Research on the Competency Cultivation System for Top Innovative Talents in the Intelligent Manufacturing Field

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Abstract: In the context of the new round of scientific and technological revolution and industrial transformation, intelligent manufacturing has become a key factor in global manufacturing competition. However, China is experiencing a severe shortage of talent in this field, particularly among those with interdisciplinary knowledge, outstanding engineering skills and disruptive innovative thinking. This paper aims to systematically explore the theoretical and practical pathways for cultivating such talent. Firstly, it analyses the key challenges currently faced in talent development with regard to knowledge structure, training models, industry-education integration, and evaluation mechanisms. Secondly, it elaborates on the urgency and strategic importance of cultivating such talent in three areas: national strategic security, industrial transformation and upgrading, and international technological competition. Building on this, the paper proposes a comprehensive talent cultivation framework comprising four pillars: 'Cultivation Mechanism-Experimental Teaching and Management System-Evaluation System-Safeguard Measures'. Notably, the paper innovatively proposes an experimental teaching and management system oriented towards deep industry-education integration. This system employs real industrial cases and implements whole-process refined management, serving as a key bridge connecting theory and industry. The system emphasises the 'Four Modernisations' goal for laboratory construction and the 'Whole-Process Refinement' model for teaching management, with the aim of substantially enhancing students' innovation and practical capabilities. The aim of this research is intended to provide a theoretical reference and practical guidance for deepening the reform of engineering education in China, as well as for the construction of a new talent cultivation paradigm that meets the future development needs of intelligent manufacturing.

Keywords: Intelligent Manufacturing; Top Innovative Talents; Competency Cultivation; Industry-Education Integration; Experimental Teaching Management; Comprehensive Evaluation

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1 Introduction

The world is undergoing profound changes unseen for a century. These changes are being accelerated by disruptive technological breakthroughs in artificial intelligence, big data, the Internet of Things (IoT), and digital twins. These developments are driving the Fourth Industrial Revolution [1]. Intelligent manufacturing, which is achieved through the deep integration of new-generation information technology and advanced manufacturing technology, is permeating the entire process of product design, production, management, and service. This is profoundly reshaping the global manufacturing landscape, industrial forms, and value chains [2]. The successive deployment of national strategies such as Germany's 'Industry 4.0', the United States' 'Industrial Internet', and 'Made in China 2025' clearly reflects a global consensus on achieving dominance in future manufacturing.

Talent is the cornerstone of innovation and the core dynamic element in the realisation of the vision of intelligent manufacturing [3]. It must be recognised that intelligent manufacturing is not simply the combination of individual technologies, but rather a complex giant system that organically unifies 'intelligent manufacturing technology' and 'intelligent manufacturing systems'. This inherent nature dictates a fundamental shift in the talent demand paradigm: from 'craftsman-type' talents who master singular skills to 'integrated-type' and 'innovative-type' talents who must amalgamate multidisciplinary knowledge spanning mechanical engineering, electronics, information technology, computer science, data science, and management science. In addition to a profound theoretical foundation and sophisticated professional skills, these top innovative talents urgently require interdisciplinary integration capabilities, complex engineering problem-solving skills, and independent innovation capacity, as a global vision and leadership skills [4].

Despite the significant size of higher and vocational education in China, there are still major challenges in cultivating highly innovative talent capable of leading the way in intelligent manufacturing. Traditional disciplinary barriers, relatively rigid training programmes, disconnected industry-education integration, and a single evaluation standard all constitute structural obstacles that stifle the innovative potential of talent. Therefore, establishing a scientific, efficient, and sustainable system to cultivate top innovative talent in intelligent manufacturing has become critical to national strategic competitiveness, industrial security, and high-quality economic development [5].

In this urgent context, the aim of this paper is to systematically diagnose current cultivation dilemmas, deeply elucidate their strategic significance, and ultimately propose a systematic construction pathway. This pathway would encompass a cultivation mechanism, an experimental teaching system, a management system, an evaluation system, and safeguard measures as an integrated whole. It is hoped that this framework will serve as a valuable theoretical and practical reference for educational institutions, government departments, and industry.

2 Dilemmas Facing Talent Cultivation in the Intelligent Manufacturing Field

Current practices for cultivating intelligent manufacturing talent in China reveal several deep-seated contradictions that hinder the emergence of top innovative talent.

2.1 Lagging Knowledge System and Rigid Disciplinary Barriers

Intelligent manufacturing is a typical interdisciplinary field characterised by rapid knowledge iteration. However, the curriculum systems and content at most Chinese universities are updated slowly and fail to systematically incorporate cutting-edge technologies such as the Industrial Internet of Things (IIoT), digital twins, and AI-powered quality inspection [6]. A more profound issue is the entrenched disciplinary barriers. Subjects such as mechanical engineering, electronics, control, and computer science have long operated in isolation, with little crossover between courses. This fragmented approach to education prevents students from developing a comprehensive understanding of the 'perception-decision-execution-feedback' closed loop of intelligent manufacturing systems. More critically, it fails to equip students with the core competency of integrating hardware (e.g. mechanical structures, sensors, and actuators) with software (e.g. algorithms, data, and models)—a key skill for intelligent manufacturing engineers.

2.2 Disconnect Between Traditional Teaching Models and Practical Ability Development

There is an inherent contradiction between the traditional 'teacher-centred, textbook-based, classroom-focused' didactic teaching model and the intrinsic requirements for fostering innovation capabilities [7]. Intelligent manufacturing is highly dependent on specific scenarios, and solving complex engineering problems requires repeated practice and refinement in real or highly simulated industrial environments. However, university teaching still tends to prioritise theory over practice and knowledge transmission over competency building. Laboratory sessions often involve only verification experiments, lacking comprehensiveness and design elements [8]. Final-year project topics often diverge from the real needs of enterprises. Consequently while students may accumulate substantial theoretical knowledge, they often struggle when faced with specific problems on the production line, such as equipment interconnectivity, data acquisition, or MES (Manufacturing Execution System) optimisation. Consequently, their engineering practice and systematic problem-solving abilities remain severely inadequate.

2.3 Superficial Industry-Education Integration and Lack of Collaborative Mechanisms

Although industry-education integration is considered essential for overcoming practical challenges, its implementation is often inadequate. The internship positions offered by companies are often auxiliary or observational in nature, preventing students from accessing core technologies and key processes. University-enterprise cooperation projects tend to be short-term and piecemeal, lacking long-term strategic collaboration and co-construction mechanisms [9]. The root cause of this lies in the differing goals and cultures of the two sectors: universities prioritise talent cultivation and academic output, while enterprises focus on economic efficiency and market competitiveness. A deeply integrated ecosystem characterised by 'joint cultivation, co-management, shared outcomes, and shared responsibility' has yet to be established. This leaves the 'last mile' of talent cultivation persistently unbridged.

2.4 Simplistic Evaluation System and the Suppression of Innovative Spirit

The current system of evaluating students remains overly reliant on metrics such as course grades and publication counts [10]. This 'grades-only, papers-only' approach severely stifles students' innovative spirit. Innovation in intelligent manufacturing involves trial and error and uncertainty. Yet, the current evaluation system rewards 'standard answers' and 'safe paths', offering little recognition for valuable exploratory efforts, even those that do not yield immediate success, in interdisciplinary projects or innovation competitions. This inevitably pushes students towards risk-averse, easily quantifiable learning paths, stifling their critical thinking, teamwork skills, and courage to explore the unknown.

3 The Vital Significance of Talent Development in the Field of Smart Manufacturing

Addressing the aforementioned dilemmas and vigorously cultivating top innovative talent for intelligent manufacturing is of overarching and strategic importance.

3.1 The Cornerstone for Safeguarding National Strategic Security and Industrial Autonomy

Global industrial and supply chains are undergoing rapid reconstruction, and competition in key technology sectors is intensifying [11]. Although China's manufacturing industry is moving towards the medium-high end, it remains vulnerable in areas such as high-end CNC machine tools, industrial software, and core chips. The key to overcoming this predicament lies in independent innovation. Top-notch innovative talent drives technological breakthroughs. Their ability to innovate from '0 to 1' is fundamental to leading core technology research and development and achieving high-level self-reliance and self-strengthening in science and technology [12]. This is crucial for ensuring the security and self-reliance of the industrial chain.

3.2 The Engine Driving Industrial Digital Transformation and High-Quality Development

Amidst the surge of the digital economy in the post-pandemic era, China's comprehensive manufacturing digital transformation is accelerating. Intelligent manufacturing is empowering the entire sector by improving quality, increasing efficiency, reducing costs, and innovating business models [13]. The successful realisation of this transformation depends on a large number of highly innovative individuals who can grasp its concepts, master its technologies, and apply them to specific scenarios. These individuals adopt new technologies, create new models and pioneer new business formats, serving as the driving force that propels manufacturing towards digitisation, networking, and intelligence. They play an irreplaceable role in enhancing total factor productivity and constructing a modern industrial system.

3.3 The Strategic Fulcrum for Shaping Future Competitive Advantages in Technology

Ultimately, global technological competition boils down to a competition for talent, especially top-tier talent [14]. Intelligent manufacturing is set to be the main future battleground for global industrial competition. Those who possess a first-class cohort of top innovative talent in this field will hold the power to set technological standards, steer industrial development and command a share of the global value chain. Cultivating a group of leading talents with an international vision who are capable of configuring global innovation resources and leading technological change is not just about keeping pace with existing developments, but also about achieving and maintaining leadership in future developments. This is the strategic pivot for China's transition from being a 'manufacturing giant' to becoming a 'manufacturing powerhouse', enabling it to participate in, and potentially lead, global technological governance and shape a future development landscape that favours its interests.

4 Establishing an Experimental Teaching System for Industry-Education Integration

Experimental teaching is the core link between theoretical knowledge and engineering practice [15]. It transforms 'armchair theorising' into 'practical ability'. In response to the current issue of a disconnect between practical teaching and enterprise demands, a new experimental teaching ecosystem is needed that integrates industry and education more closely, uses real-life examples, and is well managed. This system is the specific implementation carrier of the training mechanism and the core operational platform that ensures training quality.

4.1 Building a High-level Experimental Platform Led by the 'Four Modernizations'

In order to overcome limitations of traditional laboratories, which are dispersed, closed and inefficient, the construction of intelligent manufacturing experimental platforms should be based on the 'Four Modernizations' goal, the connotations and supportive relationships of which are shown in Figure 1.

(1) Standardised management: Unified national and industry standards should be established for laboratory construction, safety, operations and performance evaluation systems. Standardised management can significantly reduce equipment failure rates and greatly enhance safety during use.

(2) Configuration intensification: Integrated experimental platforms covering 'intelligent perception, network interconnection, digital twins, and intelligent decision-making' should be planned across faculties, based on the intelligent manufacturing system architecture. This avoids repetitive and inefficient investment.

(3) Operational informatisation: Leveraging the IoT and big data technologies enables the entire process-including equipment status, experimental procedures, and teaching data-to be managed and scheduled online. This significantly reduces labour costs and enhances operational efficiency.

(4) Resource sharing: Barriers between schools and en-

terprises can be broken down by establishing regional or industry-wide alliances for experimental teaching in intelligent manufacturing, and by deploying virtual simulation projects. This significantly increases access to cutting-edge industrial software and expensive experimental equipment.

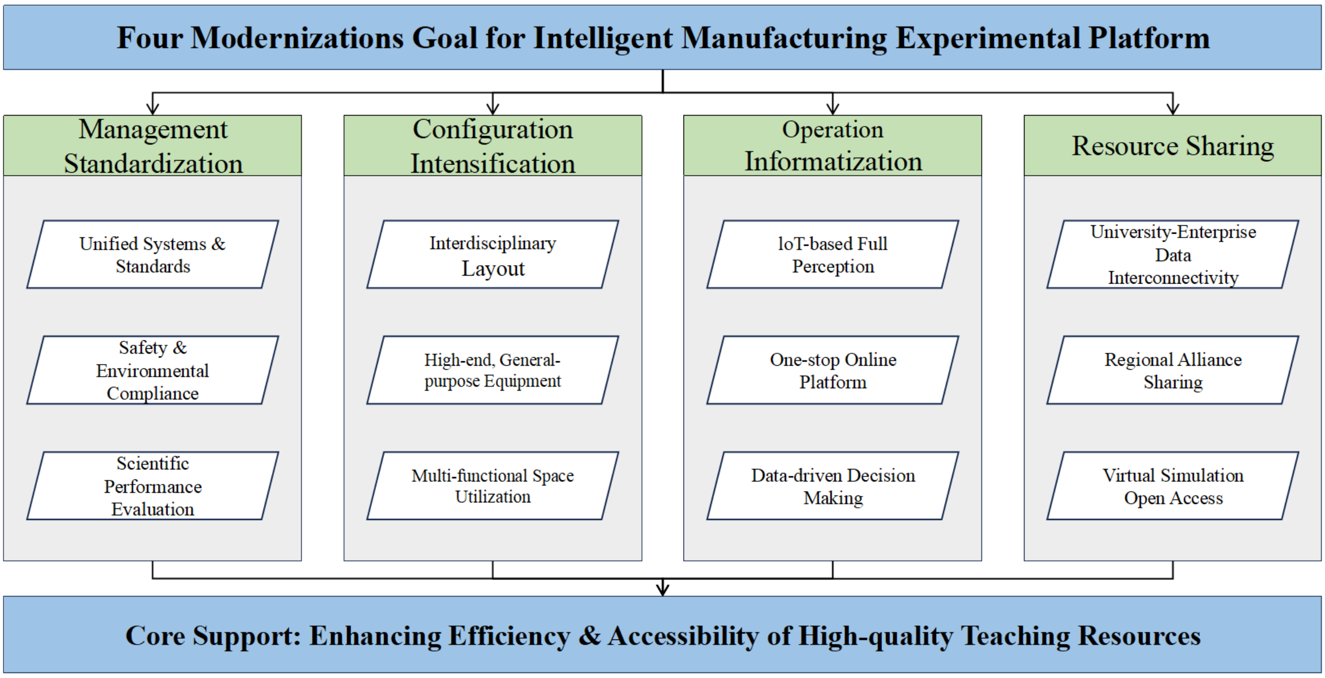

Figure 1 The 'Four Modernizations' Goal System for Experimental Platform Construction

4.2 Constructing an Experimental Project System Based on Real Industrial Cases

The content of experimental teaching should be based on real industrial problems [16]. A three-tiered, progressive experimental project repository (see Table 1) should be developed in collaboration with partner enterprises to transform real-world technical challenges, process optimisation needs or new product development tasks into teaching cases.

Table 1 Three-tiered Experimental Project System Based on Industry-Education Integration

Project Tier	Goal Orientation	Example Case Sources	Key Competency Focus	Depth of Industry-Education Integration
Foundational Verification	Mastering unit technologies and tools	Industrial robot teach programming, sensor data acquisition, MES work order execution	Basic operation, tool usage, standard understanding	Enterprises provide real equipment, software, and data interfaces
Comprehensive Integration	Solving cross-domain complex engineering problems	Flexible production cell debugging, AGV scheduling & warehouse linkage, digital twin model building & validation	Systems thinking, integration & debugging, project management, documentation	Co-developed case manuals, on-site/online guidance by enterprise mentors
Innovative Research	Exploring frontiers and disruptive innovation	AI-based quality defect prediction, production process parameter optimization, novel human-robot collaboration scheme design	Innovative thinking, algorithm development, prototype validation, IP awareness	Sourced from enterprise R&D projects or national-level grants, with shared outcomes (patents, papers)

This project system ensures that experimental teaching is cutting-edge, challenging and authentic, enabling students to 'solve real problems in a real environment'. Compared with traditional verification experiments, participation and the completion rates for problem-solving have significantly improved.

4.3 Strengthen the Quality Assurance of Refined Experimental Teaching Throughout the Entire Process

Excellent teaching resources require an exceptional management system to realise their potential [17]. In order to optimally allocate resources and maximise the effectiveness of teaching, it is necessary to establish a 'whole-process refinement' experimental teaching management system that integrates and monitors all elements, including students, teachers, venues, equipment and data.

This system relies on a unified information management platform and operates through three key stages:

(1) Front-end planning and preparation: Teaching plans are dynamically aligned with industry needs and the platform intelligently schedules experimental resources based on project requirements.

(2) Mid-end process and execution: Safety access and training are enforced, operational data is collected multidimensionally via the IoT, and remote intervention by enterprise mentors is supported to ensure the process is controllable, traceable, and interactive.

(3) Back-end evaluation and optimisation: Multi-source evaluation data is fused and platform analytics generate personalised learning and teaching diagnosis reports. These reports drive the iteration of the project repository and precise allocation of teaching resources.

Adopting such a refined approach to teaching experiments will undoubtedly boost students' confidence and improve their ability to solve complex engineering problems. It will also give teachers greater control over the turnover rate of equipment and venues.

4.4 Supporting Role: Systemic Contribution to Innovation Capability Cultivation

This experimental teaching and management system is not an isolated entity, but is deeply embedded within the overall cultivation framework. It works synergistically with the cultivation mechanism, evaluation system and safeguarding measures to shape the core competencies of the most innovative talent. Its specific contributions are:

(1) Substantive support for the cultivation mechanism: It translates interdisciplinary course knowledge and the philosophy of Project-Based Learning (PBL) into concrete, practical activities that can be implemented immediately, providing the most direct and profound realisation of industry-education integration.

(2) Data-driven support for the evaluation system: The multi-dimensional, whole-process data it generates (operation logs, project reports, collaboration records, video evidence, etc.) provides objective, rich and credible evidence for the three-dimensional 'Knowledge, Ability, Competence' evaluation system. This system is particularly effective in process-oriented evaluations and the scientific recognition of innovative outcomes.

(3) Feedback and validation for safeguard measures: The operational effectiveness and efficiency data it provides directly test the collaborative teaching capabilities of the 'Dual-Qualified' faculty and the efficacy with which the open, shared platform is constructed. It also provides precise data feedback to optimise policies and allocate resources continuously.

5 Pathways for Building a Talent Development System in the Field of Smart Manufacturing

In order to effectively overcome challenges and fulfil its mission, it is crucial to break free from path dependency and establish a comprehensive, multi-level and dynamically evolving talent cultivation system. This system should feature the 'Systematic Cultivation Mechanism' in the top-level design, the 'Experimental Teaching and Management System' in the core implementation, the 'Multi-dimensional Evaluation System' to provide guidance and feedback, and 'Comprehensive Safeguard Measures' to provide foundational support. All four components should work in synergy.

5.1 Establishing a Systematic and Scientific Cultivation Mechanism

This mechanism provides the overarching blueprint for cultivating talent. The concepts and goals set out in this blueprint must be implemented and developed through the experimental teaching system described in Chapter 4.

5.1.1 Constructing an Interdisciplinary, Integrated Curriculum System

Break down departmental and disciplinary barriers and restructure the curriculum with a 'Smart +' and '+ Smart' mindset. Introduce interdisciplinary degree programmes and experimental classes in 'Intelligent Manufacturing'. Core modules should cover the fundamentals of intelligent science (machine learning, data mining, etc.), core intelligent technologies (industrial robotics, the IIoTs, digital twins, etc.), intelligent system integration (smart production line design, MES/ERP, etc.), and intelligent manufacturing management and ethics. Students will apply and deepen the theoretical knowledge gained in these courses within tiered experimental projects based on real cases (see Section 4.2).

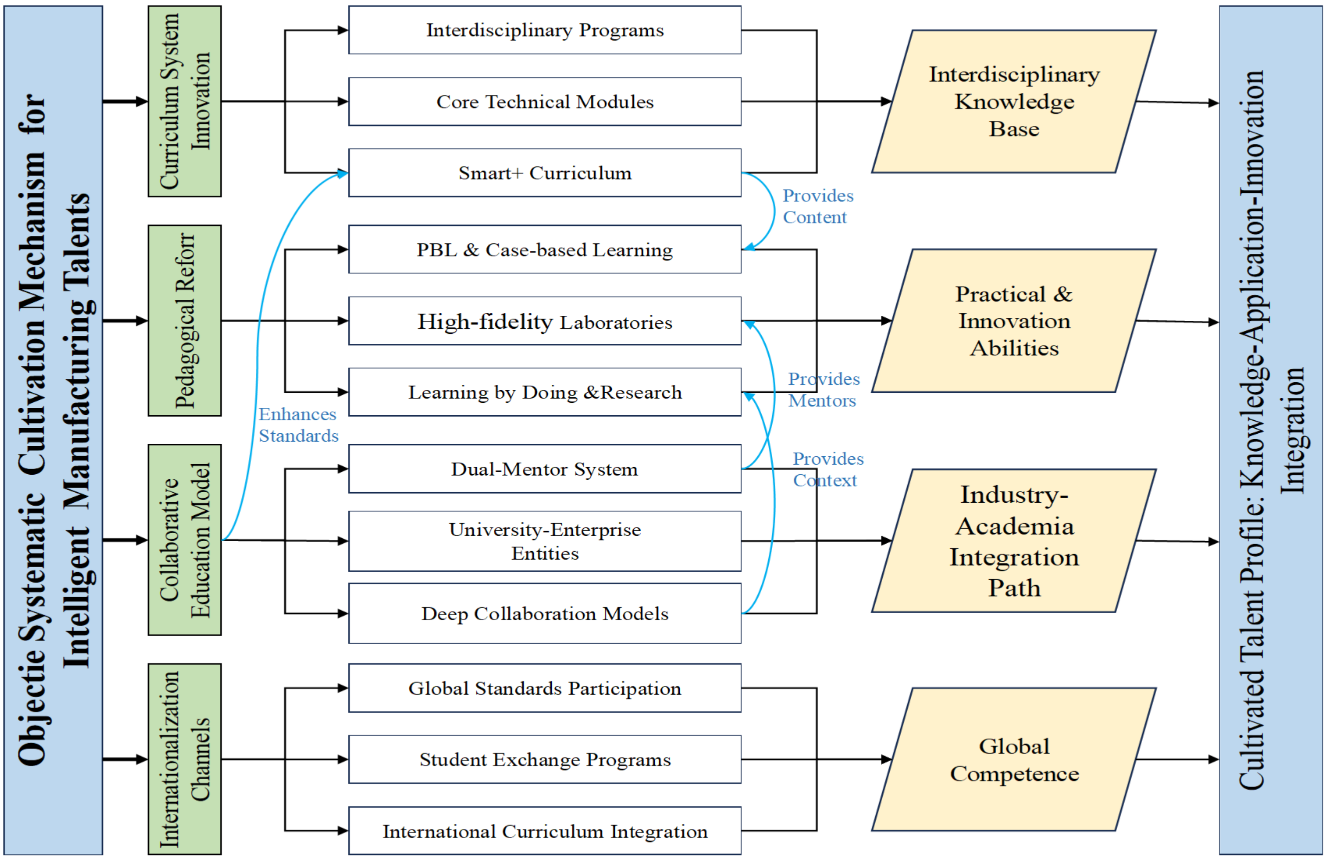

Figure 2 Logical Architecture of the Systematic Cultivation Mechanism

5.1.2 Deepening Project-Driven and Inquiry-Based Teaching Model Reform

Promote the widespread adoption of project-based learning (PBL), case teaching, and flipped classrooms. The most advanced form of this is inquiry-based learning, which involves enterprises and relies on 'Comprehensive Integration' and 'Innovative Research' tier experimental projects (see Table 1). Encourage students to engage with research projects, laboratories and teams from an early stage, honing their ability to identify and define problems at the forefront of scientific research and engineering.

5.1.3 Promoting Deep Industry-Education Integration and Collaborative Education Model Innovation

Move beyond superficial internship cooperation and consider setting up substantive entities, such as joint university-enterprise colleges, industrial technology research institutes, or schools of excellence in engineering. Comprehensively implement the 'Dual-Mentor System', appointing senior enterprise experts as industrial mentors. The Experimental Teaching and Management System (Chapter 4) will serve as the operational platform and quality controller for this deep integration, ensuring that university-enterprise cooperation is implemented and yields tangible results.

5.1.4 Expanding International Vision and Collaborative Cultivation Channels

Establish active cooperative relationships with top international universities, research institutions and leading manufacturing enterprises. Expand students' horizons by offering student exchanges, joint graduation projects, summer schools and international academic competitions. Introduce high-quality international courses and original textbooks, encouraging bilingual or English-only instruction. Support student participation in international standard-setting and academic conferences to cultivate their capacity for global competition and collaboration.

Figure 2 shows the logical architecture of the systematic cultivation mechanism. The four pillars (Curriculum, Pedagogy, Education Model and Channels) support each other and collectively contribute to the goal of shaping competencies.

5.2 A Multi-dimensional and Dynamic Evaluation System

The evaluation system acts as the 'baton', its effectiveness depends on the rich process data harvested from core activities such as experimental teaching.

5.2.1 Constructing a Comprehensive Evaluation Indicator System

Thoroughly reform the single-exam evaluation model by establishing a three-dimensional, comprehensive evaluation system that covers 'knowledge, ability and competency'. The specific observation points of this system, along with how they are supported by the experimental teaching system, are detailed in Table 2.

Table 2 Correspondence between the Three-dimensional Evaluation System and Experimental Teaching Support

Evaluation Dimension	**Core Elements**	**Key Observation Points / Evidence Forms**	**Supporting Sources from the Experimental Teaching System**
Knowledge Dimension	Interdisciplinary Integration	Interdisciplinary project analysis reports, system design proposals	Reports from Comprehensive/Innovation tier experimental projects
	Mastery of Cutting-edge Tech	Technology research reports, new tech application proposals	Usage records of new technological tools involved in experimental projects
Ability Dimension	Complex Problem Solving	Final project deliverables, problem-solving process documentation	Full-process records and outcomes of Capstone projects
	Innovation & Practice	Patents, prototypes, competition awards, business plans	Outputs from Innovative Research tier projects, preparation processes for various competitions
	Teamwork & Communication	Records of team role contributions, presentation defenses, collaboration logs	Team collaboration platform records from experimental projects, defense videos
Competency Dimension	Engineering Ethics & Responsibility	Ethical decision analysis within projects, social impact assessment reports	Discussion and decision records related to safety, environment, ethics in experimental projects
	Craftsmanship & Innovative Spirit	Operational standardization, iteration count, attitude towards failure	Operational precision in process data, project version iterations, records from 'Failure-tolerant' project reviews
	Global Vision	English literature reviews, international standard interpretations, cross-cultural communication reports	Participation records in international experimental projects or cooperative research topics

5.2.2 Implementing Process-oriented and Developmental Evaluation

Abandon the practice of 'one exam determining everything' and strengthen process assessment. Adopt a Learning Portfolio to record project participation, papers, awards, reports and reflections throughout the process. The experimental teaching management platform (see 4.3) automatically aggregates process data, which is the core material for building an e-learning portfolio. Multi-subject evaluations should be implemented by peers, oneself, mentors and enterprises. The purpose of evaluation should shift from identification to development, providing students with continuous feedback and guidance for improvement.

5.2.3 Establishing Recognition and Incentive Mechanisms for Innovative Outcomes

Create 'Innovation Credits', converting high-level competition awards, publications, patents and entrepreneurial ventures into the required credits. Set up special funds to support innovative, high-risk ideas. Introduce a 'tolerance for failure' mechanism that grants appropriate recognition to valuable failures encountered during exploration, thereby fostering a culture that encourages experimentation. The experimental teaching system, particularly the 'Innovative Research' projects, is the main incubator for these innovative outcomes.

5.3 Perfecting Comprehensive Safeguard Measures

Safeguard measures provide a stable and reliable operational foundation for the entire system, particularly the resource-intensive experimental teaching system.

5.3.1 Constructing a Comprehensive Evaluation Indicator System

The state and local governments should prioritise this training programme and offer preferential treatment in terms of student recruitment, funding, discipline setting and the evaluation and appointment of teaching staff. The education department should encourage colleges and universities to reform their systems and mechanisms to 'loosen the restrictions' on cultivating interdisciplinary talent. A special fund should be established to provide continuous support for teaching reform and the construction of the 'Four Modernisations' experimental platform.

5.3.2 Building a High-level 'Dual-Qualified' Faculty Team

The teaching staff are key. On the one hand, efforts should be made to introduce leading talent with a strong academic background and extensive industrial experience. On the other hand, a regular enterprise practice system should be established to enhance teachers' practical teaching abilities. Reform the evaluation, appointment and assessment of teaching staff, placing teaching achievements, contributions to industry-academia cooperation and the effectiveness of student guidance on an equal footing with research achievements. These are the driving force behind the 'experimental teaching and management system'.

5.3.3 Constructing Open and Shared Practical Innovation Platforms

Resources should be integrated and investment should be made in building high-level, practical platforms that integrate teaching, research, development and service. These platforms should possess bidirectional mapping capabilities between physical production lines and virtual digital spaces, covering all stages from intelligent design and processing to assembly, inspection and logistics. It must be open to the regional community to promote resource sharing, becoming a hub for talent cultivation and technological innovation. This is the concrete realisation of the 'Four Modernisations' platform advocated in Chapter 4.

5.3.4 Fostering a Culture of Courageous Exploration and Tolerance for Failure

We should promote the spirit of science and craftsmanship vigorously, fostering an academic atmosphere in which people dare to question, debate freely and tolerate failure. We should inspire enthusiasm through cutting-edge lectures, innovation workshops, technical salons and entrepreneurship competitions. Publicise the success stories of exceptional talent and encourage students to align their personal goals with the country's strategic demands. This culture enables the smooth operation of experimental teaching and management systems, encouraging students to take risks.

6 Conclusion and Future Directions

Intelligent manufacturing represents the future direction of the manufacturing industry, with top innovative talent at the helm of this journey. This paper systematically analyses the core issues within China's current talent cultivation system, focusing on knowledge structure, teaching models, industry-education integration and evaluation mechanisms. From the perspectives of national strategy, industrial development and international competition, it argues the extreme importance and urgency of undertaking systematic reconstruction.

In response, this paper proposes a systematic construction pathway comprising four pillars: 'Cultivation Mechanism', 'Experimental Teaching and Management System', 'Evaluation System' and 'Safeguard Measures'. Of these, the experimental teaching and management system, which is oriented towards deep industry-education integration, occupies a pivotal, connecting position. It guides laboratory construction towards the goals of 'management standardisation, configuration intensification, operation informatics, and resource sharing', innovates teaching content through a three-tier project system based on real industrial cases and ensures teaching quality through a 'whole-process refined' management model. This system seamlessly connects the pulse of the industry to the heart of teaching, providing an invaluable foundation for cultivating the engineering practice capabilities and innovative spirit of top talent. The system is closely linked to the cultivation mechanism, evaluation system and safeguard measures, forming a unified whole with consistent goals and logic and operating synergistically.

It should be noted that intelligent manufacturing technology is constantly evolving. This means that the talent cultivation system must also evolve dynamically and iteratively. In the future, new paradigms such as generative artificial intelligence and embodied intelligence will undoubtedly give rise to adjustments in the content, platforms, and management models of experimental teaching. AI-assisted experimental design, metaverse-supported immersive training and big data-based personalised learning path recommendations, for example, will all be areas in which the system will evolve. Therefore, universities, governments, enterprises and society must collaborate to create a mechanism for continuous feedback, evaluation and optimisation. They should also collaborate to develop a new model for cultivating innovative, top-tier talent in intelligent manufacturing that will lead the way in the future. This will lay the groundwork for the prosperous development of manufacturing in China and the rest of the world.

References

[1] Magome T. The front line of A.I. Artificial Intelligence in a medical field -whether medicine changes by A.I. [J]. Journal of Integrated Management for Risk and Crisis, 2020, 4: 3-18. https://doi.org/10.34402/simric.4.0_3

[2] Zhang S, He H, Yang X. Human-centric proactive integrated design paradigm of intelligent manufacturing system towards Industry 5.0 [J]. Journal of Manufacturing Systems, 2025, 83(000): 65-81. https://doi.org/10.1016/j.jmsy.2025.09.002

[3] Chowdary K V V S R, Kumar K, Nayak B. A comprehensive examination of shielding and core influence through finite element analysis for the dynamic wireless charging magnetic coupler [J]. e-Prime - Advances In Electrical Engineering, Electronics And Energy, 2024, 7(000). https://doi.org/10.1016/j.prime.2024.100462

[4] Yuanbin L I. Organizational paradigm change: Exploration and reflection on the construction of philosophy and social science laboratories in universities [J]. Experimental Technology & Management, 2024, 41(3). https://doi.org/10.16791/j.cnki.sjg.2024.03.037.

[5] Zhang L, Li K, Chu C, et al. Investment and remanufacturing strategies considering the application of intelligent manufacturing in hybrid manufacturing-remanufacturing systems [J]. Expert Systems with Applications, 2024, 257(000): 21. https://doi.org/10.1016/j.eswa.2024.124991

[6] Kenfield M R, Tannenbaum A P, Hess A S R W N. Fundamentals of blood banking in anesthesiology: A problem-based learning simulation session as an addition to a novel curriculum of transfusion medicine education for anesthesiology residents [J]. academic pathology, 2023, 10(3). https://doi.org/10.1016/j.acpath.2023.100089

[7] Sherman B. Unraveling the EFL expat: challenging privilege through borderlands and Asia as Method [J]. Asia Pacific Education Review, 2023, 24(2): 12. https://doi.org/10.1007/s12564-022-09790-5

[8] Edna Milena Sarmiento-Márquez, Prieto L P, Poom K, et al. Monitoring and Evaluating School-University Partnerships: Insights from the Usability Assessment and Refinement of a Conceptual Framework [J]. Social Sciences & Humanities Open, 2024. https://doi.org/10.2139/ssrn.4781252

[9] Li K W. Fostering Students' Statistical Thinking through Data Modelling [J]. Mathematics Education Research and Practice, 2023, 26(3): 127-146. https://doi.org/10.7468/jksmed.2023.26.3.127

[10] Singh J. Cost-Efficient Secure Hybrid RAG Assessment [J]. Advances in Machine Learning & Artificial Intelligence, 2025. https://doi.org/10.36227/techrxiv.173152556.61823435/v4

[11] Li X, Zhou T, Cao S. Digital transformation, supply chain collaboration, and corporate innovation boundaries [J]. International Review of Economics & Finance, 2025, 104(000). https://doi.org/10.1016/j.iref.2025.104628

[12] Wang Z L, Yan-Ru W U, Shi X F. Top-notch Does Not Equate to Innovation——Exploring Misconceptions and Crack Solutions in Cultivating Top-notch Innovative Talents [J]. Modern Educational Technology, 2024, 34(12): 5-16. https://doi.org/10.3969/j.issn.1009-8097.2024.12.001

[13] Bhandarkar V V, Kumar A, Tandon P. Warpage detection in 3D printing of polymer parts: a deep learning approach [J]. Journal of Intelligent Manufacturing, 2025, 36(5). https://doi.org/10.1007/s10845-024-02414-2

[14] Basei M, Ferrari G, Rodosthenous N. Uncertainty over uncertainty in environmental policy adoption: Bayesian learning of unpredictable socioeconomic costs [J]. Journal of Economic Dynamics and Control, 2024, 161. https://doi.org/10.1016/j.jedc.2024.104841

[15] Yan Y U, Kanghua L I, Guoyi Y U, et al. Integrated modular design and practice of semiconductor physics experiment teaching [J]. Experimental Technology and Management, 2025, 42(10): 169-176. https://doi.org/10.16791/j.cnki.sjg.2025.10.021

[16] Xu W, Chen R, Zhang L, et al. Reform and Practice of the Teaching System of Combining Virtual and Real Teaching in the Experimental Course of "Asphalt and Asphalt Mixture" [J]. Advances in Transdisciplinary Engineering, 2024. https://doi.org/10.3233/atde231376

[17] Caudill D W, Slater P J. Content analysis and ranking model of research related to qualities of excellent college teaching: Implications for business educators [J]. Journal of Education for Business, 2024, 99(4): 213-222. https://doi.org/10.1080/08832323.2023.2299430