

Reform Pathways for Cultivating Architecture Talents under the Industry–Education Integration Paradigm

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Abstract: Against the backdrop of China’s national strategy to digitalize and decarbonize the construction sector, architectural education confronts a central challenge. A widening gap between graduate competencies and evolving industrial needs. Grounded in the industry–education integration framework, this study examines reform initiatives at Hubei Urban Construction Vocational & Technological College, Tianjin Chengjian University, and other institutions. We propose an innovative talent-cultivation model that (1) leverages modern apprenticeship and “order-based” classes to intensify university–enterprise co-education, (2) embeds cutting-edge content such as BIM, smart construction, and green-building technologies into curricula, (3) utilizes cross-disciplinary joint practicums and industry colleges as key vehicles for practical training, and (4) transforms the teaching faculty into “dual-qualified” teams through reciprocal secondment. The findings provide both theoretical guidance and replicable practices for architecture-oriented institutions seeking to deepen industry–education integration.

Keywords: Industry-education integration; Architectural talent cultivation; Smart construction; Modern apprenticeship; Industry college

1. Introduction

Construction has long served as a pillar industry of the national economy [1]. Yet its extensive growth model has generated persistent inefficiencies, hazardous working conditions, and high accident rates [2]. These pressures have triggered an industry-wide shift toward smart construction technologies, making digitalization and industrialization imperative. Simultaneously, deglobalization and regional restructuring have heightened demand for highly skilled technical talent. Vocational bachelor institutions are now pivotal in supplying such talent; however, structural shortages remain pronounced in prefabrication, BIM and green-building technologies[3]. Curricula lag behind technological advances—topics such as construction robotics and BIM-based collaborative design are rarely taught, practical platforms are detached from authentic contexts, students accumulate fragmented engineering experience, and university–enterprise collaboration is weak because firms lack intrinsic incentives to engage in education.

Industry-education integration, by dissolving the boundary between education and industry, has emerged as a core remedy. Two decades of cooperation between Hubei Urban Construction Vocational & Technological College and China State Decoration Oriental Co. Ltd. demonstrate that integration significantly enhances graduate job-fit. Focusing on architecture-related programs and drawing on multiple case studies, this paper systematically explores reform pathways from the perspectives of educational models, curriculum architecture, and practical platforms.

2. Industry–education-oriented reform pathways for architectural talent cultivation

2.1 Innovating cooperative education mechanisms

Modern apprenticeship and order-based classes constitute the primary vehicles for “dual-subject” education. In the “Oriental Decoration Class,” jointly run by Hubei Urban Construction Vocational & Technological College and China State Decoration Oriental, students are recruited as employees, enrolled as apprentices, and appointed to posts upon graduation. Enterprise engineers and university tutors form 1:1 mentoring teams to co-design syllabi, deliver courses, and conduct assessments. Students alternate biweekly between campus and construction sites, creating a recursive “classroom-to-site” learning spiral. In the course Architectural Decoration Construction Technology, students first complete BIM-based process simulations and then execute ceiling and curtain-wall tasks at the Wuhan Tianhe Airport T3 terminal under real-time supervision. Over five cohorts, 130 apprentices have been trained; 85% remain with the company, 20% become core

employees within three years, labor costs have fallen by 12%, and rework rates by 8%.

Dianbai Architecture College, leveraging the “hometown of construction” cluster of more than 600 firms, co-founded the “Dianbai Construction Industry College” with the local construction association. The association president serves as chair of the college council; enterprise executives and college leaders co-govern. National labor-model experts teach 30% of core courses. Major regional projects—e.g., the Guangzhou Nansha International Financial Forum permanent site—are catalogued in an “enterprise project pool”; students participate as “quasi-employees” in technical briefings, scheme optimization, and quality inspections, with 45% of teaching occurring on-site. Jointly with South China University of Technology and the Guangdong Provincial Academy of Building Research, the college established the West-Guangdong Prefabricated Building Technology Research Institute. Within three years, 21 provincial projects were granted, technical-service revenue reached RMB 20 million, and R&D outcomes updated 20% of course content annually, synchronizing talent and industrial chains.

2.2 Reconstructing curricula and pedagogical systems

To respond to digital, intelligent, and green transitions, curricula must transcend disciplinary boundaries and integrate “technology–management–policy” dimensions. A survey by China State Construction Fourth Engineering Division Corp. identified a “three-up, three-down” competency shift: rising demand for BIM, smart construction, and green-building skills, and declining reliance on traditional drafting, empirical management, and extensive construction. Based on the jointly formulated Smart Construction Talent Competency Standard, curricula were re-engineered. New smart-technology modules include Full-Lifecycle BIM Applications and AI-Based Safety Management, using the Guangzhou Yueju Opera House project as a vehicle for students to deliver ten BIM-based deliverables, including clash detection. Policy modules incorporate “new infrastructure” and “dual-carbon” topics; interdisciplinary modules strengthen Digital Cost Management and EPC Legal Practice to foster cross-boundary thinking. Post-reform student course satisfaction rose by 32%, and enterprise satisfaction reached 92%.

Shandong Business Vocational College developed “golden courses” integrating specialization and entrepreneurship. Ideological and political education is embedded through the Hong Kong–Zhuhai–Macao Bridge case to promote craftsmanship. National standards (GB/T 51129) guide students through full-process prefabricated housing design. Innovation and entrepreneurship are cultivated via an “Innovation Workshop,” yielding 11 patents in three years. Pedagogically, German PAUL simulation software is adopted to rehearse hoisting collisions; authentic Vanke drawings serve as project-based tasks; comparative exercises aligned with German Industry 4.0 broaden global perspectives.

2.3 Constructing multi-dimensional practice platforms

Construction problems are inherently complex and require cross-disciplinary collaboration. Tianjin Chengjian University leverages a national “BIM ultra-convergence system” to form a five-discipline teaching team that has conducted four consecutive cohorts of “integrated capstone design.” The 2025 cohort worked on real enterprise projects such as an “intelligent prefabricated dormitory.” Architecture optimized spatial layouts, civil engineering selected structural systems, and building services integrated MEP systems, culminating in a full-disciplinary BIM model. Weekly enterprise reviews improved students’ complex problem-solving capacity by 37% and teamwork efficiency by 45%.

Jiangsu Vocational Institute of Architectural Technology, together with the Xuzhou municipal government and China State Construction Eighth Engineering Division Smart-Technology Co. Ltd., established the “Urban Smart Operation & Maintenance Modern Industry College” under a board-governed presidency. The college issues “challenge-based” projects such as “digital twin of campus underground pipelines.” For the project “energy-management data transformation,” students accessed enterprise IoT systems, developed 12 experimental modules and campus-based textbooks, and independently delivered energy-consumption analyses. Two outcomes have been applied to subway station retrofits, saving RMB 180,000 in annual electricity costs.

2.4 Refining evaluation and assurance systems

Reciprocal faculty mobility is central to quality assurance. Maoming Polytechnic implemented a “dual appointment and secondment” scheme: national skills champions (e.g., masonry champion Mr. Tan) serve as industry professors and convert patented devices into teaching tools, raising student productivity by 50%. University lecturers are required to spend no less than 12 months in industry within five years; a young lecturer, Ms. Li, worked six months on a Wanda Plaza project and then developed a case-based course after returning. Enterprise instructors deliver $\geq 40\%$ of practical courses and achieve 100% qualification after completing a “teaching-capacity workshop.”

Hubei Urban Construction Vocational & Technological College and China State Decoration Oriental co-developed an “apprenticeship quality diagnosis and improvement platform.” Data are collected on job-skill match, technological

innovation contribution, and career-advancement rate; a semi-annual report feeds back into curriculum revision. The 2023 report identified weakness in “BIM-based curtain-wall detailing,” prompting the addition of parametric curtain-wall design and enterprise software. On average, 6.8 improvements are implemented annually. Graduate one-year job-competency rates rose from 78% to 93%, and enterprise satisfaction has exceeded 90% for three consecutive years, ensuring full-chain quality assurance.

3. Conclusion

Through multi-case empirical analysis, this study proposes four core pathways for architectural talent-cultivation reform.

Innovate education mechanisms by scaling the “dual-subject” modern apprenticeship, reinforcing order-based training and industry-association participation, and establishing a shared responsibility community for talent co-cultivation and process co-management.

Dynamically update curricula to embed frontier technologies such as BIM and construction robotics, and build modular course clusters characterized by “specialization–entrepreneurship integration and course–competition mutual reinforcement.”

Integrate virtual–physical platforms by constructing cross-disciplinary BIM collaboration systems and physical industry colleges, driving competency development through authentic projects and smoothing the “research–teaching–application” translation chain.

Enable bidirectional faculty mobility through reciprocal secondment schemes, creating structured teaching teams covering smart construction, green building, and related domains.

Future work should further explore governance models for industry–education communities. The “quadruple-link mechanism” promoted by the Shandong Construction Science–Education Integration Forum–government planning, industry guidance, enterprise problem-setting, and university solution-providing-offers a promising route. Through jointly built training bases and R&D centers, this mechanism can close the loop between education and industry chains. Only by constructing a dynamically adaptive educational ecosystem can the construction sector secure sustainable talent support for its transformation and upgrading.

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