Research on the Curriculum System of BIM in Engineering Management Specialty of Higher Education

Yongquan Xiong

School of Architectural Engineering, Sichuan University of Arts and Science, Dazhou, 63500, China

Keywords: tertiary education; curriculum; BIM

Abstract. Based on the supporting role of BIM in the ten knowledge fields of project management and the difference between BIM manager and project manager, to analyze the obstacles of the popularization of engineering management major and BIM education in colleges and universities from four aspects; curriculum system establishment, teaching materials, teachers and students. And probes into the BIM by combining four curriculum platforms of engineering management major, i.e. technology, economy, management and law. Then it puts forward the organizational mode of cooperation and introduction, the technical means of the combination of reality and virtual, the teaching mode of combination of theory and practice, and the gradual transition from a single course to platform framework integration combined the popularization path of BIM higher education.

1. Introduction

BIM (Building Information Modeling) is a technology and management method that applies information technology in the construction field to achieve simulation and simulation of design, construction and management processes. BIM integrates the whole life cycle information of the project and has the functions of facilitating estimation and energy consumption calculation, carrying out collision tests in advance, optimizing design, etc. Therefore, different countries are developing BIM usage requirements. BIM has been taken as one of the core technologies that must be possessed by enterprises engaged in general contracting, survey and design, and construction in the "12th Five-Year Plan" for information development in the construction industry in China's "Outline for the Development of Information Technology in the Construction Industry 2011-2015". In January 2012, the Ministry of Housing and Urban-Rural Development announced the formal start of BIM standard-setting work in China in the Notice on Issuing the 2012 Revision Plan for the Formulation of Engineering Construction Standards and Specifications, which opened the curtain of standardization and institutionalization of BIM in China. The demand for this market is fed back to the reform of higher education[1]. In 2015, the Professional Steering Committee for Engineering Management and Engineering Cost Disciplines of Higher Education Institutions issued the Guiding Professional Specifications for Engineering Management Undergraduate Programs in Colleges and Universities. The computer and information technology module is selected. The computer and information technology module corresponding to the elective knowledge area includes BIM technology principles and applications.

There are a lot of types of research on how higher education can provide professional BIM talents for the industry, but basically, only consider the information characteristics of BIM. From a technical perspective, BIM is considered as a hard technical skill. The impact of management and project organization cannot organically link BIM with other areas in the curriculum system. For engineering management professional education, it is not suitable to start from a purely technical perspective. It is necessary to explore the impact of changes in technical methods on the teaching and training of engineering management majors from a management perspective. Emphasizing integrity rather than simply technical aspects can establish the entire framework.

This article analyzes a large amount of literature at home and abroad, starting from the impact of BIM on the project management knowledge system, and the differences between BIM managers
and project managers, and discusses the obstacles to the introduction of BIM knowledge by domestic engineering management majors. Based on this, the establishment of a curriculum system for engineering management majors in colleges and universities that introduces BIM, and explores ways to achieve it.

2. **BIM Impact on Project Management**

2.1. The relationship between BIM and project management knowledge system

BIM, as an information center and collaboration model, its simulation function helps to improve project management performance. This real-time collaboration model is convenient for stakeholders to communicate and share project information. Contractors and operation and maintenance experts can see the 3D building model in advance and give suggestions to influence the design work, optimize the design in advance through information integration, reduce construction rework, and optimize the project from the perspective of the whole life cycle of the project.

The typical technical features of BIM include: collision test in advance, constructability of design, and analysis of project manager, designer and engineer for better decision-making; Assist in energy consumption analysis to better manage light, temperature and other elements by changing materials, space, etc.; Time and cost management through 4D and 5D models to integrate project decision-making[2], design, construction and operation maintenance information; The export of engineering quantity is realized, and the rapid and accurate evaluation is carried out in combination with the cost database, which is widely used in the procurement procedure. BIM itself is an object-based architecture, so it's easy to decompose attributes can better define the boundary of the project. The difference between the characteristics of the object-based architecture and the elements (points, lines, surfaces) makes the results of BIM model more suitable for design, estimation and construction. From the perspective of the above BIM functions, the BIM can support the integration management, scope management, cost management, quality management, human resource management, communication management, risk management, procurement management and stakeholder management in the project management knowledge system. Through the integration of project management domain management and BIM tools, it can better promote the cooperation of all parties of the project, improve productivity by reducing conflicts and changes, achieve better quality, rapid handover, reduce waste and cost, and finally promote the realization of the objectives of project management domain, and bring better business opportunities for all stakeholders of the project.

2.2. Similarities and differences between BIM manager and project manager

BIM is not just a 3D model, but represents a change in project management methods and changes in business processes. As a social technology system, stakeholders are required to change around this technology. Meredith identified five key competencies for a project manager: communication, team building, leadership, adaptability, and technology. According to Oz and sosik, the most important ability for a project manager is adaptability, because he has to face different project environments, use different resources and work with different people in different projects. For project managers, the latest challenge is the change in mindset brought about by BIM, including both technology, process and BIM's impact on the project.

BIM managers need to be more proficient in 3D technology and Revit tools. BIM managers also need skills similar to project managers, such as team work communication skills, but these skills are required to better use BIM model to help project managers make decisions. Therefore, in addition to the necessary software skills, BIM managers need to have a deeper understanding of BIM standards and BIM workflow[3] skills. According to BIM guidelines in Singapore, the role of BIM manager does not include making decisions on the design, engineering and construction solutions of the project. Its main role is to ensure the realization of BIM objectives, coordinate the application of project BIM in model management, determine the use schedule, sharing activities, quality control, modeling responsibilities and implement them into BIM implementation plan.

Although having BIM modeling ability will increase the chance to become a project manager, the project manager's work focus is still more on considering the project development opportunities,
while BIM manager is more concerned with design, model and other technical issues. For the same skills, BIM managers and project managers are used for different purposes.

3. Obstacles of BIM Education in the Popularization of Engineering Management Major in Colleges and Universities

This paper analyzes the obstacles of introducing BIM education into higher education in domestic and foreign literature. Based on the current situation of higher education in China, this paper analyzes the obstacles to the popularization of BIM education in engineering management major from the aspects of curriculum system establishment, teaching materials, teachers and students.

3.1. Obstacles in the establishment of a BIM curriculum system

BIM is not only a visualization tool, but also a communication tool for engineering management students. BIM can integrate construction, maintenance and other information forward into the design stage, integrate design, construction, operation and maintenance and other information, and serve project stakeholders. However, in the current education of engineering management, the thinking mode of BIM application, which integrates the information of various stakeholders, has not been fully established, and it is difficult to achieve a seamless connection with the four-year undergraduate training system of engineering management.

The development of BIM in the domestic construction industry is still in its infancy. Due to the lack of BIM personnel, limited project experience in BIM Technology Application, and huge investment in BIM platform, the industry-wide application of BIM is still in the process of development. Due to the lag of the development of higher education, there is no universally recognized BIM capability level requirements and discipline guidance program, which can not guide the establishment of BIM curriculum system in higher education. In a large number of Engineering Majors in higher education, BIM education can only be conducted in a pilot way.

3.2. Obstacles from teaching materials

Because BIM applications are not widely available in the market, teaching and supporting teaching materials are difficult to obtain. The lack of BIM teaching materials dedicated to students and case teaching resources matching BIM with other management modules makes it difficult for teachers to better transfer BIM theoretical knowledge and practical knowledge to students, and it is impossible to cultivate students' BIM practical ability. Without the guidance of the corresponding BIM expert committee, the boundaries of BIM training and education cannot be determined, which makes it more difficult to compile BIM-related textbooks and case textbooks, and further hinders the acquisition of textbooks and teaching materials that meet students' cognitive ability.

The BIM software instruction manual is not suitable for the development of students' cognitive ability. The investment of BIM software will increase the teaching cost of engineering management majors. If it cannot be continuously upgraded, it will affect the sustainability of teaching, weaken the degree of convergence between theory and practice, and then affect the quality of output talents.

3.3. Obstacles from teaching teachers

Process-based BIM doesn't just refer to computer application technology. What's more difficult is that the knowledge system required by BIM is cross-professional, cross-stage, and practical. Existing teachers in colleges and universities follow the inherent knowledge system and lack of new knowledge ability, especially lack of experience in subjects requiring strong practical ability, and cannot keep up with market developments. The entry standard for newly-added teachers in universities is usually the theoretical innovation ability in publishing articles and applying for topics, but not its practical operation ability, which objectively causes defects in the newly-added teachers' practical ability. BIM teaching needs new teaching methods and high-level experts with rich practical experience. Because it is greatly affected by the market competition, the rapid renewal of products requires college teachers to have the ability of continuous learning, which objectively causes obstacles caused by the lack of qualified teachers.
3.4. Obstacles from students

College students should face the market and provide the skills needed by employers. On the other hand, in order to meet the requirements of job-hunting, students are also the demand side of higher education services. However, students themselves do not participate in social practice in a large amount, so they cannot clearly put forward the demand for higher education services, and naturally cannot meet the requirements of the industry in terms of skills. On the other hand, the cross-stage and cross-field requirements required by BIM require students to have professional construction knowledge, which is not easy for students who lack practical experience. The implementation process of BIM technology is a challenge for students with low computer learning ability. A good BIM teaching system depends on the positive feedback of students, so it can be improved day by day. A system that can't get good opinions and suggestions can't achieve a virtuous circle.

From the above analysis process, it is found that there is a gap between industry needs and the supply of higher education intellectual resources, and there is a need for BIM talents in the industry. However, the lag in the realization of this demand has led to the failure of the existing higher education to provide a standard process and the implementation of a guarantee system to achieve this demand.

4. Establishment of BIM Course System for Engineering Management Major in Colleges

4.1. The combination of BIM and engineering management technical courses

Some students will be interested in BIM and will develop towards the direction of BIM manager in the future. However, some students are not interested in computers and only have basic needs. Therefore, the curriculum system should be graded, including basic level and advanced level. The basic level is required and the advanced level is optional. Regarding the teaching of BIM software, the most controversial is the choice of software. The general opinion is to choose one of the most widely used software in the market, because this represents the mainstream of the market.

The integration of BIM and engineering management courses is mainly reflected in drawing design and crash tests, especially involving complex structures, special curves and a large number of different professional interfaces.

4.2. BIM and economic management courses of engineering management

The use of BIM technology to derive engineering quantities, supplemented by the engineering cost database and current market price information for valuation, enables work that took days to complete in the past to be completed in half an hour or an hour. The use of BIM technology makes it easy to obtain cost data, which helps to evaluate the economic effects of the solution through value analysis, thereby implementing value-added. The premise of the integration of BIM and economic courses is that the technical capabilities of BIM itself are available and depend on technical capabilities to achieve. Adopting BIM technology in the design stage of high investment, reducing construction, use and maintenance costs through optimized design, and achieving the lowest total cost from the perspective of the entire life cycle of the project.

4.3. BIM and Management Courses of Engineering Management Major

As a technology, BIM can seamlessly connect the interfaces between different professions and organizations. In theory, the construction industry BIM model can support estimation, safety, site planning, lean construction, and partnership. Therefore, at the senior level, it should be emphasized that BIM as a technology platform is compatible with the supporting management mode.

Through the integration of information and data flow, BIM can achieve the purpose of problem-solving, improving quality, accelerating construction, and promoting stakeholder communication. However, whether it can be achieved depends on technical means alone. In terms of management, BIM is inevitably integrated with Related to the management model, project partnerships and project integrated delivery models are essential.

Therefore, BIM is becoming a comprehensive and collaborative process in the construction industry. Just as BIM effectively integrates design and construction at the technical level, in terms of management, the project partner approach and project integration delivery are also project
management models that integrate design and construction stakeholders. When the 3D model adds schedule management, cost management, energy consumption, resources, and CO2 emissions to 4D, 5D, 6D, and 7D, the BIM model is not only an information center, but also a management model based on the information center.

4.4. The correspondence between BIM and law courses of Engineering Management

The transaction model is reflected in the rights and obligations of Party A and Party B in the contract. BIM is a means to promote the parties to the transaction to realize their rights and obligations. As far as the legal system is concerned, there are no laws directly related to BIM in China. When teaching, you can directly introduce foreign laws, contracts and norms related to BIM to students, especially paying attention to the principles and cores emphasized in laws and contracts Philosophy, establish a preliminary BIM legal system.

There are legal obstacles to the use of BIM. An effective way is for the parties to the transaction to form a cooperative and integrated project delivery contract. The risks of using BIM by the parties can be shared with the reward system. Such contract requirements can achieve the following purposes: the definition of hardware and software use; team members can trust the contributions of other parties to the BIM model; ensure that the risks of the project parties can be reasonably shared; Risks are dealt with reasonably. In the process of BIM application, legal issues regarding the liability of stakeholders, insurance, BIM data and ownership of copyright, contract environment, security and credibility of building information, lack of agreements, etc. have not been fully resolved. The United States already has two BIM contracts, Consensus DOCS 301 and AIA E202. These two contracts provide a template for the parties involved in the project using the BIM model to establish a contract. Other countries have also published guidelines for using BIM as a reference for BIM legal issues.

From the above analysis, it can be found that in the integration of BIM with the technical, economic, management, and legal modules of the higher education engineering management major, the integration of BIM in the technical and economic fields can be set as a basic content in the first year and second grade. After students have certain technology application ability, in the junior and senior stages, they can integrate BIM with advanced project management modes such as project partner, integrated delivery mode, and lean delivery mode, making BIM the technical support and participation of advanced management mode. Management process. The process of matching BIM with advanced project management will definitely involve the contract and the legal system supporting the contract. The essence of the contract is the sharing of risks between the two parties to the transaction. The application of BIM technology adds convenience to the parties to the transaction while increasing many risks. How to allocate the identified risks in the contract, how to set up a process for dealing with unknown risks in the contract, and how the external market provides insurance and guarantee in the form of BIM use risk transfer. The system design is also in line with BIM and the legal field.

5. Conclusion

At present, a large amount of research is still based on the technical attributes of BIM. The reform of higher education in engineering management also focuses on the technical part of BIM. Without considering the cultural and integration process characteristics represented by BIM, and without considering the combination of BIM and the current engineering management teaching system, it is difficult to complete the improvement of the teaching plan of the engineering management major based on the progressive improvement of higher education. Based on the analysis of obstacles to the popularization of higher education engineering management majors in BIM education, this study builds a framework for the integration of BIM with the current engineering management professional technology, economics, management, and legal curriculum system. The teaching form and the final integrated training form are helpful for the cultivation of BIM talents in higher education engineering management.
References


