



Innovation and Practice of Assembly Building Professional Construction Based on IDT Practical System

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Abstract. This paper provides a comprehensive examination of the innovative strategy pertaining to assembled building professional construction, grounded in the practical application of the IDT system. It critically evaluates the limitations inherent in traditional professional construction methodologies and elaborates on the specific applications and substantial impacts of the IDT combat system in innovating talent training models and optimizing training mechanisms. Furthermore, the paper illustrates the significant role of this system in enhancing students' practical skills and professionalism, supported by relevant examples and data. The findings aim to offer novel insights and practical examples for the advancement of the assembly construction profession, thereby contributing to the enhancement of talent training quality within the industry.

Keywords: Assembly building; IDT practical system; professional construction; talent training

1 Introduction

With the construction industry rapidly industrializing, assembly building has become a crucial part of modern construction development. It has transformed production and construction methods. Assembly building's advantages, such as higher efficiency, environmental friendliness, and better quality control, have increased the demand for skilled professionals. However, traditional assembly building professional training methods face many challenges. They can't meet the urgent need for applied and interdisciplinary talent. To solve this, the IDT Practical Exercise System for Assembly Engineering (IDT Practical Exercise System) was developed. Its highly simulated environment and various functional modules provide a new way of professional training in assembly construction. This system promotes professional development and improves talent cultivation quality.

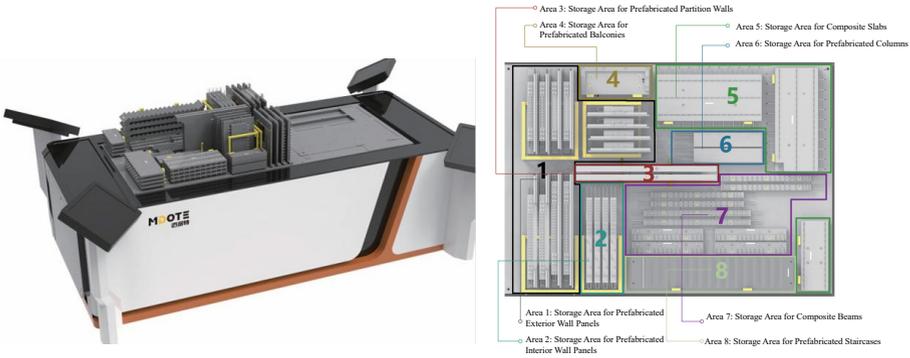


Fig. 1. Composition of the IDT System.

The IDT Practical Exercise System (Figure 1) uses digital twin technology to cover the whole engineering lifecycle. It's an innovative educational tool for enhancing students' practical skills and professional abilities. This paper will analyze the challenges of traditional training methods and explain the IDT system's innovative practices and achievements in talent training model innovation and training mechanism optimization^[1].

2 The Dilemma of Building a Traditional Assembly Building Program

The conventional training of professionals in assembly building faces numerous challenges, particularly evident in the inadequacies of practical instruction, the misalignment between the curriculum framework and industry requirements, and the rigidity of the talent development mechanisms. These issues significantly hinder the quality of education for assembly building professionals and necessitate urgent resolution through the implementation of innovative educational models and the optimization of the teaching system.

2.1 Weaknesses in Practical Teaching and a Single Form of Instruction

Traditional practical teaching in assembly building suffers from insufficient time, limited resources, and a dearth of teaching diversity. Many higher education institutions confine practical training to basic model observation or on-campus laboratory simulations. As a result, students rarely engage in component production, transportation, assembly, and construction management within real-world or highly simulated engineering scenarios. For instance, prefabricated component production and installation are vital in assembly construction. However, high equipment costs and space limitations prevent universities from offering comprehensive practical training. Consequently, students' understanding of real-world projects remains predominantly theoretical. Furthermore, the practical teaching content in some universities does not

align with industry requirements. When teaching prefabricated component production, students primarily rely on textbooks or lectures. They lack hands - on experience operating complex machinery and participating in component quality testing and optimization. This approach hinders students from grasping real - world engineering practices and accumulating practical experience.

2.2 Disconnect Between the Curriculum and the Needs of the Industry

The assembly building industry is advancing rapidly in technology, yet university curriculum systems commonly lag. Building Information Modeling (BIM), a core technology in design, construction, and management, has not been systematically integrated into many universities' core curricula, making it hard for graduates to adapt to workplaces needing new - tech proficiency^[2]. Moreover, course content is often overly theoretical with insufficient practical focus; advanced techniques like new grouting and connection node methods for prefabricated components, widely used in real - world projects, are not timely incorporated, leading to a large gap between students' academic knowledge and industry - required practical skills^[3].

2.3 Lack of Flexibility in Talent Development Mechanisms

The existing personnel training mechanism for assembly building professionals often adheres to a unified teaching plan. It fails to flexibly adapt to individual student variances and industry changes. For instance, teaching programs remain static for extended periods, making it challenging to promptly update curriculum content and teaching methods in response to industry technological innovations and market demands.

Moreover, numerous colleges and universities lack profound enterprise - university cooperation in talent cultivation. As a result, students have limited exposure to real - world engineering projects during their studies. This leads to a prolonged post - graduation adaptation period before they can proficiently perform their jobs. For example, some enterprises report that newly hired employees are deficient in BIM technology application and assembly building construction management, failing to meet the enterprises' requirements for high - quality technical talents.

3 Innovation of Talent Training Mode Driven by IDT Practical System

With the increasing demand for high-quality composite talents in the assembly construction industry, the traditional talent training mode has been difficult to meet the requirements of the industry development. IDT (Immersive Digital Training) system subverts the traditional teaching mode by integrating the technologies of virtual reality (VR), augmented reality (AR), and artificial intelligence (AI), from the aspects of teaching mode, practical operation, talent ability cultivation, and teaching management. IDT (Immersive Digital Training) system subverts traditional teaching in terms

of teaching method, practical operation, talent ability cultivation and teaching management, and drives the innovation of talent cultivation mode^[4] :

3.1 Immersive Teaching Experience Revolutionizes Traditional Theoretical Indoctrination

Traditional teaching methods place excessive emphasis on theory, leaving students with limited practical experience. The Integrated Design and Technology (IDT) combat system creates an immersive learning environment for assembly construction projects. It does so by establishing practical training platforms and sand trays that cover the entire process from component production to construction installation. This makes learning more dynamic and intuitive, transforming the dullness of traditional theoretical teaching and boosting student engagement.

As shown in Figure 2, the combination of virtual and physical elements, with the help of tangible component models, enables students to interact with and understand component shapes, sizes, and connection structures. Through virtual scene simulations, students can then visualize component installation positions and overall layouts in real - world settings. This integration of theory and practice effectively improves students' practical skills and spatial reasoning. Moreover, the system provides real - time operational outcome feedback, which overcomes the shortcomings of traditional teaching's practical aspects.



Fig. 2. Identification of Component and Support Installation Positions.

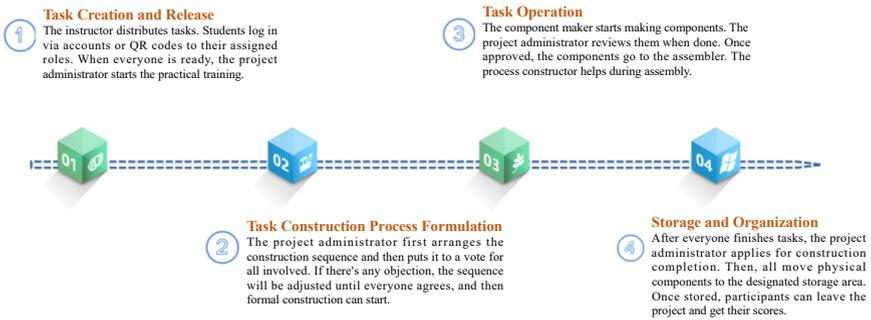


Fig. 3. Instructions for the Training Process.

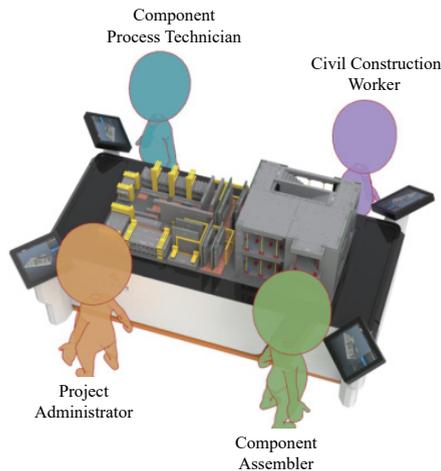


Fig. 4. Illustration of Training Post Distribution.

3.2 Omni-directional Job Training Transcends the Limitations of Traditional Single-skill Development

Conventional educational approaches often concentrate on specific facets of knowledge transfer; in contrast, the Integrated Development Training (IDT) combat system encompasses the practical training processes for various roles (Figure 3), including component craftsmen, component assemblers, civil construction workers, project administrators, and others (Figure 4). Through the operational tasks associated with these diverse positions, students are afforded the opportunity to acquire a comprehensive understanding of project management, component production, installation, quality inspection, and other essential skills pertinent to the entire assembly building construction process. This approach effectively addresses the issue of narrow skill sets typically associated with traditional educational methods, thereby fostering the development of versatile professionals who meet the demands of real-world projects.

3.3 Real-time Interactive Collaboration to Enhance Teamwork and Problem Solving Ability

In the training process, the project manager and other positions need to work closely with each other, such as the project manager to prepare plans to be reviewed by other personnel, after the production of components need to be audited and assembled and other links. This real-time interactive collaboration mechanism breaks the traditional teaching of the situation in which students work individually, so that students learn to communicate in a team, joint problem solving, and better adapted to the needs of teamwork in the actual work. This real-time interactive teaching method not only cultivates students' teamwork ability, but also improves their resilience and communication ability under pressure, laying a solid foundation for their future career development.

3.4 Intelligent Components and System Feedback to Optimize the Learning Process

The intelligent prefabricated components in the system can display their own status, such as charging, networking, and whether the installation is in place, etc., by means of lights and other means. At the same time, the system will have corresponding feedback on the operation of the students, such as task review does not pass the need to readjust. This is different from the lack of timely feedback in traditional teaching, and students can adjust their learning and operation strategies according to these feedbacks in time to improve their learning efficiency and accurately enhance their abilities.

3.5 Standardized Process and Strict Assessment to Ensure the Quality of Talents

IDT combat system in accordance with the actual construction process and standards of assembly building project design training tasks, from raw materials inspection to component installation, grouting, steel bar binding and other links have clear operational specifications and quality requirements. And the quantitative assessment of students' practical training achievements through performance evaluation ensures that the cultivated talents have solid professional skills and rigorous work attitude, changing the situation of relatively single and insufficiently clear standards of traditional teaching assessment.

3.6 Interdisciplinary Collaboration Ability Cultivation

In the IDT Practical System, students can simulate cross - professional collaborative work. Project managers, for example, formulate detailed construction plans, allocate resources, and manage timelines for component production and assembly, while coordinating with civil construction workers on on - site foundation work and communicating with component technicians to guarantee timely and high - quality component delivery. During construction, close cooperation occurs among different posi-

tions: component assemblers and civil construction workers jointly handle column footings when installing prefabricated columns to ensure proper foundation connection, and civil construction workers coordinate with component assemblers for prefabricated component protection and reinforcement management during floor concrete pouring to avoid component damage. This inter - professional collaboration allows students to master their own skills, understand the work and collaboration requirements of other professions, cultivate teamwork spirit and comprehensive project management capabilities, and better prepare for complex future work scenarios.

4 Optimization of Training Mechanism Based on IDT Practice System

With the increasing demand for high-quality composite talents in the assembly construction industry, the traditional talent training mechanism has been difficult to meet the requirements of industry development. The optimization of training mechanism based on IDT (Immersive Digital Training) practical system aims to comprehensively improve the quality and efficiency of talent training through technology-driven and mechanism innovation.

4.1 Personalized Teaching Plan Customization

The IDT Hands - on System precisely records students' operation data such as operation time, error types and frequencies, and task - completion quality. Teachers can deeply analyze this data to accurately evaluate each student's learning progress and ability level. Accordingly, it caters to students with different capabilities: for those with weak fundamentals, it automatically offers basic knowledge explanations and simple practice tasks like video tutorials and simulation scenarios for rebar - tying in component production; for students with stronger learning abilities, it presents more challenging project tasks such as simulating complex - structure assembly building construction or optimizing component production, like designing a new prefabricated component connection node and validating it via system simulations. Based on students' diverse needs and progress, teachers formulate individualized teaching plans, thus ensuring each student's full development and enhancing teaching relevance and effectiveness.

4.2 Strengthening the Joint Training Mechanism of School-enterprise Cooperation

The training mechanism based on IDT system emphasizes school-enterprise cooperation, and promotes the deep integration of schools and enterprises in talent training through the construction of enterprise practice bases and joint laboratories. For example, students can use the IDT system to complete the simulation operation of real projects in the enterprise practice bases, and the enterprise instructors and school teachers jointly guide the learning process of students. This joint training mechanism

not only enhances the practical ability of students, but also strengthens their understanding and adaptability to industry needs^[5].

In addition, school-enterprise cooperation also provides students with more employment opportunities and career development paths. For example, enterprises can directly select talents that meet the job requirements through the student performance data in the IDT system, thus realizing a seamless connection between talent cultivation and industry needs.

4.3 Multi-dimensional Accurate Teaching Assessment and Interactive Learning Feedback

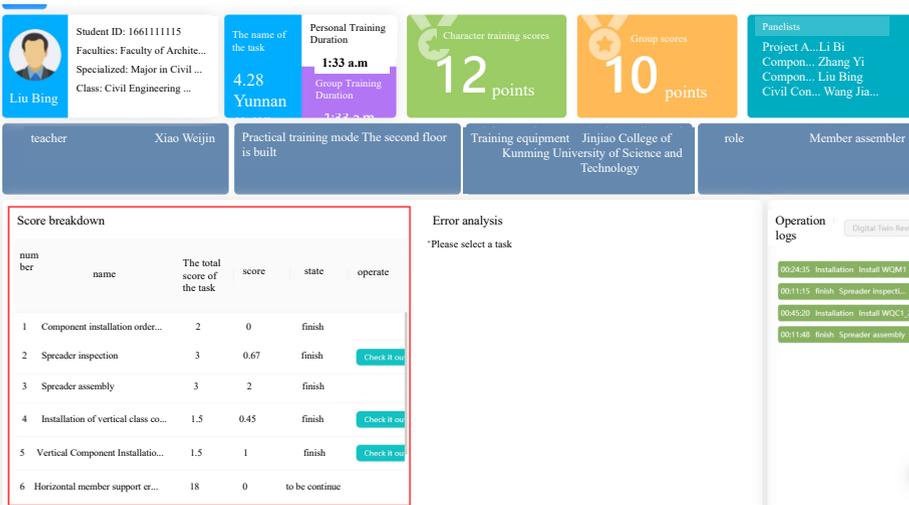


Fig. 5. System's performance evaluation feature.

The performance query function of the IDT assembly exercise system (Figure 5) offers substantial benefits for teaching reform: In teaching evaluation, it provides a comprehensive and detailed breakdown of task scores. This enables teachers to accurately assess students' mastery of assembly - building knowledge and skills, replacing the previous imprecise assessment mode with a more scientific and comprehensive one; For students, the clear display of results helps them visualize their task performance, identify strengths and weaknesses, and thus promotes targeted self - improvement and the cultivation of independent learning ability. The system - recorded operation logs and task completion statuses also serve as a basis for students to reflect on their learning processes and refine their learning methods; From the teaching - management perspective, teachers can easily monitor students' learning progress through the system, identify common teaching issues, and promptly adjust teaching strategies. The system's ability to separately analyze group and individual performance facilitates diverse teaching activities, such as group - based collaborative learning assessment, thereby promoting teaching - organization innovation.

Furthermore, the data accumulated by the results - query system can be utilized for teaching research. By analyzing students' learning patterns and difficulties, it offers strong support for optimizing course design and practical training content, continuously driving the in - depth development of teaching reform.

5 Conclusion

The application of the IDT (Immersive Digital Training) practical system in prefabricated building program construction has effectively addressed multiple challenges in traditional education. Through talent cultivation model innovation and training mechanism optimization, it has significantly enhanced students' practical and professional skills. Innovation in program construction is continuous. To further refine the educational framework, it is crucial to continuously explore the IDT practical system's potential according to industry development needs. This will ensure the cultivation of more high - quality, application - oriented talents for the prefabricated building industry, promoting its sustainable growth. Future research should concentrate on integrating the IDT practical system with emerging technologies such as artificial intelligence and virtual reality to expand teaching scenarios and functions. Long - term tracking and evaluation of teaching effectiveness should be conducted to optimize teaching methods and content. Strengthened enterprise - university cooperation, based on real projects and industry demands, will enrich the system's teaching cases and practical projects, achieving seamless integration between program construction and industry development, thus injecting new vitality into prefabricated building education.

Acknowledgments

This paper is one of the phased achievements of the Scientific Research Fund Project of the Yunnan Provincial Department of Education in 2024, titled "Research on the Innovation and Application of Connection Nodes of Prefabricated Buildings under the Background of Dual - Carbon Goals in Yunnan" (Project No.:2024J1184).

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