Education Reform and Development, 2026, Volume 8, Issue 8
https://ojs.bbwpublisher.com/index.php/ERD
Online ISSN: 2652-5372
Print ISSN: 2652-5364

# Exploring Training Pathways for Interdisciplinary Industrial Software Professionals

**Jing Wang, Yan Lu*, Zhaoying Chen, Chenxi Zeng**

School of Engineering, Nanfang College Guangzhou, Guangzhou 510970, Guangdong, China

***Author to whom correspondence should be addressed.**



**Abstract:** Against the backdrop of industrial software localization and the increasing integration of artificial intelligence, computer-related programs urgently need to prepare interdisciplinary professionals who combine software development skills, an understanding of industrial contexts, and AI engineering competence. Using a literature review, theoretical analysis, and illustrative case analysis, this study examines current challenges in industrial software education. It identifies three major problems: a mismatch between curricula and industry needs, insufficient depth in industry-education collaboration, and an expanding shortage of interdisciplinary professionals as AI reshapes the field. The study then proposes a curriculum model with regularly updated case resources, AI-augmented teaching supported by AI teaching assistants (AI-TAs), differentiated development of industrial scenario judgment, industrial data sandboxes, and a graded competence evaluation system. The proposed framework offers a reference for computer-related programs seeking to strengthen industrial software education and advance AI-enabled teaching reform.

**Keywords:** Computer education; Industrial software; Artificial intelligence; Interdisciplinary professional development; Industry-education integration

**Online publication:** September 10, 2026

## 1. Introduction

Industrial software provides a critical foundation for intelligent manufacturing and new industrialization. It encompasses R&D and design, production and manufacturing, and operations and management tools, including CAD, CAE, EDA, CAM, and MOM. Large language models, digital twins, and AI agents are increasingly being integrated into industrial software R&D and applications. Consequently, practitioners are expected not merely to operate tools but also to understand industrial processes, software architectures, data governance, and human-AI collaboration [1-3]. However, the market penetration of locally developed R&D and design software in China remains limited. The revenue of China's industrial software products reached RMB 294 billion in 2024 [4]. China's proposals for the 15th Five-Year Plan identify basic software as a strategic area and call for coordinated, end-to-end efforts to achieve breakthroughs in core technologies [5]. IDC projects a compound annual growth rate of 41.4% for China's "AI + industrial software" market from 2024 to 2029 [6], indicating sustained demand for interdisciplinary professionals. For computer-related programs, this field presents both an opportunity for program development and an important avenue for AI-enabled educational reform. Against this background, the study asks how computer-related programs can prepare interdisciplinary professionals for the industrial software sector. It translates industry needs into actionable proposals for curriculum design, teaching practice, student development, data support, and institutional evaluation. On this basis, it presents a five-layer collaborative framework and a set of reform pathways for undergraduate institutions.

## 2. Scope of the reform and research methods

### 2.1. Scope of the reform

This research targets undergraduate majors with foundational disciplines such as Software Engineering, Computer Science and Technology, Artificial Intelligence and Intelligent Manufacturing Engineering. It mainly serves professional courses, comprehensive practical training, school-enterprise projects and micro-major construction for sophomores, juniors and seniors. The reform goal is not to add an isolated course titled Introduction to Industrial Software, but to embed industrial software cases, domestic tool chains, AI-assisted teaching and real enterprise tasks into existing computer curricula, so that students can form an integrated competence profile that combines software development ability, industrial scenario judgment ability and AI engineering application ability.

### 2.2. Research methods

This study combines a literature review with theoretical analysis. First, it reviews literature, policy documents, and industry reports published since 2019 using keywords such as industrial software, AI-enabled manufacturing, talent development in computer-related programs, and industry-education integration. Second, drawing on the CDIO model and outcome-based education (OBE), it synthesizes research on AI-enabled engineering education, industrial software education, and industry-education integration to identify major weaknesses in existing training systems. Third, it evaluates the contextual applicability of the proposed pathways. The case analysis is intended to illustrate how the reform framework can be mapped to practice rather than to establish causal effects.

## 3. Major challenges in preparing industrial software professionals in computer-related programs

### 3.1. Disconnection between curriculum system and industrial demands

Strong scenario relevance, strict engineering constraints and tight coupling of tool chains characterize industrial software. Students who only master general programming, algorithms or database knowledge cannot naturally transfer such capabilities to scenarios such as EDA wiring, CAE modeling, MOM systems and intelligent manufacturing data processing. Many current courses still focus on general software development workflows, with insufficient attention paid to domestic CAD/CAE/EDA tool chains, industrial data modeling, expression of process constraints and the domestic industrial software ecosystem. As a result, a common phenomenon emerges that students can write programs but fail to understand industrial problems.

### 3.2. Insufficient depth of industry-education integration

The teaching of industrial software relies on real process data, engineering tasks and enterprise evaluation standards. However, core enterprise data involves trade secrets, intellectual property rights and data security, making it difficult for universities to obtain directly. Meanwhile, the time cost, achievement ownership and incentive mechanism for enterprise engineers to participate in curriculum co-construction remain unclear. This creates a contradiction where enterprises possess industrial scenarios yet are reluctant to open them, while universities have curricula but lack real engineering constraints, which easily limits industry-education integration to shallow cooperation.

### 3.3. Artificial intelligence intensifies the shortage of interdisciplinary professionals

Generative AI is reshaping how industrial software is developed and applied. Students must learn not only to use AI tools but also to understand model limitations, data compliance, engineering reliability, and human-AI collaboration in industrial settings. If courses remain focused on training students to operate a single tool, a new gap will emerge between the ability to invoke AI functions and the ability to solve industrial problems. A sector forecast by the China Center for Information Industry Development (CCID) projected that, by 2025, the additional shortfall across China's key software fields would reach approximately 830,000 professionals, including about 120,000 in industrial software. These figures are projections rather than official workforce counts and are cited only to indicate the anticipated scale of demand [7].

## 4. AI-driven implementation paths

### 4.1. Develop a continuously updated curriculum and a four-track case library

The proposed continuously updated curriculum retains a stable core while cases and practical training resources are refreshed on a regular schedule, following a "stable curriculum framework + regularly updated case resources" model. The core courses in the training program remain unchanged, whereas course cases, experimental tasks, and industry projects are maintained through a sustainable update mechanism. The case library is organized into four tracks: the R&D and design track introduces locally developed CAD/EDA tools and AI-enabled generative design; the production and manufacturing track covers PLC, MOM, and digital twin applications; the operations and management track focuses on industrial ERP and intelligent supply-chain analysis; and the operations and maintenance track includes PHM and equipment-log analysis. Syllabi, source code, and practical assignments may be hosted in GitHub or Gitee repositories and updated jointly by faculty members and industry engineers, with version numbers and change logs retained. The design of the case library can draw on project-based teaching practices that emphasize innovation capability. To support long-term maintenance, case development may be recognized in faculty teaching evaluations, while industry engineers' contributions may be counted as school-enterprise collaboration achievements and used as supporting evidence in professional title evaluations and collaboration awards [8].

### 4.2. Establish an AI-augmented teaching model supported by AI-TAs

At the teaching level, an AI teaching assistant (AI-TA) can be developed for industrial software courses. Its domain corpus may include course materials, assignments from previous years, technical documentation for locally developed software, open-source industrial software cases, and anonymized enterprise tasks. The AI-TA can support three functions: (1) basic question answering and code review to reduce repetitive teaching workload; (2) reminders about process constraints, such as boundary conditions in CAE modeling and impedance matching in EDA design; and (3) generation of adversarial error-based exercises that help students develop industrial scenario judgment by analyzing typical mistakes [9].

### 4.3. Carry out diagnosis and differentiated training of industrial scenario judgment capability

At the student level, "industrial intuition" is redefined as "industrial scenario judgment capability" that can be measured in education evaluation, namely students' rapid recognition of geometric constraints, process boundaries, failure modes and engineering costs. This definition corresponds to the intuitive judgment at the proficiency and expert stages in the Dreyfus skill acquisition model, and its knowledge foundation bears typical characteristics of tacit knowledge as described by Polanyi[10]. In practice, open-ended tasks such as material failure prediction, PCB wiring rationality judgment and equipment log interpretation can be used to diagnose this capability. Diagnosis results will not be used for one-off ranking, but to divide students into three growth tracks: elite class focusing on enterprise R&D tackling, application class centering on micro-majors and industrial certifications, and open-source contributor track encouraging participation in the domestic industrial software ecosystem. Dynamic transfer between the three tracks shall be allowed to avoid premature labeling. The capability requirements of representative posts in the AI transformation of industrial software are shown in **Table 1**, which can serve as references for setting training objectives of three tracks.

**Table 1.** Capability Requirement Matrix for Representative Posts in AI Transformation of Industrial Software

| Representative Post | Process & Domain Knowledge (Content Layer) | Software Engineering & Development (Content Layer) | AI/ML Modeling Capability (Teaching Layer) | System Architecture & Integration (Teaching Layer) | Data Governance & Compliance (Data Layer) | Industrial Control & IoT (Data Layer) | Product Thinking & Collaboration (Student Layer) | Professional Responsibility & Ethical Awareness (Institutional Layer) |
|---|---|---|---|---|---|---|---|---|
| AI Trainer | ● | ◐ | ● | ○ | ● | ◐ | ○ | ◐ |
| Digital Twin Engineer | ● | ◐ | ◐ | ● | ◐ | ● | ○ | ○ |
| Smart Factory Engineer | ◐ | ○ | ◐ | ◐ | ○ | ● | ◐ | ○ |
| Industrial Data Governance Specialist | ◐ | ◐ | ○ | ○ | ● | ○ | ○ | ● |
| Industrial Software Architect | ● | ● | ◐ | ● | ◐ | ○ | ◐ | ○ |
| Industrial AI Product Manager | ◐ | ○ | ◐ | ○ | ◐ | ○ | ● | ● |

Notes: ● Proficient (core requirement), ◐ Familiar (systematic mastery required), ○ Basic understanding (general knowledge reserve); capability levels are divided based on the Dreyfus skill acquisition model, and the brackets mark the main collaborative layer each capability corresponds to.

## 4.4. Build industrial data sandbox and federated practical training platform

A three-level mechanism of desensitized data + data sandbox + federated practical training can be adopted at the data level. Public data and desensitized samples are used for classroom teaching; comprehensive practical training adopts real tasks stored in the sandbox provided by enterprises, where student models are trained within the sandbox without data leaving the enterprise or joint experimental environments. For cross-enterprise and cross-college projects, federated learning is explored: the leading university deploys an aggregation server, each enterprise sandbox acts as a participant node, student models are trained locally at nodes and only parameter updates are uploaded for aggregation to form a global model, realizing the principle of data staying put while models circulate.

## 4.5. Improve institutional safeguards and graded competence evaluation

At the institutional level, a joint school-enterprise curriculum committee, a dual-mentor mechanism, data-use agreements, and negative lists for industry-education cooperation should be established to ensure that collaboration extends beyond routine student placement and generates substantive educational and engineering value. For evaluation, a three-tier competence framework - tool user, AI engineer, and industrial intelligence architect - is developed in accordance with OBE principles. Tool users are evaluated on their proficiency with locally developed software and the quality of basic task completion; AI engineers are assessed on their AI-TA interaction records, sandbox-task quality, and model interpretability; and industrial intelligence architects are evaluated on open-source contributions, enterprise project outcomes, and system integration capability. Drawing on existing assessment practices in computer-related programs, the framework combines process- and outcome-based evaluation, incorporates multi-stakeholder scoring, and dynamically adjusts indicator weights across year levels. Academic integrity is treated as a prerequisite for participation in and recognition under the comp etence evaluation system. The key implementation measures and indicators for the five-layer pathways are summarized in **Table 2**.

**Table 2.** Implementation Key Points and Evaluation Indicators of the Five-layer Collaborative Training Path

| Reform Link | Main Practices | Teaching Priorities | Evaluation Indicators |
|---|---|---|---|
| Content Layer | Continuously updated curriculum & four-track case library | Replace single tool operation with domestic CAD/CAE/IMA and intelligent manufacturing cases; update case library every semester | Annual case update rate, domestic tool coverage, number of student open-source contributions |
| Teaching Layer | AI-augmented teaching supported by AI-TAs | Provide Q&A, code review, assignment feedback and error generation based on course corpus and engineering constraints. | AI-TA usage frequency, feedback adoption rate, assignment iteration quality |
| Student Layer | Diagnosis & differentiated training of industrial scenario judgment capability | Identify students' judgment of geometric constraints, process boundaries and failure modes via open tasks | Consistency of expert scoring, project completion rate, track transfer rate |
| Data Layer | Industrial data sandbox & federated training | Enterprises keep data within domains; students train models in sandboxes; desensitized data for class experiments | Completion rate of real tasks, data compliance records, enterprise satisfaction |
| Institutional Layer | Professional responsibility & graded competence evaluation | Establish dual tutors, negative lists, three-tier evaluation and post-graduation tracking mechanisms | Job retention rate, enterprise satisfaction, competence level achievement rate |

## 4. Conclusion

Against the backdrop of industrial software localization and AI-enabled transformation, computer-related programs need to move beyond general software training toward integrated development of software engineering, industrial-domain understanding, and AI engineering competence. The proposed five-layer collaborative framework connects curriculum renewal, AI-augmented teaching, differentiated student development, data governance, and institutional evaluation within a unified training system. It is intended to address outdated curricula, shallow industry-education collaboration, and the shortage of interdisciplinary industrial software professionals, while aligning with the growing international emphasis on competence-based education and AI literacy.

## Funding

First-class Undergraduate Course Project of Guangdong Province: Object-Oriented Programming (Project No.: SJYLKC2305); 2021 First-class Undergraduate Major Construction Site of Guangdong Province: Computer Science and Technology (Project No.: SYLZY2103)

## Disclosure statement

The author declares no conflict of interest.

## References

[1] Pan S, Li J, Gu N, 2025, Artificial Intelligence, Industrial Integration and Industrial Structure Transformation and Upgrading. China Industrial Economics, 2: 23–41.

[2] Lu C, Zuo X, Jin B, et al., 2025, Research and Exploration on Application of Large Model Empowered Industrial Software in Intelligent Manufacturing. Digital Transformation, 2(11): 41–46.

[3] Guo J, Qu J, Chen J, et al., 2026, Research on Promotion Path of Integrated Application of Industrial Software and Artificial Intelligence in China. Digital Transformation, 3(3): 60–65.

[4] Ministry of Industry and Information Technology, 2025, Economic Operation of Software and Information Technology Service Industry in 2024, visited on June 5, 2026, https://www.miit.gov.cn/.

[5] CPC Central Committee, 2025, Suggestions on Formulating the 15th Five-Year Plan for National Economic and Social Development. People's Publishing House, Beijing.

[6] IDC, 2025, Market Forecast: China Core Industrial Software Market, 2025–2029. IDC China, Beijing.

[7] China Center for Information Industry Development (CCID), 2021, Forecast Report on Talent Demand in Key Software Fields. CCID, Beijing.

[8] He S, Yu L, Li Y, 2024, Exploration of Industrial Software Talent Training Mode Based on Industry-Education Integration. Digital User, 2024(24): 3–4.

[9] Li T, Zhang Y, Ye M, 2024, "AI", "AI+" or "+AI"? Mode Construction and Path Analysis of Artificial Intelligence Talent Training. Research in Higher Engineering Education, 2: 24–30.

[10] Xu S, Guan D, Xu J, 2022, Research on University Artificial Intelligence Talent Training Oriented to Industrial Demands. Software Guide, 21(7): 6–11.