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Construction of Practice Teaching Mode of "One Core, Two Wings, Two Wheel Drive": A Case Study of Construction Management Major

Xiaohan Zhou[1,a], Minyun Chen[2,b], Qin Li[1,c]

[1]Department of Engineering Management, Shanghai Sanda University, Shanghai, China
[2]School of Engineering, Shanghai Sanda University, Shanghai, China
[a]bailan6589@163.com, [b]757361299@qq.com, [c]liqin2017@my.swjtu.edu.cn

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Abstract: In China, engineering management is a cross-discipline combining civil engineering and management, serving two major industries: construction and real estate. In order to meet the requirements of the industry on the practical ability of engineering management talents, it is crucial for universities to explore the reform of practice teaching. At present, the teaching of undergraduate education is generally characterized by low proportion of practice, obsolete content, single method, insufficient innovation, less cross-border integration and other problems. This paper takes the engineering management major of Shanghai Sanda College for example, and builds a practical teaching system with the core of practical training courses, discipline competition and "double creation" training as two wings; with the teaching reform of universities, and the integration of industry and education of enterprises as the driving force (referred to as "one nucleus, two wings and two-wheel drive"), which can provide a good solution for the cultivation of practical ability of engineering management talents in universities.

1. Introduction

The construction industry and real estate industry are the two pillar industries of China's national economy and play an important role in national construction. As China turns to the stage of high-quality development, the construction industry and real estate industry are all transforming and upgrading towards digitalization, industrialization and greening, which inevitably puts forward new requirements for the quality, knowledge and ability of engineering management professionals. These requirements not only include traditional engineering technology and project management knowledge, but also involves the prefabricated assembly building, green building, BIM and other emerging building technologies of the composite professional knowledge, in addition to good engineering social awareness, professional ethics, hard-working and other quality qualities. What's more, it also needs to have strong professional practice ability and job adaptability. However, according to the feedback of the employer survey, the current situation that engineering management graduates are not strong in technical ability, lack of practical operation experience and

weak project management ability in practical work is still common[1] (Lv Zhong and YUAN Jing 2022), and it takes a long time to adapt to the actual work when they go to the enterprise. Therefore, it is imperative for colleges and universities to explore practical teaching reform and improve the application of students' professional knowledge and practical hands-on ability, and it is also an objective need to achieve industrial transformation and high-quality development of the social economy.

2. Analysis of the current situation of practical teaching

According to statistics, in 2020, China has 454 colleges and universities with undergraduate engineering management majors, with an enrollment of 27,500 students, 133,500 students, and an average annual number of graduates of 39,800 over the past five years, which is the second largest major after civil engineering in the undergraduate major system of civil engineering and construction[2](WANG Yao-wu et al 2021).It can be seen that the training of engineering management professionals in colleges and universities has an important impact on the transformation and upgrading of the construction and real estate industries. In order to explore the practical teaching reform of the engineering management major, the paper conducted interviews and questionnaire surveys among the school-enterprise cooperation units (6 construction enterprises and 4 real estate development enterprises) of the university, the previous engineering management graduates of the university (107 questionnaires were effectively collected), and the directors or senior teachers of the engineering management major of brother universities (6 persons). At the same time, it also combed the relevant literature. It is found that the following problems generally exist in the practice teaching of engineering management major in colleges and universities:

2.1 Low proportion of practical teaching, disconnection between theory and practice

Most of the colleges and universities that set up engineering management major in China are research universities, and there are also some application-oriented colleges and universities. The phenomenon of "emphasizing theory and neglecting practice" still exists widely[2] (WANG Yao-wu et al 2021).Their practice teaching in the entire curriculum teaching system accounted for a low proportion, according to China's national standards for teaching quality of undergraduate specialties in ordinary colleges and universities, engineering management professional practice and innovation and entrepreneurship courses accounted for a minimum of 20% of the total credits. Many colleges and universities do not pay enough attention to, and do not invest enough in, practical teaching, laboratory and internship base construction, showing the phenomenon of disconnection between theory and practice.

2.2 The form of teaching content is outdated, and the method is single

In recent years, BIM, 5G, industrial Internet, artificial intelligence, cloud computing, blockchain, Internet of Things, big data and other new technologies are developing rapidly, and the traditional construction model is bound to merge with the cutting-edge digital technology to form a brand new construction model and management approach[3](YU Tao and SHEN Jin 2022).However, most of the teaching content of engineering management majors in colleges and universities is relatively outdated, and the content of teaching materials is lagging behind and in a traditional form. There are few practical courses integrated with new building technologies, insufficient investment in the construction of digital virtual practice teaching scenes, insufficient introduction of application software of new technologies such as digitization, industrialization and greening of buildings, and lack of corresponding practical guidance textbooks. In addition, the practical teaching method is

relatively single, most of them take case teaching, still lecture-based, and the case material is old and detached from reality, which makes the students' professional practice ability is not effectively cultivated, and after graduation, they will inevitably talk on paper when facing complex engineering problems after graduation, and their practical hands-on ability is generally weak.

2.3 Insufficient innovation, and little cross-border integration

Solving complex engineering management problems requires solid specialized knowledge of multidisciplinary integration, strong engineering practice and good innovative thinking. At present, most of the engineering management majors in China's colleges and universities have opened practical training courses, and professional internships, graduation theses and other comprehensive practice links, in order to cultivate students' engineering practice ability. The practical teaching mode is more traditional, single and lacks innovation. In terms of teaching, the "double-qualified and dual-capable" teachers of engineering management major are poorly equipped, and most teachers' knowledge is characterized by "specialization, precision and sharpness", which limits the interdisciplinary integrated teaching and the innovation of teaching content and form. In addition, the cultivation of practical ability is inseparable from the integration of production and education. However, the lack of substantive and deep cooperation between schools and enterprises is a common phenomenon, which undoubtedly reduces the soil for practical teaching innovation and the opportunity for cross-border integration, making the innovation training and practical ability training of engineering management students inadequate.

3. "One core, two wings, double-wheel drive" practical teaching mode construction

3.1 Model design

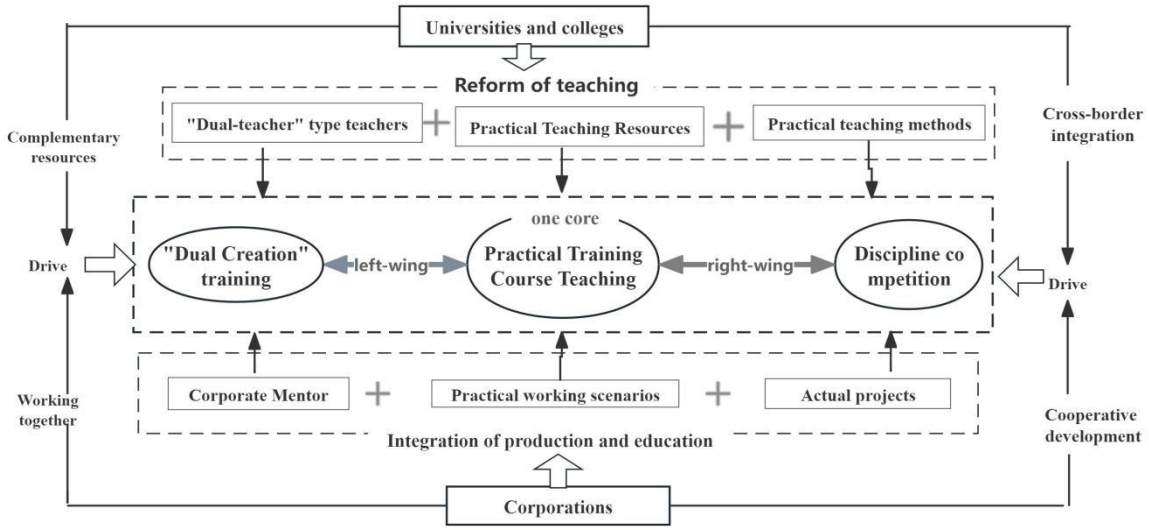

Figure 1 "One core, two wings, two-wheel drive" practice teaching model

Based on the current situation of engineering management professional practice teaching in colleges and universities, this paper focuses on the central goal of "improving students' practical ability and innovative thinking", combines the experience of engineering management professional practice teaching reform in Shanghai Sanda University, and puts forward the "one-core, two-wing, two-wheel drive" practice teaching model. as shown in Figure 1.The model takes the teaching of

practical training courses (including a series of professional practical training courses and comprehensive practical courses such as cognitive internship, production internship, graduation internship, graduation thesis, etc.) as the core, innovation and entrepreneurship training and professional disciplinary competitions as the two wings, which form the main battlefield for the cultivation of students' practical ability and innovative thinking. At the same time, driven by the three-dimensional teaching reform of "teachers, teaching resources and teaching methods" in the school and the multi-faceted industry-teaching integration of "enterprise mentors, actual work scenes and actual projects" in the enterprises, which supports the integration and mutual promotion of the teaching of practical training courses, "dual innovation" training and disciplinary competitions, so as to enhance the students' practical ability and innovative thinking.

3.2 Implementation Path

3.2.1 Optimization of the Practical Training Curriculum System

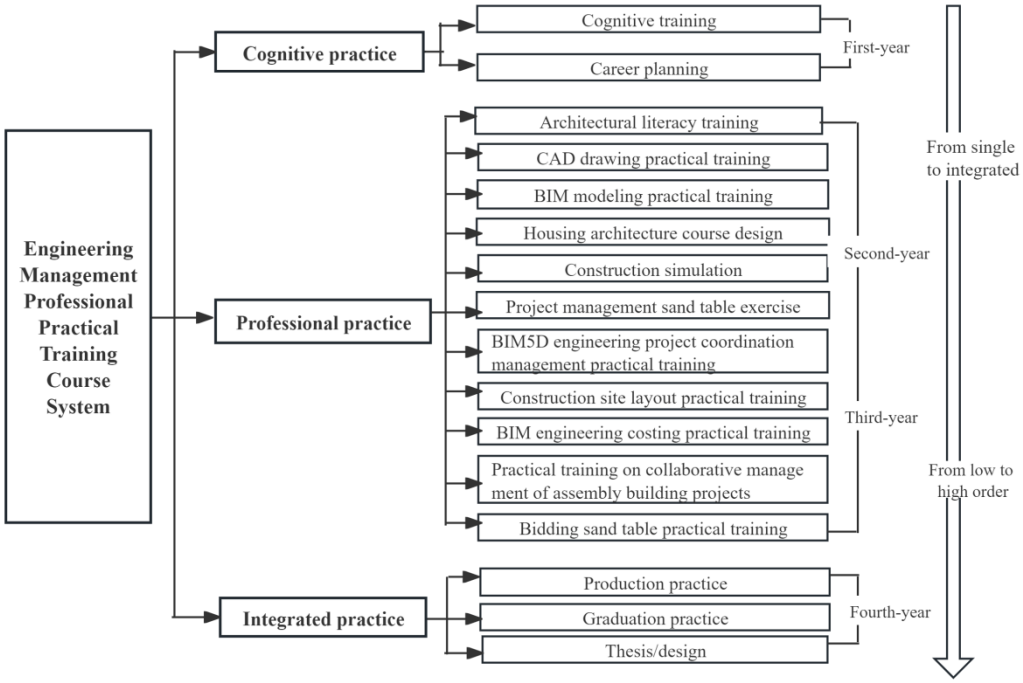

Figure 2 Practical training course system of engineering management majors

Curriculum is the core carrier of talent cultivation, therefore, optimizing the practical training course system is the core path for engineering management majors to implement the "one-core, two-wing, two-wheel-driven" practical teaching mode. As shown in Figure 2, the whole practical training course system is divided into three modules: cognitive practice, professional practice and comprehensive practice. According to the logic of single to comprehensive and low to high order, cognitive practice is carried out in the freshman year, professional practice is carried out during the sophomore to junior year, and comprehensive practice is carried out in the senior year. Cognitive practice mainly cultivates students' cognition of majors and industries as well as their vocational abilities, laying a foundation for subsequent professional studies. Sophomore and junior years are the stage for students to learn professional knowledge systematically, and professional theory courses and professional practical training courses are offered synchronously in order to strengthen the interaction between theory and practice. Since the cultivation objectives of our engineering

management program focus on the three core professional abilities, namely, "construction technology and project management ability", "project cost and cost control ability" and "bidding and contract management ability", the professional practical training courses are mainly set around the above three core professional abilities. At the same time, they are integrated with the use of digital technology, including basic professional knowledge training (architect drawing training, CAD drawing training, BIM modeling training...), Construction technology and project management knowledge training (construction simulation, BIM5D project collaborative management training, project management sand table...) , BIM project costing practical training, bidding sand table practical training and so on. Finally, through industrial internship, graduation internship and graduation thesis (design) the professional knowledge will be comprehensively applied to actual engineering projects to solve practical problems in order to cultivate comprehensive practical ability.

3.2.2 Building a "dual-teacher" teaching force

Teachers are the key factors to determine the quality of the curriculum, so building a "double teacher" type of teachers is the key path to improve the effect of practical teaching[5]. The "dual-teacher" teaching force can be composed of on-campus teachers and enterprise mentors. On the one hand, the measures of "introduction and education" are taken simultaneously. Strengthen the introduction of teachers with industry experience, at the same time, strengthen the cultivation of school teachers, support teachers to practice in enterprises, or participate in the industry's cutting-edge technology training. On the other hand, we adopt the measures of school-enterprise cooperation, and employ enterprise tutors to participate in the guidance of practical training courses, industrial internships, graduation internships, graduation thesis (design), disciplinary competitions, and "double creation" project training, etc. and take up the teaching contents of their respective advantages from different perspectives in practical teaching, so that the advantages of teachers on campus and tutors of the enterprises are fully complemented ,and the resources complemented so as to improve the quality of teaching.

3.2.3 Building practice teaching environment and resources

The environment and teaching resources of practice teaching are the important support for the cultivation of students' practical ability. The construction of practical teaching environment and resources mainly includes two aspects: first, the construction of digital engineering management experimental training center to create a digital virtual practice teaching scene. As shown in Figure 3.There are six special laboratories, namely, architectural literacy, drafting, modeling, construction site layout, BIM project collaborative management, BIM project cost management, digital bidding management, drone mapping and engineering surveying, etc., so that students can master the use of professional knowledge in practical operation and be familiar with the digital software of various engineering management, so as to enhance the application ability of digital construction technology and engineering. Second, optimizing practical teaching resources. This includes the development of a series of new-format digital professional course materials, practical training guides, practical training project materials, course videos and websites, as well as the adoption of online and offline blended classroom, flipped classroom and other teaching methods, with the help of “rain classroom”, “cloud classroom”, “wisdom tree” and other digital intelligence teaching tools, empowering the improvement of the quality and effect of practical teaching, while promoting the cultivation of students' digital thinking and digital literacy.

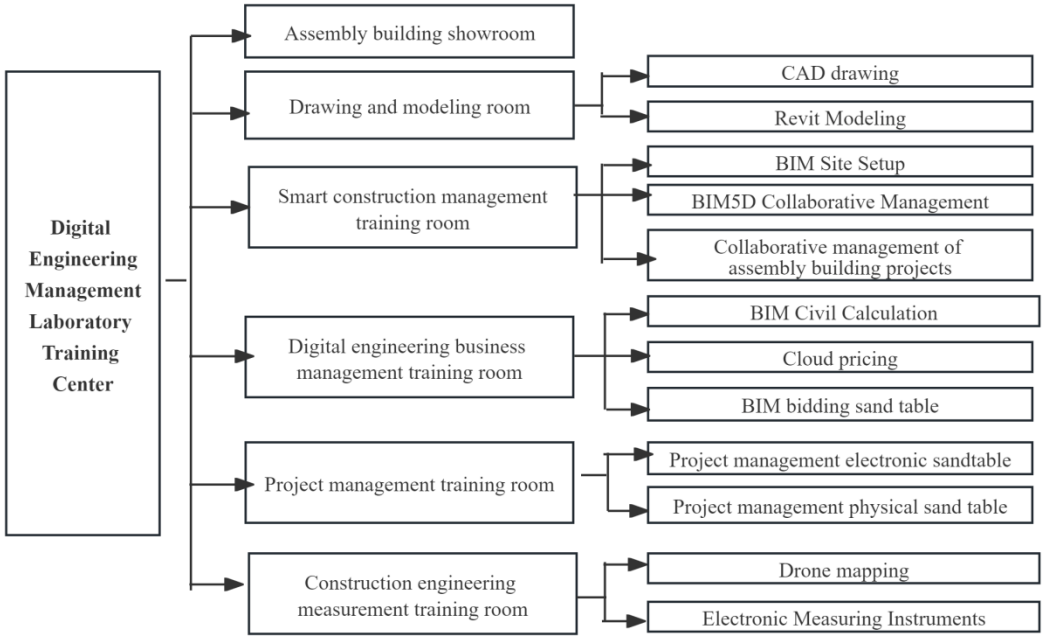

Figure 3 Digital engineering management experimental training room and practical project system

3.2.4 Innovate Practical Teaching Methods for the Integration of "Competition, Creation and Teaching"

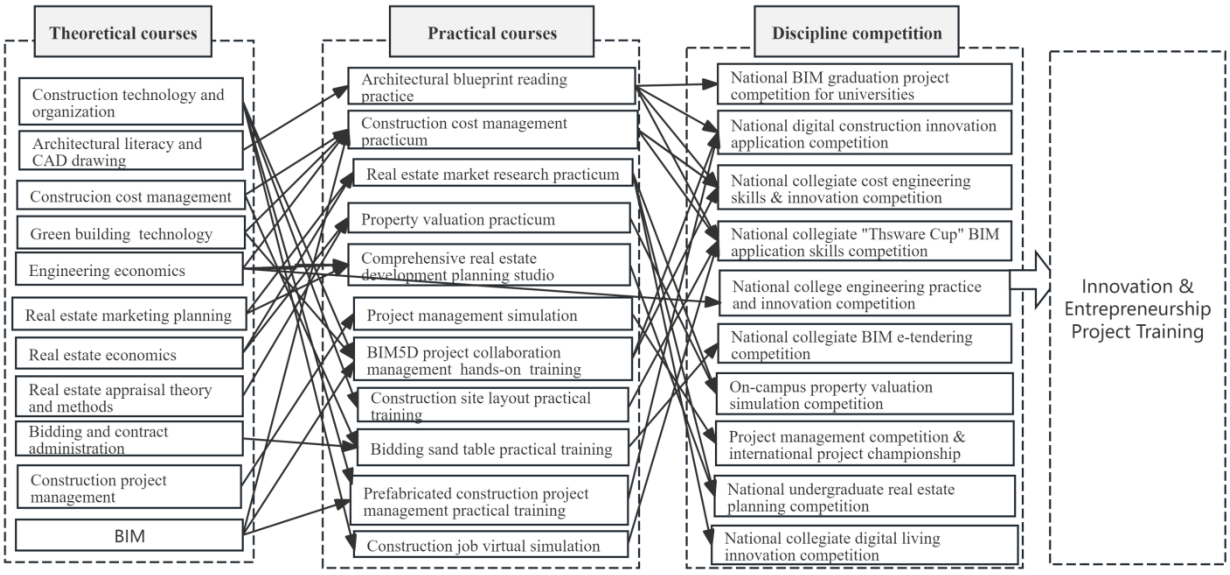

Figure 4 Corresponding integration relationship between professional curriculum, discipline competition and innovation & entrepreneurship training

The practical teaching method of "competition, creation and teaching" integrating is an important part of the "one core, two wings" model. As the tasks of professional discipline competitions are clear, the questions are based on the actual problems of the industry and updated year by year, and the practical application of professional knowledge is highly demanded, it is conducive to

stimulating students' independent learning, promoting the cultivation of students' creativity, hands-on ability, and teamwork, and it is very suitable for integrating into the teaching of professional practice. According to the different professional knowledge involved in each science competition, the discipline competition is introduced into the corresponding theoretical courses and practical courses, as shown in Figure 4.The person in charge of the corresponding course is both the lecturer and the instructor of the subject competition, and carries out the "four-in-one" practical teaching method of integration of teaching and competition resources, integration of teaching and competition process, integration of teaching and competition evaluation[4], and integration of teaching and competition ability and forms a form of teaching organization in which the in-class teaching is linked with the second classroom outside the classroom, the students' clubs, and the learning interest groups.

3.2.5 Deepening the mechanism of "school and enterprise" linkage for the integration of industry and education

Deepening the mechanism of "school-enterprise" linkage between industry and education integration is a powerful guarantee for cultivating students' practical ability. Colleges and universities as the supply side of talent, enterprises as the demand side of talent, the two sides to strengthen the docking, can avoid the mismatch of talent supply and demand. Especially in the cultivation of students' practical ability, enterprises can formulate the practical course system in collaboration with universities according to the requirements of actual positions, and front-line engineers of enterprises can participate in part-time lectures of practical links, the guidance of disciplinary competitions and "double creation" training, and collaborate with teachers on campus in the cultivation of human beings. In addition, vocational qualification training, production internships and graduation internships can be carried out between schools and enterprises, which can effectively improve students' practical hands-on ability and vocational ability through the actual working environment, and participation in actual projects, which is conducive to the talent strategy of enterprises.

3.3 Optimization of Practical Teaching Assessment Methodologies

Scientific and reasonable course assessment methods can motivate and constrain students' learning behavior, which is a guarantee mechanism for teaching activities to be carried out smoothly and achieve the desired effect[6]. Transforming the traditional exam-oriented assessment approach into a diversified, process-based evaluation system. Specifically, the evaluation of students' learning consists of formative evaluation, which examines the learning process, and summative evaluation, which examines learning outcomes, accounting for 60% and 40% respectively. Formative evaluation sets up diversified investigation points, such as students' learning motivation, course participation, discussion of problems, project practical program development, research program, research analysis report, research and innovation strategy report, etc. Final evaluation is no longer limited to exams, but can take a variety of forms and flexible and complementary assessment methods, such as the project and project completion report of the "dual innovation" project, awards of disciplinary competitions, models, small programs and other works of the design of the practical project, the project research report, publication of a small thesis, application for patent, etc., so as to fully reflect the students' creativity and diversity of practical results and promote the enhancement of the effectiveness of practical teaching.

4. Continuous improvement of the "one core, two wings, two-wheel drive" practical teaching model

The formation of teaching quality is a gradual and dynamic process. Therefore, the PDCA cycle can be used for reference to the "one core, two wings, two wheels drive" practice teaching mode for quality management. That is, on the basis of the planning (P) and doing (D) of the practical teaching mode mentioned above, we can further do a good job in the follow-up check (C) and act (A). The main measures are: 1) Collect feedback from students, teachers, enterprises and the community, and constantly adjust the teaching content and methods. 2) Track the development of graduates and evaluate the impact of the practical teaching mode on students' career development; 3) Update the course content and practical activities according to the development trend of the industry and technological changes, so as to maintain the foresight and adaptability of the teaching content. In this way, the quality and effect of the practice mode of "one core, two wings, two-wheel drive" on the cultivation of students' practical ability will be continuously improved.

5. Conclusion

Practice teaching is an important part of professional education and teaching system, which is crucial to cultivate students' practical ability, innovation ability and comprehensive quality improvement. Taking engineering management as an example, the article investigates and analyzes the status quo and problems of practice teaching of engineering management majors in colleges and universities in China, and combines with the practice of Shanghai Sanda College, puts forward the practice teaching model with practical training course teaching as the core, disciplinary competitions and "double creation" training as the two wings, and the teaching reform of universities, and industry-teaching fusion of enterprises as the driving force (referred to as "one core, two wings, two-wheel drive").The paper further expounds the main ways of cultivating students' practical ability and innovative thinking under this mode, in order to provide reference for universities to improve practical teaching effect, and help the transformation and development of China's construction and real estate industry.

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