as a project progresses. In this case, each project partner may use the information gathered by any other parties and may also process and modify the information based on the existing one. This process would definitely involve with all the legal responsibility in the ownership of intellectual property rights (Qi and Hui, 2010). For example, according to the provisions of China's Copyright Law, the sixteenth article: "The creation of a citizen to complete the tasks of legal persons or other organizations is post works and the copyright shall be enjoyed by the author but the legal persons or other organizations have the priority to use it within the scope of their business. Within two years of the completion of the works, without consent of the unit, the author may not permit a third person to use the works in the same way with the use of the unit". However, for the post works like engineering design chart, product design chart, map, computer software and so on, whose creation is mainly based on the material and technical conditions of the legal persons or other organizations, the author shall enjoy the right of authorship but, the copyright shall be enjoyed by the legal persons or other organizations.

In the project contract based on the BIM standard, the intellectual property rights protection of the BIM software platform, the use and management rights and the treatment of tort responsibility and so on shall be defined.

At the same time, the contract responsibilities for failing to deliver the project work for every stage as per the agreed time and standards shall be stipulated.

Solving the keeping and archiving issues for the project files formed by the BIM technology:

The traditional construction project document management system has been unable to meet the development of current building informationization and the data sharing requirements of the building information model in information retrieval and reuse of knowledge. With the transition of the way of information generation and exchange from manual to with computer as an aid in the construction engineering area and with the application of various information storage and interaction modes developed and generated together with 3D or even higher dimensions of information technology, the problems of the construction project documents management system in the traditional sense have become more and more prominent. Although the computer has been widely used as an aid, the traditional study document management is still the main form of the information storage and communication in the construction project document management (Jiang and Li, 2012).

Therefore, there is the necessity and feasibility for establishing document management system in BIM environment. It is important to design the framework of document management system under BIM environment and put forward the framework that is to be solved, facing the Chinese texts files management system in the construction project management in China.

It is stipulated in the national standard Code for Construction Project Document that, construction project files are the history records in the forms of words, charts, audio-visual and other forms which are worth keeping and archiving and are formed directly in the engineering construction activities and they could also be referred to as the project files for short. It could be seen that there is no legal difficulty to archive the project management results files generated with the application of BIM technology but there is the need for the construction administrative departments to clarify the requirements for the scope of the archiving files and the files quality of BIM technical documents, so that it could be stipulated in the project contract by all parties involved in the project.

ENGINEERING CONTRACT SYSTEM AND PATHS SELECTION OF CHINA'S BIM STANDARD

Construction contract is a typical contract which has the particularity and complexity of its own. The project contract structure and effective management would be

able to promote the application of BIM as a new technology. In China, as for the establishment of the project contract which is suited to the BIM technology, there are three alternative paths.

Multilateral standard protocol under integrated project delivery (IPD) mode: In the IPD schema evolution process, a key aspect is the evolution of IPD contract. In 2007, the emergence of the Consensus DOCS 300 three-party cooperation agreement marked the beginning of multiparty protocol under IPD mode. Under the IPD multilateral agreement, all parties involved in the project integrate together organically through signing contracts between each other. It could help realize the cooperation and information sharing so as to improve project efficiency and increase benefits.

Rewritten BIM project contract based on traditional project management mode: The uniform BIM technology standard could help get the owner participated in the whole process of the project and could help supervise and regulate a whole of several projects. This is because the BIM technology standard could help rewrite the relative contracts about the design, construction and supervision and then the owners could sign the independent contracts with the design side, the contractor and all the parties involved in the project contract relatively. But there is no mutual agreement or cooperation between each other parties other than the owner which is not conducive to the exchanges between all parties involved in the project and not good to achieve project objectives.

Annex BIM engineering contract which is suited to multiproject management modes: Since, 2010, the Ministry of Housing and Urban-Rural Construction has related with relative departments to issue the multiple version contract for construction project for different project management modes (Su and He, 2010). These include the construction contract terms and conditions in the 2010 edition of the Housing Construction and Municipal Engineering Construction Standard Bidding Documents; the 2012 edition of the General Contract of the Construction Project Engineering (Model Version); the contract terms and conditions in the 2012 edition of Concise Standard Construction Bidding Documents; the contract terms and conditions in the 2012 edition of the General Contract Bidding Documents of Contract Standard Design Construction and it is about to issue the revised Construction Engineering Contract (Model Version).

Combined with the status quo and practical development of BIM technology in China, in the conditions of contract for works of all the above editions, it is used to constrain the rights and obligations of the parties involved in a project which is to state in the form of attachment that the project would be carried out in BIM mode and then the related content would be stipulated. This model would be able to maximize the stability and continuity conditions of contract for works of each edition which would facilitate the application and promotion for BIM technology in various engineering projects. Therefore, it ought to be the ideal choice of Chinese BIM contract system. In addition, the consulted, new edition of Construction Project Construction Contract (Model Version) which is going to be released soon, has already obtained relatively mature research results. In the revised construction contract model text, the use of information between the parties and the content such as intellectual property are written into the terms and conditions of the contract.

The national line ministries or industry associations develop and establish the contract documents which are suited to China's national conditions and they are used to be the attachments of the existing project contract. The formulation of the construction engineering contract system of the BIM standard which is suited to China is the contract basis and institutional guarantee of BIM technology application in the concrete projects. Only if the establishment of BIM models, delivery standards, intellectual property rights, administrative privileges and so on at every stage in the project life cycle could be clarified, the effectiveness and value of BIM technology could be truly realized. The BIM standard conditions of contract for works could help to regulate the construction market, improve the efficiency of signed construction contract and create a fair market environment, coordinate the conflict between model text and engineering law and also contribute to the internationalization of Chinese project management standards. In addition, it could help to realize the cooperation expectations of the construction project participants to share the benefits through using the information-based platform to integrate the resources at different stages of the whole life cycle of the construction projects.

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