

# Research on the Construction of BIM Based Evaluation System for the Learning Effectiveness of Graduation Design of Engineering Management Specialty

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**Abstract:** With the continuous promotion of BIM technology in the construction industry, the lack of BIM talents has become the bottleneck for the development of BIM, which puts forward higher requirements for civil engineering, engineering management and other related majors in colleges and universities. It has become the general trend to integrate BIM technology into the curriculum reform and teaching reform. The graduation project is a link to test students' learning ability and practical ability in the last semester of university. Introducing BIM technology into the graduation project link can fully improve students' understanding and mastery of the whole process of engineering management, and effectively improve students' cross-specialty learning and practical ability. BIM learning effectiveness analysis is feedback to teachers' teaching results after students learn BIM, and teachers can know the shortcomings of BIM teaching through evaluation. BIM teaching of engineering management can formulate more accurate training scheme and teaching design through BIM learning effectiveness analysis and evaluation, and improve the quality of professional talent training. In this paper, using literature analysis, field investigation and comprehensive study methods of project management professional graduation design based on BIM learning evaluation system of in-depth research, based on the software operating ability, professional coordination ability and team cooperation ability and the ability of individual field four evaluation index system, based on the practice of evaluation index shows that The BIM based graduation design of engineering management major has achieved remarkable learning results. Under the background of actual cases, the requirements and specific tasks of BIM based graduation design of engineering management major are analyzed and studied, and the specific evaluation index system of BIM based graduation design of engineering management major is established for reference.

**Keywords:** Project Management, BIM, Graduation Design, Evaluation Index, Team

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## 1. Introduction

With the continuous development of digital technology in the construction industry, BIM (Building information Modeling) has become the trend of industry development, and has been continuously developed and applied in various fields such as engineering design, engineering construction, engineering cost, engineering bidding, engineering supervision, engineering operation and maintenance management, etc. The industry has a large demand for talents skilled in BIM. In this context, how to train engineering management talents skilled in BIM technology to meet the

needs of society has become a crucial issue for colleges and universities, and the effect of BIM learning evaluation is an important basis for education and teaching reform. This paper studies the BIM based evaluation system for the learning effectiveness of graduation project of engineering management specialty, and provides an effective evaluation mechanism for teachers of engineering management specialty, so as to further guide the BIM teaching reform of engineering management specialty [1].

At present, according to the research findings of domestic and foreign scholars: At present, many colleges and universities at home and abroad have integrated BIM

technology into the teaching process of engineering management specialty. On the one hand, BIM technology has been integrated into specific professional courses, and on the other hand, special BIM courses have been started to integrate BIM technology into the talent training system of engineering management specialty, Auburn University, for example, offers a BIM software course for construction students as part of its undergraduate curriculum, Worcester Polytechnic Institute (WPI) has applied BIM technology to professional teaching courses in civil engineering and environmental engineering [2, 3]. In China, Tongji University and Tsinghua University have opened professional courses responding to BIM technology. Meanwhile, they have cooperated with enterprises to jointly establish BIM comprehensive research center and integrate BIM into university education [4]. However, compared with developed countries, the application scope of BIM technology in China still has certain limitations. BIM concept not completely through to the college of architecture and engineering teaching process, only a handful of colleges and universities set up BIM course, will not fully BIM technology into the university four years of in the course teaching system, further development of BIM course teaching mode comparative convergence and strong practicality is the link of graduation design, The graduation project is an important link to test students' comprehensive practical ability [5]. It can evaluate students' mastery of professional knowledge and skills through the graduation project, and also adjust and improve the shortcomings in teaching according to students' feedback on the learning effect of the graduation project.

## 2. Research Status of BIM Teaching in Engineering Management

At home and abroad at present, many efficient began to blend in BIM project management professional teaching, the teaching reform of BIM, BIM in the engineering management professional curriculum integration and reform and improve the comprehensive application abilities for students majoring in engineering management,, compared with the developed countries, the application and development of BIM technology in China is limited, It has not been applied in the whole process of engineering management, but at present, most efficient and enterprises have recognized the concept of BIM as the development direction of the future construction industry. Therefore, many universities and enterprises in China are also constantly exploring BIM reform, and many universities have also set up BIM related professional courses. The setting of BIM courses is also constantly trying, some setting up a separate course, some integrating BIM technology into a course, some setting up separate practical training courses. Some integrate BIM into their graduation projects. In college teaching, graduation project is an important part of the whole professional teaching [6]. So far, but based on BIM to learning how to project management professional graduation design, need an effective feedback, based on this, this ask for engineering management major based on BIM study of

performance evaluation system of graduation design, hoping to evaluation system of examination for students majoring in engineering management based on BIM learning of graduation design, It is helpful for teachers to optimize teaching and further improve the quality of professional talent training [7].

## 3. Requirements and Tasks of BIM Based Project Management Graduation Design

### 3.1. Requirements for Graduation Design of Engineering MANAGEMENT Major

Taking Zhanjiang University of Science and Technology as an example, the graduation design of engineering management major is carried out in the way of cross-major graduation design, which has been implemented for three years. The specific requirement is that civil engineering and engineering management major can adopt cross-major joint graduation design. Two students through free combination, across different professional class of graduation design team, carry out joint graduation design, the student team participate in the graduation design process, to promote students to understand the industry design type, the whole process of building the professional division of labor between collaboration, consolidate our knowledge, cultivate the students' team cooperation ability. Most of the graduates are required to form a graduation design team. If a small number of graduates cannot join the graduation design team, they can choose a single design type. Graduation design team to single items of projects as a project as the background, architectural design, structural design, construction, water supply and drainage and electrical equipment design, design of BIM, project cost, project bidding, bidding, construction organization design, project supervision, etc. The overall design, the student team members from the architectural plan design to the whole process of graduation reply, tightly bound, and fully fuses in together, Ensure the consistency of design objectives, working procedures and evaluation system.

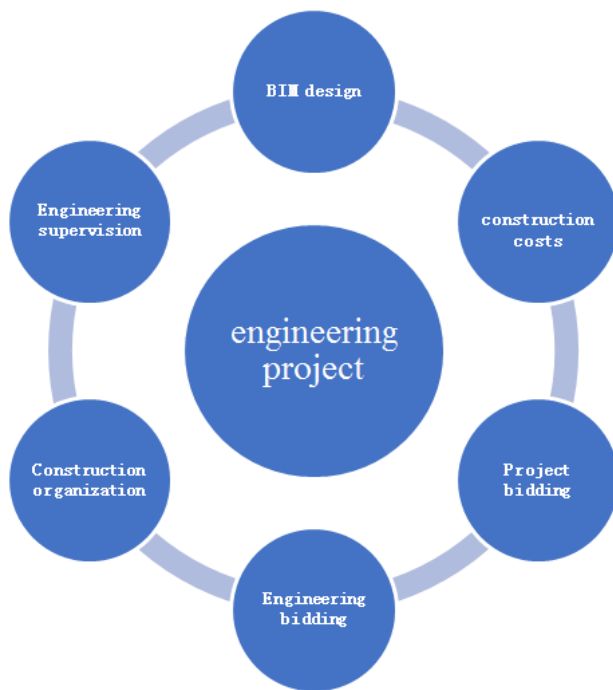
The graduation design team is classified into five types: newly built reinforced concrete construction engineering, newly built steel structure design, the existing full set of construction drawings, the existing civil engineering (architecture and structure) construction drawings, the existing construction drawings, and the corresponding instructor group for guidance. Graduation design is classified into the architectural design, structural design (base), steel structure design (including the base), the construction organization design, BIM design, the construction equipment design, decoration engineering design, project cost, project bidding documents preparation, project bidding documents preparation, project supervision, design, project feasibility study report, real estate marketing plan design, real estate appraisal and property Design. Civil engineering

and engineering management graduates to form a team, team and single topic selection and selection of tutors are conducted in the "School of Civil Engineering and Civil Engineering Graduation design Topic Selection system", graduation design team, single graduation design and tutor group are conducted according to the principle of two-way selection [8].

### 3.2. Graduation Design Task of Engineering Management Major

Taking a complete set of construction drawings as an example, the team members first determine the scope of the project (civil engineering, water supply and drainage, electrical, HVAC, decoration).

BIM design: integrated building, structure (including foundation and basement), HVAC, water and electricity, decoration and other design to conduct overall modeling and establish data, ensure the accuracy and sharing of data, and provide data and services for cost, bidding, bidding, construction, supervision and operation. Use Revit and Magi CAD as well as Glodon software to create engineering project models.



**Figure 1.** Task diagram of BIM based project management team graduation design.

Project cost: use BIM data to export the bill of quantities, check the bill of quantities, price the bill according to the quota, and form the cost file.

Bidding: according to the bill of quantities and cost documents of the cost, use BIM cost software to prepare the index control price and the tender.

Bidding: price according to the bill of quantities, determine the bidding price, and prepare the bidding documents (including commercial and technical parts). Using the Project

to prepare the schedule, establish three-dimensional construction site layout model, template scaffold model, and Project management virtualization case design of case engineering.

Construction organization: determine the construction layout plan, according to the bill of quantities and construction procedures (foundation, main body, masonry, doors and Windows, plastering, water and electricity, HVAC, decoration, final acceptance, etc.), prepare the construction progress plan (transverse map or network map) and complete the monthly investment, write the construction organization design. In this process, BIM5D is combined with pricing documents, schedule plan and site layout model to simulate site construction through BIM modeling.

Project supervision: according to the construction organization design (bill of quantities and construction process, construction schedule, monthly investment, etc.), the implementation of project quality, progress, investment supervision, preparation of project supervision plan.

Teamwork: (1) All members interpret all drawings collectively; (2) Project cost, bidding, bidding, construction organization, supervision to participate in BIM design, establish model and database; (3) Bidding, bidding, construction organization, supervision to participate in the project cost; (4) Participate in the preparation of bidding documents; (5) Construction organization and design to participate in the preparation of bidding documents; (6) The supervision participates in the construction organization design; (7) Team members review all design results and put forward suggestions and suggestions for modification.

## 4. Construction of Evaluation Index System Based on BIM Engineering management Graduation Design

### 4.1. Types of BIM Based Evaluation Indicators of Graduation Design of Engineering Management Major

In the evaluation index setting of graduation project of engineering management major, there are four kinds of indicators, which respectively reflect software operation ability, professional cooperation ability, team cooperation ability and personal practical operation ability. Among them, software operation ability can reflect the learning of basic software of engineering management major, and is also a necessary professional skill for the graduation project of BIM based engineering management major. Professional collaboration ability is the development direction of the graduation design of the engineering management major of basic BIM, and it is also the feature of this major. Different majors need the cooperation of people with different specialties [9]. Teamwork ability reflects the basic attributes of social people. After graduation, the graduates of this major must cooperate with the team to solve the problems and difficulties in engineering management and give full play to

the advantages of this major. Personal practical ability is the real demand of enterprises, through the training of graduation design, graduates of this major can directly integrate into the practice of specific projects of enterprises to engage in specific work of related professional direction. Different questions are set around these four indicators and questionnaires are conducted to better understand and evaluate students' mastery of the graduation design of engineering management major based on basic BIM and analyze the learning effect of the graduation design of engineering management major based on BIM [10].

#### 4.2. BIM Based Evaluation Index System of Graduation Design of Engineering Management Major

A second-level index system is set up for the three kinds of evaluation indexes of BIM based graduation design of engineering management major. Fourteen questions are used to evaluate the learning effect of graduation design of engineering management major, as shown in Table 1 below. This evaluation system has been applied and practiced, and a professional survey has been carried out on the graduates of engineering management major [11].

**Table 1.** Evaluation table of BIM based project management graduation design learning results.

Level indicators	The secondary indicators
Software operation ability	1. Proficient in Revit and MagiCAD 2. Proficient in GGJ, GCL, GQI, GBQ software 3. Proficient in using Project, GBQ, 3D field cloth GCB, formwork scaffold GMJ 4. Can skillfully use BIM5D
Professional synergy	1. Proficiency in professional courses 2. Good command of computer aided courses 3. Proficient in BIM modeling courses 4. Skilled in comprehensive application of various professional knowledge
Team work ability	1. Can present useful ideas in the team's graduation project 2. Can communicate with team members in a timely and effective manner 3. Can build long-term friendships with team members
Personal practical ability	1. Can participate in actual projects 2. Can master a specific professional direction of a specific project 3. Can participate in the practice of specific projects in the practice base

The survey results show that students who spend a lot of time learning software independently have higher quality graduation projects, accounting for more than 70%. Similarly, students who invest less time in software learning contribute less to the team's graduation projects, and contribute much less to the team and their own ability training. At the same time, 50% of the students showed that their professional coordination ability and personal practical operation ability have been greatly improved, and some students can directly participate in the cooperation units of our school practice teaching base for internship and participate in the actual project work. More than 70% of the students also expressed that their team cooperation ability has been greatly improved. The practice shows that the BIM-based interdisciplinary team graduation project has greatly improved the software operation ability, professional coordination ability, team cooperation ability and personal practical operation ability of the students majoring in engineering management.

## 5. Suggestions on Improving the Learning Effect of BIM Graduation Design

### 5.1. Establish a Reasonable and Efficient BIM Graduation Design Team

To improve the effect of engineering management graduates of graduation design, each team member to basic good professional accomplishment, for the purposes of this

professional master professional knowledge must be perfect, at the same time to team in a reasonable, effective scientific division of tasks, avoid because of a module task is not complete, affect the graduation design of the whole progress, In the process of graduation project construction, each team member will be assigned a graduation project team advisor in addition to a graduation project advisor for their own direction, who is also a member of the graduation project team. In the process of graduation project construction, the tutor of the team's graduation design team should also participate in the guidance of the whole team, and give guidance to the whole team's graduation design as a whole, so as to improve the efficiency and quality of the team's graduation design [12].

### 5.2. Further Deepen BIM Teaching Reform

The application of digital technology in the construction industry is more and more widely, the development of BIM technology is the trend of The Times, to meet the need of the era of talent cultivation, teaching reform is necessary, plus various colleges and universities to keep up with the development of digital technology, to further strengthen BIM teaching reform, training more accord with BIM teaching faculty, further strengthen the laboratory construction at the same time, Improve and strengthen the construction of BIM application and practice teaching environment [13]. At the same time, how to integrate BIM into the four-year teaching of engineering management major should be constantly reformed and tried, and the reform of engineering management teaching system integrating BIM technology

should be carried out. At the same time, it establishes a teaching base integrating industry, teaching and research with enterprises, and sets up advanced teaching teams to cooperate with high-tech enterprises in teaching, scientific research and practice, so as to improve students' practical ability and teachers' BIM practical ability. Students' graduation projects are directly used in practical cases of enterprises, so as to further improve students' learning effectiveness and enhance the learning effectiveness of BIM-based graduation projects [14].

### 5.3. Establish a Scientific and Reasonable Teaching Evaluation System

BIM in the process of curriculum reform in BIM teaching into the teaching assessment, can promote the development of BIM integration teaching, specify the relevant to the specific requirements of the BIM course, case teaching method, and revised the relevant training scheme, teaching outline, etc., effectively improve various BIM teaching management files, can give BIM teaching reform more guidance and support, This can further promote the scientific standardization of the graduation design of engineering management major of basic BIM [15].

## 6. Conclusion

In this paper, the basic project management professional graduation design of the learning result of BIM set up a corresponding evaluation index system, through the establishment of the evaluation index system, hope to be able to better evaluate engineering management specialty's graduation design based on BIM learning, further evaluation of project management professional graduation design based on BIM study effect, It provides a certain reference for BIM teaching of engineering management specialty and a new mode for the organization method of graduation design of engineering management specialty. At the same time, the practical effect of the evaluation system is analyzed, and it is found that the graduation design of the BIM based cross-professional team of the evaluation system has greatly improved the software operation ability, professional coordination ability, team cooperation ability and personal practical operation ability of the engineering management major students, but there are also some problems. Such as graduation design schedule due to the delay of some team members may affect the whole team, such as BIM into project management professional course teaching is still not perfect, under the background of this paper to provide a case based on BIM to the specific requirements of the project management professional graduation design and evaluation, for the same type colleges and universities of engineering management major has a certain reference for the graduation design.

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