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Optimization of Talent Cultivation in Engineering Management under the Context of Intelligent Construction

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Abstract: *With the development of intelligent construction technology, the traditional talent cultivation model for engineering management majors can no longer meet the demands of industry development. Therefore, it is imperative to reform the talent cultivation model and update the talent cultivation system for engineering management majors. This study first analyzes the current status of engineering management talent cultivation under the background of intelligent construction, as well as the major challenges it faces. Subsequently, targeted reform measures are proposed from three key aspects: updating the talent cultivation framework, strengthening university–industry collaboration, and building a high-level teaching faculty. These measures aim to enhance the quality of talent cultivation and provide systematic support for higher education institutions to train high-quality engineering management professionals who are better aligned with industry needs.*

Keywords: *Intelligent Construction; Engineering Management; Talent Cultivation; Educational Reform*

1. Introduction

In the context of development in the new era, traditional construction modes of the building industry can no longer meet the emerging requirements for high efficiency, superior quality, and sustainable development. Transformation and upgrading have become the only viable pathway to achieving high-quality development of the construction industry. With the integrated application of modern information technologies and advanced construction technologies, intelligent construction has emerged, injecting new momentum into the industry. The rise of intelligent construction signifies a fundamental shift of the construction industry from a labor-intensive sector to a technology-intensive one. This transformation has also exerted a profound impact on the engineering management discipline. Intelligent construction involves the deep integration of next-generation information technologies with engineering construction technologies [1], including Building Information Modeling (BIM), the Internet of Things (IoT), artificial intelligence (AI), and automated construction technologies. The application of these innovations is redefining the roles, functions, and practical approaches of engineering management [2]. Consequently, the development and widespread adoption of intelligent construction technologies necessitate the optimization and reform of talent cultivation models in engineering management [3]. Engineering management professionals must not only master traditional engineering techniques and management knowledge, but also proficiently apply advanced technologies to adapt to the ongoing trends of digitalization, informatization, and intelligentization in the construction industry, thereby driving its continuous innovation and development.

With the rapid advancement of intelligent construction technologies, the cultivation of engineering management professionals is facing a series of challenges. First, the integration of advanced information technologies—such as BIM, IoT, and AI—with engineering construction is increasingly in demand. This requires engineering management professionals not only to possess traditional engineering management knowledge but also to have an interdisciplinary knowledge base that enables them to effectively integrate information technologies with engineering management practices. Similarly, this also poses new requirements for talent cultivation and curriculum design in higher education institutions. Secondly, intelligent construction emphasizes practical application; however, many universities lack sufficient collaboration with industry, leaving students with limited opportunities to integrate their acquired knowledge with real-world practice. Furthermore, institutions also face challenges in their faculty composition. As an emerging field, intelligent construction requires instructors to possess up-to-date knowledge and technical competencies in this area; however, many current faculty members lack sufficient expertise in these aspects.

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In response to the accelerating technological iteration, engineering management programs must readjust their curriculum structures and strengthen the teaching of knowledge related to intelligent construction [4], so as to remain aligned with industry development trends [5]. At the same time, with the expanding application of intelligent construction technologies, how higher education institutions, as the primary entities responsible for training engineering management professionals, can seize this opportunity to cultivate innovative talents capable of adapting to industry transformation has become a new and pressing issue in the optimization of engineering management talent cultivation[6].

2. Analysis of the current state of talent cultivation in engineering management

2.1 Insufficient alignment between talent cultivation and industry demand, and an urgent need to optimize the training system

With the rapid development of intelligent construction technologies, new requirements have been imposed on engineering management professionals, encompassing technical competence, specialized knowledge, and innovation capability [7]. However, most existing talent cultivation systems in engineering management still emphasize traditional engineering management knowledge and fail to adequately integrate intelligent construction technologies such as big data, cloud computing, the Internet of Things, and artificial intelligence. As a result, graduates majoring in engineering management generally lack sufficient knowledge of intelligent construction technologies [8], making it difficult for them to effectively bridge theoretical learning with practical job requirements. On the other hand, as engineering management is an interdisciplinary field integrating engineering and management, some higher education institutions lack precise disciplinary positioning and clear training objectives. The mismatch between curriculum design and industry demands further leads to graduates whose professional competencies do not fully meet the needs of the construction industry.

At present, engineering management curricula primarily emphasize traditional engineering technologies and management theories, with limited coverage of content related to intelligent construction. Although some higher education institutions have introduced BIM-related courses, these offerings remain at an initial stage, with relatively basic teaching content and insufficient exploration of the integration of BIM with project management practices. Furthermore, the applications of the IoT, big data, and AI in the construction sector have not yet been adequately incorporated into the curricula of most institutions. Owing to the interdisciplinary knowledge required by intelligent construction, particularly the integration of information technology and management expertise, many engineering management graduates lack the essential technical competencies needed to effectively adapt to the demands of an intelligent construction environment.

2.2 Insufficient teaching facilities and resources constraining student competency development

The shortage of teaching facilities and educational resources poses a significant challenge to the cultivation of engineering management professionals. Traditional teaching methodologies have also been challenged by emerging learning media. Due to limited funding, some higher education institutions are unable to provide adequate teaching equipment. Particularly in the field of engineering management, the introduction of new technologies and methodologies requires financial support. In many cases, institutional budgets prioritize visible expenditures such as basic infrastructure, while neglecting equipment upgrading, which is a less apparent but critical investment. This imbalance restricts the effective implementation of digital and intelligent teaching in engineering management programs. This results in students being unable to proficiently master the necessary tools, thereby failing to meet the market's demand for high-caliber engineering management professionals. Some institutions can only offer basic BIM software, but lack access to teaching resources related to cloud computing and big data analytics, preventing students from acquiring proficiency in essential digital tools. In addition, delays in equipment renewal mean that laboratory facilities and teaching software in some universities are not aligned with current industry practices, resulting in outdated knowledge with limited practical applicability.

Moreover, practical courses require the simulation of real construction environments, particularly in areas such as construction process simulation and cost control. This places higher demands on resource allocation in terms of space and equipment. However, many institutions lack the necessary practice venues and facilities, which undermines the effective development of students' practical competencies. This limitation is especially pronounced in practice-oriented components related to intelligent

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construction, such as the commissioning and management of Internet of Things devices and automated construction processes, all of which require advanced equipment and sufficient practice space. Due to these constraints, many universities are unable to fully implement practice-based courses, leaving students to acquire such knowledge primarily through theoretical instruction, and consequently preventing the comprehensive development of their professional capabilities.

2.3 Insufficient university-industry collaboration and inadequate practical competence

Insufficient university–industry collaboration has results in a mismatch between the cultivation of engineering management talents and actual industry demands. As a critical bridge linking higher education with industrial practice, university-industry cooperation plays a vital role in aligning academic training with professional requirements. However, at present, collaboration between many universities and construction enterprises remains at a preliminary stage, characterized by limited depth of cooperation and inadequate resource sharing. Although some institutions have established partnerships with enterprises, such collaborations are often confined to providing internship opportunities and recruitment channels, with insufficient involvement in curriculum design, teaching content development, and instructional implementation. This limitation is particularly evident in the field of intelligent construction, where university curricula and teaching content frequently fail to align with real-world enterprise application scenarios. As large construction enterprises increasingly demand professionals proficient in intelligent construction technologies, the lack of close and sustained collaboration between universities and industry has constrained the effective cultivation of students' practical competencies. Consequently, graduates often struggle to translate theoretical knowledge into practical skills that meet the requirements of intelligent construction practices. In many countries, practice-oriented teaching models have been widely adopted to enhance students' professional competencies; however, most universities in China still rely on traditional teaching methods, which struggle to meet the demand for practical skill development required by the evolving engineering management discipline under intelligent construction paradigms.

2.4 Uneven quality of teaching staff and the need to enhance teaching competence

At present, faculty evaluation systems in many universities primarily rely on academic achievements, such as the quantity and quality of scholarly publications and the acquisition of vertically funded research projects, when assessing professional title promotion, research funding, and teaching awards. This evaluation orientation incentivizes faculty members to focus predominantly on academic research, particularly the application for research projects, while providing limited motivation to participate in practical engineering projects. In the field of intelligent construction, where cutting-edge technologies and theories evolve rapidly, limited engagement in industry practice makes it difficult for instructors to update their professional knowledge in a timely manner. As a result, classroom teaching content often becomes disconnected from industry needs, thereby adversely affecting the cultivation of students' comprehensive competencies. Against the backdrop of the rapid advancement of intelligent construction technologies, the continuous updating of faculty expertise and the accumulation of practical experience are crucial for fostering students' comprehensive competencies.

In addition, the teaching methods and knowledge structures of many university instructors remain relatively traditional, with a conservative approach toward modern educational concepts and the application of information technologies. Many instructors continue to rely heavily on conventional teaching methods, such as blackboard-based instruction and one-way theoretical lecturing, while the adoption of modern teaching tools and approaches, including virtual laboratories and digital learning platforms, remains limited. Consequently, student engagement and learning outcomes are often suboptimal.

3. Optimization strategies for talent cultivation

3.1 Update the training system to improve teaching quality

The curriculum system constitutes the core framework for achieving the talent cultivation objectives of engineering management programs. It not only defines the scope and structure of instructional content but also serves as the foundation for daily teaching activities. In the context of intelligent construction, the engineering management talent development system urgently requires optimization and updating to enhance both teaching quality and the overall quality of talent cultivation. The curriculum system of engineering management should be designed around key competencies, including BIM, IoT, big data

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analysis, and AI. Through systematic design, the talent development system can be aligned with the forefront of industry advancements and the practical demands of intelligent construction, thereby enhancing students' core competencies[9].

The curriculum system must evolve in parallel with technological advancements in the construction sector to ensure that students acquire up-to-date knowledge and cutting-edge skills. In response to the new competency requirements imposed on engineering management professionals by the intelligent construction environment, higher education institutions must adjust and innovate their talent cultivation strategies. Teaching practice should emphasize interdisciplinary integration by effectively combining engineering management knowledge with disciplines such as computer science and artificial intelligence, thereby fostering professionals with diversified skill sets. At the same time, faculty members should strengthen the relevance and precision of teaching content through in-depth analysis of the emerging requirements for engineering management professionals under intelligent construction.

3.2 Enhance practical teaching and strengthen university-industry collaboration

To cultivate students' practical skills, universities should establish appropriate practice-oriented teaching facilities and training platforms. Institutions can develop engineering technology laboratories equipped with advanced intelligent software and create comprehensive bases that integrate industry, academia, and research. Additionally, organizing various skills competitions can further enhance students' hands-on capabilities. By collaborating with enterprises, universities can provide students with internship opportunities, promoting a mutually beneficial relationship among students, universities, and industry. The combination of on-campus practical training facilities and on-site enterprise-based learning broadens students' opportunities for hands-on experience.

University–industry collaboration serves as an effective mechanism for improving students' practical skills and professional competence. This collaborative approach addresses the gaps in students' engineering practice experience. Enterprises can also participate in curriculum design and textbook development, ensuring that teaching content keeps pace with technological advancements and aligns closely with industry needs. In the field of intelligent construction, many enterprises have accumulated extensive practical experience. Through active involvement in curriculum design and educational resource development, these enterprises can effectively transfer up-to-date knowledge and industry practices to universities, enabling students to gain insights into cutting-edge technologies and applications.

3.3 Increase financial support and build a high-level teaching team.

To ensure that educational reforms keep pace with industry development, universities require adequate financial support. Funding can be obtained through multiple channels, such as government education grants, university-industry partnerships, and social sponsorships. Institutions should optimize resource allocation, prioritizing updates to professional curricula and the procurement of necessary teaching equipment, and establish dedicated funds to support faculty training and course development, thereby ensuring the cutting-edge nature of teaching content. At the same time, cost-effective strategies should be implemented during teaching reforms, such as collaborating with enterprises to build internship bases and leveraging virtual reality technologies to reduce reliance on physical resources.

To meet the talent cultivation needs of the engineering management programs in the intelligent construction environment, universities should develop a high-quality teaching team. This team should consist of "dual-competence" faculty members who possess both extensive engineering practice experience and outstanding teaching skills. Regular training and continuing education opportunities should be provided, particularly in areas such as BIM, IoT, and big data analytics, to help instructors update their professional knowledge and enhance their technical application abilities. Faculty exchange programs with enterprises or industry organizations can further improve instructors' sensitivity to evolving industry requirements and technologies, deepen their understanding of talent cultivation characteristics in intelligent construction environments, and strengthen their comprehensive mastery of relevant technologies, thereby better integrating industry practices into classroom instruction.

Additionally, universities can invite external experts with rich practical experience to participate in teaching, thereby enhancing the overall strength of the teaching team. Institutions should also gradually establish and refine a faculty evaluation system centered on "teaching quality" and "industry practice competence," shifting away from the traditional "publication-oriented" evaluation model and increasing the weight of industry experience, practical achievements, and teaching innovation in performance

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assessments.

4. Conclusion and Prospects

In the context of intelligent construction, the development of engineering management programs should align with contemporary trends and actively integrate digital and intelligent teaching approaches to meet the evolving demands for talent in the industry. Talent cultivation in engineering management professionals must emphasize innovation in educational models under the intelligent construction framework, aiming to comprehensively enhance the quality of training and to produce interdisciplinary professionals capable of adapting to and driving industry development. The core objective of teaching optimization and reform in engineering management is to cultivate high-quality, well-rounded professionals who meet industry requirements. Achieving this goal requires systematic efforts in optimizing training programs, updating curricula, and strengthening practical teaching. Simultaneously, improvements in teaching effectiveness can be achieved through targeted financial investment, enhanced university-industry collaboration, pedagogical innovation, and the development of a high-level teaching faculty. These strategies collectively serve to enhance students' competencies, satisfy industry demands for skilled professionals, and promote the high-quality and sustainable development of engineering management education.

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