The Application Of BIM In Intelligent Construction

Lijia Wang[1, a], Xu Huang[2,b] and Rongyue Zheng[3,c]

Ningbo University of Architectural Engineering and Environmental Sciences, Ningbo, China, 315211

[a]monica773@126.com, [b]archangelblade01@gmail.com, [c]rongyue@nbu.edu.cn

Abstract. "Intelligent Construction" is an innovative idea adapted to a new era of development for the construction industry. In promoting the development of "Intelligent Construction" concept, it can make various stages of the design; the construction and implementation of a project more effective in conserving resources, saving costs, reducing pollution and improving the efficiency of the desired target. BIM is an integrated expression of the construction projects information and model. The effective use of BIM technology can improve the efficiency of the projects construction, while saving cost thus making "Intelligent Construction" necessary. This paper is to propose a strategy for BIM Intelligent Construction, based on a through analysis of the concept of Intelligent Construction and the relationship described between BIM and Intelligent.

Intorduction

The construction industry is a pillar industry of our country, but there are still serious wastes of resources in development, with low production efficiency, low level of information technology and various other problems. The existence of this situation, coupled with the industries outdated ideas, the complexities of construction management, single building products, building products in the production process data mass, impromptu formation of project teams are all characteristics triggered by it. "Intelligent Construction" concept on the one hand to requires construction companies to conserve resources and improve production efficiency in the construction process, on the other hand requires the use of new technology instead of traditional construction techniques and construction methods, in order to achieve the project management information, to promote the construction sustainable development. Therefore, in order to comply with the construction of low-carbon, efficient and development requirements, "Intelligent Construction" will become the new direction of development of construction industry.

Intelligent Construction

The Concept Of Intelligent Construction. "Intelligent Construction" has two meanings: First, the harmonious development of the industry, sustainable development in harmony with nature. It has the same purpose as low-carbon construction, namely to maximize resource conservation and protection of the environment, reducing pollution. Second, the use of advanced digital programs and equipment to arm the industry, so that the entire construction industry, business management and project management information level has a substantial increase, reaching a refinement in management. [1] Intelligent Construction is a combination of low-carbon, refinement, and information all rolled into one, to comply with the innovative concepts of a new era of development in the construction industry. If the concept of "Intelligent Construction" is imbedded into construction entrepreneurs, they will realize its value from the following multiple aspects: First, to improve the quality and extend the projects life cycle, thus significantly reducing resource consumption. Second, the meticulous construction on the front line of the project site will significantly reduce extensive waste, rework, schedule delays and other delay type phenomena, thus improving production efficiency. Third, "Intelligent Construction" concept will greatly enhance large-scale construction enterprise information management and construction requirements, thus enhancing the level of construction information.

The Main Technical Skill Needed To Make "Intelligent Construction" A Reality. Material substitution, strengthening recycling. To replace high resource consumption, high-energy materials with more green engineering materials and construction materials. Templates, construction site water consumption and the likes to be reused, thus reducing construction resources.

The use of new construction technology and construction tools to replace old process and old technology, thus reducing loss and waste of engineering materials.

Using information technology to improve all aspects of construction of the construction process. Refinement of construction similar to that of the manufacturing sector through Information Technology,more resources can be reduced, energy consumption, and improve the level of construction companies and project management. Common Information Technology include PIP (Project Information Portal), ERP (Enterprise Resource Planning) BIM (Building Information Modeling) to be use throughout the whole process.

BIM

BIM Concept. There are many takes in regards to the definition of BIM, however the one version with more authoritative weight is the United States definition on BIM, the U.S. National BIM Standard (NBIMS-National of Building Modeling, Standard), which is defined as follows: "A Building Information Model is a digital representation of physical and functional characteristics of a facility. As such it serves as a shared knowledge resource for information about a facility forming a reliable basis for decisions during its life-cycle from inception onward. "[2] This definition is very clear; mainly expressed that BIM not only contains the physical information of the project, but also contains the functional information of the project as well as the life cycle of the project with all its values of expression and shared knowledge resources to provide a reliable basis for a variety of decision-making.

BIM Current Research. Currently, BIM technology in the United States to Europe, Japan, Korea, Singapore and other developed countries is very popular, generally used in the design phase, construction phase and after the completion of the project, the maintenance phase. At present, the construction industry in the United States has more than half of agencies are using BIM, and the United States military is the first applicant to benefit from using BIM.

In South Korea, have been a number of government agencies committed to the development of standards of BIM applications, such as South Korea's Ministry of Land and Marine, Korean Education Ministry of Science and Technology, South Korea Public Procurement Service Center and others. Among them, the South Korean Public Procurement Service Center, the Construction Utilities Board developed a BIM implementation guide and roadmap.

In China, the current uses of BIM applications is still in its infancy, less than 10% of the construction enterprises use BIM applications. [3] Since the 2008 Olympic Games, the country began the use of BIM technology in many projects to optimize the process of project management information. Such as the Olympic Village with floor planning and materials management information system; South to North Water Transfer Project; the Hong Kong subway project; Hangzhou Olympic Sports Center Stadium; Shanghai World Expo China Pavilion; Shanghai GM-corporate pavilion in the design, construction, operation stage have used BIM technology.

The policy guidance also helps promote the domestic development of BIM. Issued by the Ministry of Housing and Urban Construction "2011 ~ 2015 Information of Construction Industry Development Outline". It outlines "The 12th Fifth-Year" period, to speed up the building information model, to promote the construction of information technology standards, and the formation of a number of applications of information technology to reach the international standards for construction enterprises. [4]

 A BIM Strategy Based On Intelligent Construction

The Relationship Between BIM And Intelligent Construction. BIM has been recognized by the international project management community as a revolutionary technology in the construction industries productivity. As it bring a much need technical support to help solve two fundamental problems of project management, in the amount of engineering data from creation, management, sharing of information and project collaboration. Therefore, improving the constuction process of information, for which "Intelligent Construction" is a critical path for BIM.

 Using BIM Technology To Promote Low-carbon Construction process. Low-carbon construction process is a process to maximize conservation of resources, protecting the environment and reduce pollution. Using BIM technology to conduct a collision check, you can reduce the possibility that during the construction phase that there may be error loss and rework, thus improving construction quality and economic benefits.

 BIM Technology To Accelerate The Refinement Of Project Management. A traditional project construction schedule is prepared only a theoretically complete schedule of the construction phase of the project, a rough estimate of the time required by the various stages of construction, many projects, especially large-scale key construction projects, because of the accumulation of vast amounts of information, the construction schedule arrangement can not properly be done. This makes for very tight schedule requirements on certain stages, and the results is the construction progress on the construction side is thus under intense pressure. When the construction schedule prepared is unreasonable, there will be non-normal sequence of construction, a blind rush to finish certain parts, and various professional construction interfaces all happening at once.

 Using BIM technology to create a virtual construction, before the construction even begins, one can visually demonstrate the construction processes construction schedule and construction process accurately. From it, shortens the construction period and reduce cost to achieve the project management refinement requirements.

 BIM Technology To Improve The Level Of Construction Enterprises And Project Management Information. First of all, project managers can at any time, quickly, gain universal access to the latest, most reliable, accurate 4D associated data. For example, we in the BIM model select one column, then click on the same property, you can get its column material, size, and all of its specification as well as those for a number of different columns, and so on, making it very easy to compile. Secondly, BIM technology in construction unit has brought great convenience, it also brings a new information management model, the original segmentation of transmission of information management into interactive management of the overall information around the BIM data library, to solve information in creation, operation and management, during construction period information transfer problem. Thus the overall inheritance and timely transmission of information bring in a new streamline design for information management mode. [5,6] With this new management model, using the 3D BIM models can achieve a perfect sharing of information, to make information management more efficient, to lay a solid foundation for the realization of "Intelligent Construction".

 By using new energy-saving materials and construction techniques to solve the extensive construction methods problems, due to funding constraints, the use of BIM technology can still achieve a win-win situation.BIM technology is not only used to promote the construction of low-carbon, refine, and level use of information, but also, the whole process of BIM technology application with that of a 3D virtual model changed the original extensive construction mode, that benefits from many factors, thus is an "Intelligent Construction" method.

The Use Of BIM Technology In Intelligent Construction.

 Using BIM Technology To Do 3D Collision Detection. Construction departments use BIM to further develop the design. BIM technology is established on the model being able to reflect the collision location, and at the same time because it is a 3D visualization model, therefore, at the place of collision the real-time change in angel all round, multi-angle observation and facilitate discussion changes to improve the actual efficiency of reducing the existence of any possibility of error losses and rework during construction.

Using BIM Technology For Virtual Construction. Through virtual construction not only can one get a clear understanding of the progression of the work and plans, but also it can identify wrong arrangements, and places that lack consideration in the construction process in advance in order to modify the design to optimize the construction process. Virtual construction can enhance team collaboration, therefore, whether on the construction side, management side, or even the owners from a non-engineering industry background leadership, will be well aware of the various problems and situations in and around the project. [7]

BIM And RFID (Radio Frequency Identification) The Combination And Implementation Of Construction Real Time Tracking. RFID main function is used for information collection, the collection of information transmitted over the Internet to the information center for information processing. In the BIM model, all parts and components have an RFID information unique number, therefore, the condition and whereabouts of these parts and components can be tracked in real time through RFID, smart phones, and the Internet, and will be displayed in the BIM model.

When live on site tracking of RFID and BIM information management and performance come together, the status of parts and components can be collected by the RFID information to create a 4D simulation of formation for the BIM model. When site personnel need specific records for the construction schedule, key parts, and concealed projects, according to the RFID messages, they automatically record the site photographs to the BIM model with the whereabouts of the parts and components are, so the managers can grasp the what's going on at the construction site, to timely detect any potential for uncertainties and then to avoid adverse consequences, while monitoring the quality of the construction.

Problems That May Arise During The Process And Some Suggestions

According to Stanford University's Integrated Facilities Engineering Center from the 32 projects using BIM technology the following results were: eliminated 40% extra-budgetary change; cost estimated damage fee reduced by 20%; through discovery and settlement of conflict, the contract price was reduced by 10%; project duration reduced by 7%, achieving an early return on investment. [8] The advantages of BIM are obvious, but looking at China's BIM development, to promote the development and implementation of BIM technology, so that BIM can further advance the development of the "Intelligent Construction" concept, there still exist a wide range of issues to be addressed.

BIM Applications Are At The Primary Levels Of Development. According to the 2011 China Construction BIM applications research report shows that 39% of the respondents in the project using BIM technology, 64% of users are on the design side. [9], but few understand the BIM in the design institute, building design professionals are also involved in a number of foreign large-scale construction projects have contact with but limited contact, and to truly master BIM essence are far and few. Therefore, the establishment of effective staffing, effective training and retraining mechanism becomes urgent.

The Project Management Model Needs To Be Compatible With BIM Technology. Popular implementation of the project include the parallel contract (Multi-Prime), design - bid - Construction (Design of Bid-Build), design + construction or turnkey (Design-Build) and bearer of risk CM (Construction, Management at Risk) and other patterns. The management model for different projects are different, when should BIM be inserted in the project is an issue that needs to be explored.

Using DBB mode as an example, when the construction contractor confirms the project, the BIM is involved in the entire project from the design stage. Design Institute establish the BIM model, construction use BIM to guide the construction, management use BIM supervise the construction, the last will improve the BIM models are then delivered to the owners, to guide owners in property management. But in DBB mode, there is a birth defect in the process of project implementation, as each party involved is in opposition, as are their respective goals and the overall project objectives are inconsistent, and this often happens, thus the goal of the project is not completed (for example, cost exceeds the budget), but from a participant perspective a satisfactorily goal is completed (such as the construction side achieves profitability). Therefore, the emergence of new problems, as what kind of project management model embodies the biggest advantage of BIM that fulfills "Intelligent Constructions" needs.

The IPD (Integrated Project Delivery) is integrated project management model that combines different parties into a mutual collaborative work team. Through this type of management model a variety of techniques are to use so that the team's knowledge and experience may make contributions early on in the project, and can thus allow for the construction project on whole achieve its max life cycle.Therefore, IPD is the maximum of BIM value in project management implementation mode: BIM is an integrated database from a range of information using three-dimensional projects of geometry, physics, performance, spatial relationships, and professional rules that are combined into a database, that can assist project participants from the project concept stage various types of modeling projects in support of the BIM model, analysis, and simulation work to improve the scientific decision-making. [10]

IPD advantage is obvious, but to truly implement, the challenge is enormous, as these challenges include technical, administrative, legal, and cultural fronts, its thus has a long road ahead of it. But the ideas, principles and methods of IPD can be gradually applied in the existing mode of project implementation, so as to enhance the operational level and efficiency of the overall management of the project.

Establish A BIM Evaluation System. In the construction process, how to determine whether the project is using BIM technology to achieve "Intelligent construction" or what to what degree how useful BIM is? If the two projects are compared, how to distinguish which of them is "Intelligent" to a higher degree? Therefore a BIM Evaluation System must also be establish, to quantified in the practical application the process of the project life cycle, information exchange and to use as the core of the "Intelligent Construction" degree evaluation system.

Conclusion And Outlook

The matter of how deep or whether or not "Intelligent Construction" is an important criterion to be used to test the constructions enterprise's core competitiveness, while using BIM technology to build a central digital control system for "Intelligent Construction" to appear is inevitable. Of course, as described, when using BIM technological limitations and traditional construction ideas, the concept of "Intelligent Construction" in the course of being put into practice, there exist a wide range of issues that need to be further studied and improved.

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