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Exploring the Industry-Academia Co-Creation Model for Graduate Education in Sector-Specific Universities: Evidence from Harbin Engineering University's Practice

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Abstract: Under the framework of emerging graduate education models, Industry-Academia Co-Creation Model (IACM) significantly enhances graduate students' innovative capabilities and industry relevance. This study takes Harbin Engineering University as an example to propose a collaborative innovation framework for graduate education, grounded in the *Emerging Engineering Education* paradigm. Through critical analysis of the limitations inherent in the traditional graduate training model and the imperative for IACM, we propose four IACM pathways for graduate students' training, comprising dual-advisor system, university-enterprise joint development of training programs & curriculum system, industry-university-research-application (IURA) collaboration platform and quality-centric evaluation metrics. These strategies cultivate "theory-application integration" competencies in graduate students, achieving dual objectives of elevating the quality of talent development in universities and addressing industry demands for real-world engineering solutions, thereby in line with the evolution of modern higher education.

Keywords: Industry-Academia Co-Creation Model, sector-specific universities, talent development, Harbin Engineering University, graduate student

1. Introduction

Amid the *Double First-Class* construction and *Emerging Engineering Education* reform, sector-specific universities, serving as pivotal hubs for high-level engineering talent development, play pivotal roles in driving China's industrial upgrading and technological innovation through their graduate education outcomes. Nevertheless, the accelerating pace of technological advancement and evolving societal demands have exposed critical limitations in traditional training paradigms. Based on this, the paper takes Harbin Engineering University as a case study, and examines its IACM of graduate students with industry-specific characteristics formed in its long-term practice of serving national strategies and industrial needs as a university with characteristics in the field of shipbuilding industry. This model meets the needs of the development of national strategies and provides a reference experience for the training of high-level graduate students in the new era, thus helping to realize the goal of *Education Powerhouse* (Ke, 2024).

2. The Dilemmas of the Traditional Graduate Student Training Model

2.1. Academic programs lag behind industry advancements

Traditional graduate student training model often lags behind industry advancements, essentially resulting from the mismatch between

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academic frameworks and real-world industry demands. This mismatch manifests through three critical dimensions. Initially, the rapid pace of technological evolution in modern society reveals a growing temporal gap between academic curricular systems and industry innovation cycles. This leads to a dilemma where traditional training content struggles to keep pace with evolving industry demands. For example, it is difficult to match with emerging fields such as big data and artificial intelligence accurately. Secondly, traditional graduate students are trained under a single-advisor system. But because most advisors are "theoretical scholars", and the content of their trainings is still limited to their own specialties, this is likely to lead to a disconnect between the direction of talent development and the needs of society. Thirdly, due to the lack of guidance from frontline industry practitioners, academic advisors cannot obtain the real needs of enterprises in time, not to mention the transformation of achievements and service to society. And this results in talent development and industry development not progressing together.

2.2. Emphasize theory over practice

The traditional model of graduate students' training focuses on the inculcation of theories, but lacks the cultivation of practical ability. First, from the perspective of the evaluation mechanism, since the graduate students' entrance examination, the mode of talent development has left the shadow of examination-oriented education, that is, the selection of talents through scores. Moreover, the exam content is mostly confined to textbook knowledge. As a result, graduate students' ability to innovate cannot be improved effectively. Second, from the conceptual point of view, many higher education institutions have not fundamentally changed their educational philosophy from "imparting knowledge to students" to "enhancing students' abilities". This consequently leads to many universities in accordance with the traditional training concepts fail to cultivate "theory-proficient and practice-capable" professionals that meet the demands of the new era.

2.3. Homogeneous evaluation criteria

The traditional model of graduate students' training paradigm exhibits an over-reliance on examination scores as the primary evaluative metric. This inadvertently cultivates a grade-centric mentality among students, marginalizing the cultivation of engineering practical outcomes and technological translation competencies. In addition, under the pressure of intense global academic competition, universities tend to pursue more standardized evaluations, such as the quantity of academic papers, so as to obtain higher international rankings and disciplinary assessments (Kang et al., 2025). This inadvertently steers graduate education into a "standardization trap". At the same time, graduate students naturally lose their critical thinking and innovation ability.

3. The Goal and Significance of IACM for Graduate Students

3.1. The goal of IACM

In the face of the multiple challenges of the traditional graduate students' training models, the goal of IACM is particularly important. As a university with industry-specific characteristics in the field of shipbuilding industry, Harbin Engineering University aims to establish a comprehensive graduate education system encompassing "demand-driven orientation, collaborative research, and achievement transformation". The realization of this goal not only requires a dual-advisor system as a power guarantee, but also requires the setting of a reasonable talent development program and IURA collaboration platform. Additionally, it is also particularly important to establish an evaluation system with the quality of talent training as the core. In this process, universities provide enterprises with knowledge and technology, and enterprises provide universities with market information and application scenarios. This symbiotic relationship facilitates complementary advantages between universities and enterprises, ultimately cultivating high-level compound engineering technology talents capable of addressing real-world challenges.

3.2. The significance of IACM

IACM can achieve a win-win situation for universities, enterprises and society. From the academic perspective, this partnership enables universities to rapidly enhance graduate students' practical and innovative capabilities, ultimately contributing to the establishment of an innovative talent development system. From the corporate standpoint, IACM enable enterprises to utilize the talent advantages and knowledge spillovers of universities to track the frontier of scientific research and thus accelerate technological innovation. From the societal perspective, university-industry partnerships effectively promote the employment of university graduates (Arranz et al., 2022). Academic research breakthroughs gain accelerated commercialization through corporate channels, creating a self-reinforcing cycle where education drives industry growth and industry progress elevates community prosperity.

4. Path Selection of IACM for Graduate Students

Under the mechanism of IACM for graduate students, we take Harbin Engineering University as a representative case to explore the specific training path selection. The specific implementation plan is shown in Figure 1.

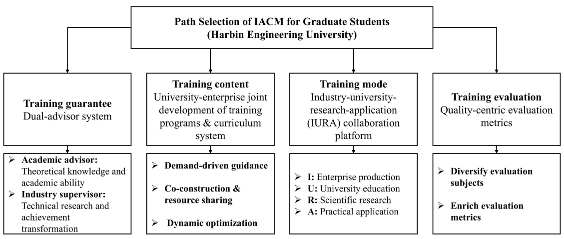

Figure 1 The Implementation Paths of IACM for Graduate Students in Harbin Engineering University

4.1. Training guarantee: dual-advisor system

The faculty team is the dynamic main body of graduate students' training. Traditional graduate students are often trained under a single-advisor system, where a graduate student is guided solely by an academic advisor. However, due to the difficulty of practical exposure to real production scenarios, graduate students often lack the ability to solve complex engineering problems. Therefore, university leaders should establish a dual-advisor system that cultivates graduate students through integrated theory and practice. The dual-advisor system refers to the joint cultivation by an academic advisor and an industry supervisor (Li, 2024). Among them, industry supervisors are usually frontline experts with rich practical experience. This dual-advisor system between universities and enterprises, leveraging horizontal collaboration (industry-academia projects) and vertical research initiatives (government-funded programs) as practical platforms, integrates the theoretical expertise of academia with the technological resources of industry. It not only enhances graduate students' academic innovation capabilities but also effectively cultivates their practical competencies in addressing industrial technological challenges.

Harbin Engineering University, capitalizing on its disciplinary strengths in shipbuilding industry and ocean engineering, establishes a dual-advisor system. This innovative framework aims to resolve the long-standing disconnect between theoretical knowledge and practical application inherent in traditional single-supervisor training models. Academic advisors focus on academic guidance, primarily responsible for ensuring mastery of theoretical knowledge and tracking academic frontiers, thereby guaranteeing the rigor and compliance of academic research. Industry supervisors are comprised of frontline experts from leading industry players and research institutes such as China State Shipbuilding Corporation (CSSC), Harbin Electric Corporation (HE) and so on. Their primary responsibility is to guide students in tackling critical technological challenges and translating research outcomes into practical applications. Taking the College of Power and Energy Engineering as an example, the "National Exemplary Joint Training Base for Engineering Professional Degree Graduate Students", co-established by the school and the 703rd Research Institute of China Shipbuilding Industry

Corporation (CSIC), adopts a "1+1" training model. Under this model, graduate students focus on building their academic foundation through the on-campus curriculum during the first academic year. In the second year, they are directly stationed at the enterprise to conduct technological breakthroughs in key areas under the technical guidance of industry supervisors. Furthermore, the thesis topics for these graduate students are directly derived from the practical needs of the enterprises they are stationed in.

4.2. Training content: university-enterprise joint development of training programs & curriculum system

Currently, while China's IACM for graduate education has achieved initial progress, it still faces challenges such as insufficient sustained motivation in constructing industry-education integration platforms and inadequate depth in university-enterprise collaboration (Zhang, 2022). Therefore, it is crucial to establish an effective university-enterprise joint training program and curriculum system. In developing talent cultivation plans, university leaders should adhere to the principles of "demand-driven guidance, co-construction & resource sharing, and dynamic optimization". "Demand-driven guidance" means aligning training programs and curricula with industry technological advancements and corporate needs to avoid an insular approach. "Co-construction & resource sharing" involves integrating universities, enterprises, advisors, and graduate students into the talent development framework, while emphasizing industry-specific priorities in course design. "Dynamic optimization" refers to continuously evaluating and adjusting training plans and curricula based on graduate employment outcomes, evolving enterprise demands, and cutting-edge technological advancements.

In terms of training programs, Harbin Engineering University has established a talent cultivation system by deepening the integration of emerging engineering education with industry. Leveraging its disciplinary strengths in shipbuilding industrial software, the university collaborates with leading enterprises in the industry, such as China State Shipbuilding Corporation (CSSC), to cultivate "dual-competency" graduate talents who possess both maritime expertise and software operation skills. Regarding course design, Harbin Engineering University actively promotes a co-teaching model involving both academic and industry experts. For instance, the course "Computational Ocean Acoustics" is jointly developed by Harbin Engineering University's College of Underwater Acoustic Engineering and the National Key Laboratory of Underwater Acoustic Countermeasure Technology in Zhanjiang, Guangdong. This course integrates theoretical instruction from university faculty (covering progressive analysis principles, WKB approximation methods and so on) with practical applications taught by industry professionals, such as analyzing underwater acoustic field characteristics. Aimed at fostering students' ability to "apply theoretical knowledge to practical applications", this collaborative model enhances graduate students' engineering practice capabilities and professional competencies through shared curriculum development, resource integration, and faculty synergy. It serves as a valuable reference for sector-specific universities implementing IACM.

4.3. Training mode: IURA collaboration platform

In the model of IURA, "I" refers to enterprise production, "U" is university education, "R" is scientific research, and "A" means practical application. The IURA collaboration model can be traced back to the "quadruple helix theory" (Loet & Henry, 2003). Building upon the traditional IUR tripartite framework, this theory introduces users as the fourth stakeholder, emphasizing synergistic collaboration among industry, universities, research institutions, and end-users. Its core objective is to leverage academic research resources and corporate practical environments for resource sharing and complementary advantages, with the goal of meeting user demands and cultivating versatile, innovative talents in higher education for the modern era. This kind of cooperation mode between universities and enterprises will play a two-way promotion role. On the one hand, the basic research of universities can be realized through the transformation of the results of enterprises, thereby better serving end-users. On the other hand, the knowledge and technology spillovers from universities accelerate enterprises' technological innovation and competitiveness. (Cao et al., 2023). For policy-makers, expanding IURA collaboration platforms should be prioritized to accelerate the translation of academic innovations into real-world solutions that address societal needs.

In recent years, Harbin Engineering University has vigorously developed IURA platforms. For instance, the School of Economics and Management has launched a joint doctoral program with the China International Engineering Consulting Corporation (CIECC), aiming to cultivate industry-leading engineers with modern consulting expertise. Under this program, CIECC provides practical training platforms for graduate students, while Harbin Engineering University offers theoretical learning frameworks. Students are required to deepen their theoretical knowledge through hands-on enterprise projects. On January 15, 2025, Harbin Engineering University further established the Institute of Carbon Neutrality and the Institute of Marine Digital and Intelligent Technology, creating IURA collaboration platforms that bring together renowned professors and industry experts. These initiatives leverage the university's disciplinary strengths in its signature shipbuilding industry domain. By integrating industry resources with educational elements, Harbin Engineering University systematically advances the development and implementation of an innovative talent cultivation system, setting a benchmark for engineering education reform.

4.4. Training evaluation: quality-centric evaluation metrics

In the evaluation of talent cultivation quality, traditional approaches exhibit significant limitations. First of all, there is a singularity in evaluation subjects, as assessments are confined to internal academic evaluations conducted solely by university supervisors. Secondly, the evaluation metrics are oversimplified, overly relying on quantitative measures like publication counts rather than practical competencies as criteria for graduate student evaluation. Hence, within IURA framework, policy-makers are supposed to track quality-centric evaluation metrics. Firstly, diversify evaluation subjects: establish a multi-stakeholder assessment framework that integrates the government's macro-level oversight, the universities' academic guidance, and enterprises' practical expertise. This includes peer-assessment and self-assessment mechanisms involving all stakeholders (Wang et al., 2024). Secondly, enrich evaluation metrics: develop a holistic evaluation system that accounts for graduate students' diverse strengths. Beyond academic performance (e.g., exam scores) and research outputs (e.g., publications), prioritize assessing hands-on practical skills and innovative capabilities to align with industry demands.

In talent cultivation evaluation, Harbin Engineering University has established a multi-subject and multi-metric assessment framework. In terms of diversified evaluation subjects, Harbin Engineering University adopts a "dual-advisor system". Among this, academic advisors oversee students' academic integrity and ensure alignment between corporate internships and thesis requirements. While industry supervisors actively participate in curriculum design, thesis topic selection, and defense evaluations, ensuring assessment criteria closely align with industry demands. As for diversified evaluation metrics, Harbin Engineering University moves beyond the "publication-centric" model by incorporating patents, technology commercialization outcomes, and other innovation-driven indicators into its evaluation system. This shift effectively bridges the gap between academia and industry, facilitating the transition of research achievements "from the lab to the production line".

Conclusion

The IACM model has achieved remarkable results in graduate students' training in sector-specific universities. Under the background of

Double First-Class construction and *Emerging Engineering Education* reform, this study explores the dilemmas of traditional graduate students' training mode and the goal and significance of IACM, taking Harbin Engineering University as an example. At the same time, this paper describes the path selection of graduate students' IACM systematically, including the implementation of dual-advisor system, the joint development of training programs & curriculum system, the establishment of IURA collaboration platform, and quality-centric evaluation metrics. The IACM can not only improve the theoretical knowledge level of graduate students, but also strengthen the practical application ability of graduate students effectively. In the future, for the needs of China's major research in the field of core technology, sector-specific universities should deepen IACM mechanism, focusing on cultivating high-level composite engineering and technology talents to support the development of modern industrial system.

Conflict of Interest

The authors declare that they have no conflicts of interest to this work.

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