

# Reform Initiative for Engineering Masters' Education with Energy and Power Characteristics: A Case Study of North China Electric Power University

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**Abstract:** In light of the global energy and power sector's rapid shift towards decarbonization, digitalization, and intelligence enhancement, a structural misalignment has arisen between the traditional master's degree training model in engineering and the industry's changing requirements. In addressing this difficulty, North China Electric Power University (NCEPU), characterized by its unique industrial focus, has taken an innovative initiative by implementing the Outcome-Based Education framework. The institution has implemented a backward design approach to create a new, continuously enhanced, collaborative training model that encompasses the entire educational process. Since its adoption, this strategy has exhibited exceptional outcomes in enhancing the integration of industry and education, ensuring a precise alignment between talent development and industrial requirements. This paper utilizes NCEPU as a case study to systematically examine the fundamental concepts, specific measures, and implementation strategies of its reform in the training model for engineering master's students. It begins with a comprehensive analysis of the industry's current state and the identification of existing issues, followed by the exploration of optimization strategies for student enrollment and training processes through the reverse chain of graduation outcome reform as the primary pathway. Empirical evidence indicates that an outcome-oriented training system markedly improves students' practical innovation skills and professional adaptability, ensuring a robust foundation for the development of high-quality engineering talent and presenting a replicable and scalable model for other industry-specific universities to facilitate the reform of engineering master's education.

**Keywords:** Master of Engineering; Training program; Innovative achievements; Electric power industry; School-enterprise cooperation



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The worldwide energy and power sector is presently experiencing a revolution marked by low-carbonization,

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digitization, and intelligentization. The National Energy Administration has clearly articulated the necessity to “advance the profound integration of digital technology with the development of the energy sector and enhance the establishment of new infrastructure that amalgamates traditional energy with digital and intelligent technologies”. At this pivotal moment for the energy and power sector, continuous technical innovation is vital, alongside a significant cohort of well-rounded engineering master’s graduates with robust professional foundations and extensive competencies. Traditional engineering master’s training models are plagued by issues including uniformity in educational objectives across academic programs, inadequate alignment between professional orientation and societal needs, subpar professional practice outcomes, and a deficiency of practice-oriented faculty. These deficiencies lead to a disjunction between talent development and corporate requirements, alongside inadequate engineering practice skills among graduate students (Yu, 2023). Consequently, colleges ought to promote the development of students’ practical competencies and the enhancement of their holistic capabilities. This entails highlighting practical elements such as course-based projects, internships, and fieldwork, while advocating a transition from a “scientific paradigm” to an “engineering paradigm”. The objective is to cultivate proficient experts adept at adapting to engineering technologies and resolving intricate issues, therefore fulfilling the requirements of national and regional energy and power sectors while promoting economic development and advancement.

To this end, universities across China are actively adapting and pursuing transformative changes. For instance, Tongji University has investigated pedagogical reforms for practice-oriented engineering courses within the “dual carbon” framework (Wang et al., 2022); Hangzhou Dianzi University has created on-campus practice facilities as autonomous exploration environments connecting academic knowledge with industry practice (Xie & Ni, 2020). Zhejiang Sci-Tech University has established a collaborative training mechanism involving government, academia, and industry for engineering master’s programs, employing an immersive, practice-oriented educational approach aimed at fostering intrinsic motivation among faculty and students, while developing a comprehensive competency evaluation system (Chen, 2023). The varied strategies among universities collectively delineate the exploratory trajectory for reforming engineering master’s programs. Nonetheless, institutional innovations in training models have primarily concentrated on partial optimizations inside the educational framework, neglecting the interrelations among different stages. This oversight reinforces systemic challenges: a structural misalignment between “training stages” and “graduation assessment” results in inadequate corporate involvement and cursory student practice.

North China Electric Power University has completed a detailed model rebuild. Employing “graduation outcomes” as the strategic pivot, it facilitates a comprehensive overhaul of the training process via reverse engineering, thereby creating a closed-loop educational system. This research employs the reform practices of North China Electric Power University as a case study to systematically elucidate its new engineering master’s training paradigm. This paradigm is primarily guided and evaluated by the reform of “graduation assessment standards” with the “reverse chain of graduation outcome reform” as its central approach. Empirical cases from the initial batch of graduates validate the reform’s substantial effectiveness in aligning talent cultivation with industrial demands. This is a pragmatic framework for the integration of industry and education in engineering talent cultivation and gives a reproducible, scalable approach for reforming professional degree graduate education in China’s energy and power colleges.

# 1 Graduation Outcomes-Driven Reverse Chain

## 1.1 Core Concept

In 2022, China's Organization Department, in conjunction with nine ministries and commissions, initiated a unique program to overhaul engineering master's and doctoral curricula. This strategy mandates universities to engage with firms in critical industries through work-study alternation models to collaboratively develop engineering master's and doctoral candidates. Students may obtain degrees by demonstrating their practical accomplishments, signifying a significant advancement in the assessment reform of engineering master's and doctoral programs. In this context, North China Electric Power University developed a student-centered talent cultivation system emphasizing practical experience. The institution commenced a reverse-engineered, comprehensive reform process centered on the "graduation exit point". This training program is initiated at the student enrollment phase, including thesis selection, graduation criteria, and curriculum development. During the process, teaching operations are meticulously structured and monitored, with immediate instructional enhancements informed by the quality of results and input from academic management divisions. The objective is to reformulate the value framework of the entire training ecosystem.

The university shifted degree conferral criteria from institutional "academic judgment" to industrial "value recognition". Students may now pursue degrees founded on verified, substantial results derived from extensive industrial experience. Secondly, utilizing a diverse evaluation system for graduation outcomes, the phases of admission, topic selection and training are designed in reverse to align with an "output-oriented" core concept. This implements a project-oriented admissions framework and a project repository tailored to corporate requirements, while modifying the curriculum to integrate work-study alternation and profound practical experience concepts. Ultimately, by synthesizing feedback from internal and external sources along with practical results, the program perpetually identifies deficiencies in its current engineering master's curriculum by aligning with the developmental needs of the energy and power sector and the stipulations of the "dual carbon" strategy. This facilitates continuous enhancement of the teaching model, thereby fostering practice-oriented, multidisciplinary engineering master's graduates prepared for emerging engineering fields and the "dual carbon" strategic goals.

## 1.2 Comprehensive Assessment of Graduation Results and Corporate Certification Framework

The integration of industry and education is essential for improving the practical skills of engineering master's students. The primary obstacle in collaborative training between universities and corporations is the discordance between academic training goals and corporate requirements. The fundamental answer entails both parties forming a collaborative training consortium motivated by intrinsic requirements (Zhu et al., 2024).

Consequently, North China Electric Power University has established an innovative and multifaceted evaluation system for graduation outcomes. It explicitly articulates and enacts a principle: altering the degree evaluation criteria from "academic papers as the exclusive measure" to "practical achievements being commensurate with academic papers" and transforming the degree conferral standards from the university's "academic judgment" to the industry's "value recognition". Students can now apply for degrees based on validated substantive outcomes derived from extensive industry interaction, including engineering management practice reports, successful product design and research and development, technical solutions, and patent applications. This pushes students to amalgamate their efforts

with avant-garde engineering research, significant project design, and the innovation of new products or apparatus.

Moreover, to enhance university-industry collaboration, a corporate certification mechanism has been instituted for graduation project evaluations in conjunction with prominent national enterprises: certification authority is no longer exclusively vested in the university academic committee, but now includes “corporate acceptance stamps” and “evidence of application efficacy” as fundamental criteria. The institution concurrently conducts joint defense sessions with enterprises, mandating that industry specialists comprise at least 50% of the defense committee to guarantee substantial industry influence in degree conferral determinations. These measurements provide collaborative monitoring, assessment, and direction of student learning outcomes, hence fostering intrinsic motivation for proactive learning and active engagement among both enterprises and students. This establishes a robust framework for developing a system to expand engineering practice capabilities driven by internal demand. Table 1 presents a comparison of metrics before and after the reform.

**Table 1** Certification Standards and Process for Graduation Requirements

Process	Traditional Requirements	Reform Requirements	Certification Criteria
Form of Outcomes	Academic Papers	Product Design / Technical Solution + Practice Report	Innovation, Practicality, Feasibility
Achievement Certification	Academic Innovation Review	Corporate Acceptance Seal + Proof of Application Effectiveness	Value in Solving Real-World Problems
Defense Requirements	Led by Internal Experts	University-Industry Joint Defense (Enterprise Experts ≥ 50%)	Industry Recognition
Degree Conferral	Approved by the Academic Committee	Comprehensive evaluation by the university-industry joint committee	Achievement of Educational Objectives

### 1.3 Admissions Based on Projects and Correspondence with Research Topic Requirements

To guarantee that the engineering master’s talent cultivation system accurately corresponds to industrial requirements from the point of enrollment, thereby achieving “precision planning” and “demand-driven training”, North China Electric Power University has methodically developed and executed a “project-based” enrollment and training framework. This system incorporates the tenets of “outcomes-based education”, prioritizing the ultimate competency outcomes mandated by the business as the foundational element. It addresses genuine company project requirements to deconstruct enrollment strategies, training goals, and assessment standards. Concurrently, via the collaborative establishment of a “Demand Project Database” between the university and firms, businesses get comprehensive involvement in student development. They, in conjunction with the university, constitute a collaborative community for decision-making and implementation. This seeks to establish dynamic alignment in both structure and quality between the provision of high-level engineering talent and the strategic requirements of the energy and power sector through proactive project planning and a reciprocal “project-student” selection process. The adoption and institutionalization of these concepts guarantee that the talent cultivation process aligns with industry technological advancements and innovative development.

Initially, the establishment of the “Project Repository” was for topic selection. The university emphasizes essential core technologies that firms must address, including research initiatives like “Protection Control System Simulation Modeling and Intelligent Early Warning Technology”. These correspond to 377 master’s and doctoral engineering training subjects, encompassing 31 projects within national strategic R&D programs and significant national science and technology initiatives. A “Demand Project Repository” has been collaboratively built with 15 prominent firms, including

State Grid and China Datang, encompassing advanced domains such as ultra-high voltage transmission and renewable energy integration, as seen in Table 2.

Table 2 Overview of the University-Industry Collaborative Project Database

Business Domain	Project Repository	Affiliated Group
Smart Energy	Typical Fault Characteristics and Test Simulation for Flexible DC Grid Integration in Offshore Wind Power	State Grid
	Development of Digital Driver Chips for IGBTs and Driver Design	
	Simulation Modeling and Intelligent Early Warning Technology for Protection Control Systems	
	Research on Novel DC Converter Topologies Resistant to Commutation Failure and Prototype Development	
	Analysis of Weak Fault Characteristics in New Power Systems and New Protection Principles	China Electric Power Construction Corporation
	Prototype Development and Equivalent Testing Techniques for High-Voltage DC Transformers	
	Defense Technology Against Commutation Failure in Multi-Feed High-Voltage DC Transmission Systems	
New Energy	Electricity-Carbon Coordinated Control Technology for Multi-Type Power Sources, Including Wide-Area Distributed Renewable Energy Clusters and Clean Energy	China Three Gorges Corporation
	Research on Wake Effects and Ecological Impacts of Large-Scale Wind Farms	
	Complete Design and Engineering Demonstration of DC Collection Systems for Offshore Wind Farms	China Huadian

Secondly, implementing a mutual selection system between projects and students. The institution established a “project-student” mutual selection strategy focused on research projects to ensure harmonious alignment between talent development and industry requirements. This methodology incorporates genuine R&D initiatives based on national strategic priorities and industry leaders into the admissions process from the outset. In the selection process, students choose their research focus, practical framework, and future critical technical goals with the joint support of university and industry mentors. This effort seeks to convert students from “prospective graduate students” to “pre-engineers”, fulfilling the strategic objective of “entering the field upon enrollment”.

#### 1.4 Work-Study Integration and Intensive Practical Training Framework

This program aims to transcend the limitations of conventional training models and enhance the innovative capacities of engineering master’s students by developing a comprehensive training system that integrates “contextual learning” with “institutional safeguards” throughout the educational framework. This system employs a “1+2” work-study alternation model: the initial academic year emphasizes theoretical foundations and interdisciplinary coursework on campus, whereas the subsequent two years entail full-time engagement in partner enterprises for engineering practice and research projects, situating students within authentic R&D and production settings. A tiered practical teaching approach based on “3+3” project-based challenges is built, building upon this basis. Students are assured adequate exposure to frontline engineering through three months of fundamental internships followed by three months of technical problem-solving, enabling the development of comprehensive skills in cognition, involvement, and invention. Utilizing physical platforms like university-industry collaborative laboratories and practical training facilities, the program offers reliable resources to guarantee the adequacy and sophistication of practical training elements, as shown in Table 3.

Table 3 Phased Tasks and Requirements in the Training Process

Stage	Time Allocation	Core Tasks	Outcome Assessment	Responsible Party
Coursework	First Academic Year	Theoretical Foundations + Industry-Academia Collaborative Courses	Course Assessment + Project Design	On-campus Mentor
Corporate Internship	Years 2-3	“3+3” Project Development: 3-month foundational internship + 3-month technical challenge	Mid-term Review Report Prototype Testing Outline	Dual Mentorship
Deliverables	Year 3	Practical Outcomes Refinement Final Report Writing	Outcome Acceptance Review	University-Industry Expert Panel

To effectively facilitate the transition in engineering education from a “discipline-centered” to a “practice-centered” approach, the university has systematically restructured its curriculum from a traditional linear model to a “competency-oriented, multidimensional coupling” framework. The traditional course structure adhered to a linear progression of public foundation courses, professional foundation courses, professional elective courses and professional frontier courses, whose hierarchical framework failed to address the requirements for comprehensive competencies in intricate engineering contexts. The new curriculum system focuses on the synergistic integration of course modules and project-based practice, creating a pedagogical framework that thoroughly incorporates “knowledge-competency-context”, as shown in Figure 1. This system attains systemic innovation via three dimensions: Initially, it methodically reconstructs the public foundational course cluster by incorporating interdisciplinary subjects such as engineering ethics and project management, thereby creating a composite knowledge framework that amalgamates humanistic literacy with engineering cognition. Subsequently, it innovatively establishes “self-designed specialty course modules”, systematically integrating advanced content such as innovation design methodology, intellectual property strategy, and technology foresight analysis to form an interdisciplinary knowledge matrix. Third, it creates a closed-loop cultivation mechanism of “classroom learning-enterprise practice-outcome transformation”, integrating project-based learning throughout the entire talent development process through the collaboratively established “knowledge-action coupling field” between universities and enterprises. This redesign not only creates organic coherence between curricular material and industrial difficulties but also builds institutional frameworks for converting theoretical knowledge into engineering practice. Ultimately, it methodically develops students’ advanced cognitive and practical skills to address intricate issues in real-world engineering environments.

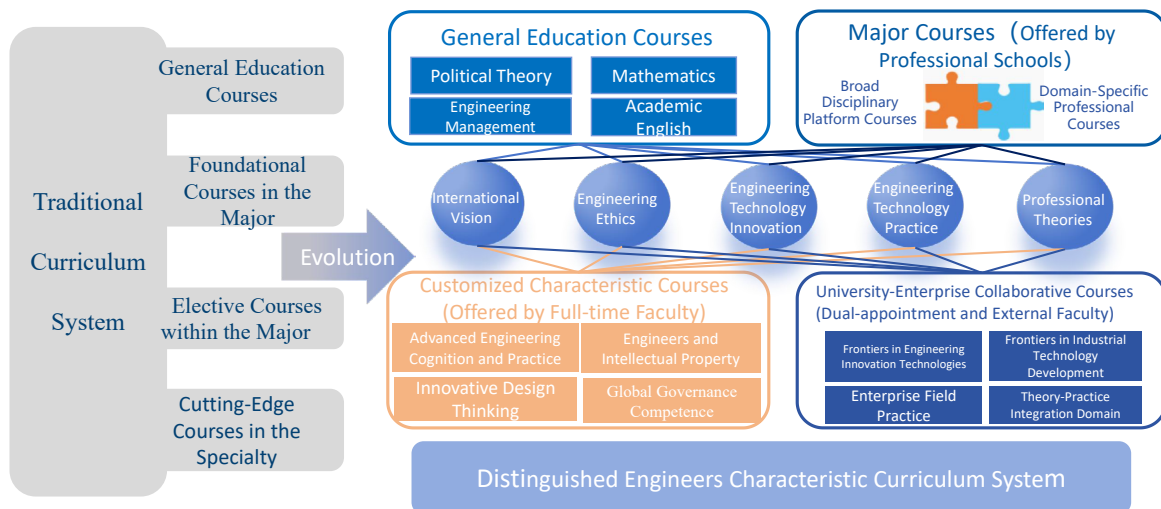


Figure 1 Comparison of Curriculum Framework Before and After Reform

Moreover, in accordance with the principle of industry-education integration, North China Electric Power University methodically promotes the reciprocal alignment of curriculum material and pedagogical approaches. The collaborative creation of 66 core courses with enterprises facilitates a systematic integration of general education with vocational training, as well as theoretical frameworks with practical implementation (Table 4). At the implementation stage, industry specialists actively participate in educational transformation, translating frontline industrial technological requirements into scientifically significant teaching challenges and case studies. In collaboration with faculty, they develop innovative teaching models to create a course implementation mechanism that addresses industry challenges and is supported by a cycle of theory and practice.

Table 4 University-Industry Joint Technical Specialty Courses

No.	Name	Key Field
1	Electric Vehicles and Energy Internet	Smart Energy
2	Modern DC Transmission Technology and Applications	
3	Energy Economics	
4	Electricity Market Theory and Technology	
5	Flexible Transmission Technology and Applications	
6	Power Grid Dispatch Automation	
7	New Energy Power Generation Control Technology	
8	Optimized Control Technology for Thermal Power Units	
9	New Energy Technologies	
10	Communication Network Planning and Reconfiguration Technology	Next-Generation Information and Communication Technologies
11	5G and Post-5G Communication Technologies and Their Applications	
12	Automatic Control Devices and Systems	
13	Fiber Optic Sensing Technology and Applications	
14	Perceiving Technologies for the Ubiquitous Power Internet of Things	New Materials
15	Course Development for Luminescent Materials and Devices	
16	Energy Internet and Protection Technology	
17	Cyberspace Security Sub-Protection	Cybersecurity
18	Big Data and Artificial Intelligence	Artificial Intelligence
19	Advanced Nuclear Detection Technologies and Applications	Nuclear Science and Technology
20	Application of Probabilistic Safety Analysis in Nuclear Power Plants	
21	Development of a Nuclear Accident Emergency Response and Consequence Evaluation Case Library	
22	AP1000 Nuclear Power Plant	

### 1.5 Four-Dimensional Dual-Mentor Educational Framework

To enhance the synergy between university and industry resources, the institution has methodically established a high-caliber, organized mentorship team. The “Implementation Rules for the Selection and Management of University-Industry Joint Training Mentors” delineate the responsibilities, rights, and participation mechanisms of industry mentors during critical phases such as topic selection, research, and evaluation, thereby institutionalizing industry engagement throughout the talent development continuum. The concurrent establishment of an “engineering-oriented” practice system for junior professors has enhanced engineering proficiency at the origin of mentorship resources. This has established a solid framework of university-enterprise mentoring defined by “complementary competencies, shared obligations, and cooperative education”. This has ultimately built a sustainable collaborative educational framework characterized by a four-dimensional linkage: “qualification access

— engineering empowerment — expert guidance — spiritual cultivation”. This mechanism efficiently guarantees complementary competencies, shared obligations, and a cohesive educational alliance between the university and enterprises. The specific manifestations are as follows.

**Qualification Access:** Enterprise mentors are required to possess senior professional technical titles or considerable engineering experience, and are recruited and appointed through a collaborative screening process between universities and enterprises. The university established the “Regulations on the Selection and Management of Externally Hired Graduate Advisors” and the “Implementation Rules for the Selection and Management of University-Enterprise Joint Training Advisors for Engineering Master’s and Doctoral Students”. Industry specialists endorsed by firms function as industry mentors, with clear stipulations for them to serve as principal advisors for thesis projects.

The “Management Measures for Engineering-Oriented Practice of Young Faculty at North China Electric Power University” mandates that engineering faculty must undertake a minimum of three months of engineering-oriented practice to qualify for senior professional titles or to verify student recruitment eligibility.

The institution presently boasts 104 corporate mentors, each with senior professional ranks or higher. This group comprises 15 scholars from the energy and power sector, including Huang Qili, Jin Hongguang, Shen Guorong, Chen Weijiang, Tang Guangfu, and Shu Yinbiao. Academician Shen Guorong’s team was recognized as one of the inaugural “National Outstanding Engineer Teams”.

**Fostering the Spirit:** The essence of educators is incorporated into the mentor cultivation management system. Adhering to the philosophy of “current exceptional engineers nurturing future exceptional engineers”, the institution integrates “outreach” with “inward development” to routinely implement corporate culture education, university-enterprise mentorship training, and symposiums. Scheduled mentor training sessions are conducted, necessitating business mentors to engage either virtually or in person.

## 2 Mechanisms of Reform and Paradigmatic Innovation

### 2.1 Chain Reaction of the Reform Driven by Graduation Outcomes

This structural reform focused on graduation criteria has produced a significant “backward pressure” effect on the engineering master’s training system, instigating a series of systemic and chain-reaction paradigm transformations. This is explicitly demonstrated in the following three dimensions.

#### 2.1.1 Transforming Student Motivation to Establish an Intrinsic “Problem-Driven” Framework

In the conventional paradigm, students concentrated their learning goals on producing thesis papers that adhered to academic standards, regarding industry practice as an ancillary resource for thesis composition. The reform directly associates graduation outcomes with the efficacy of addressing real-world corporate issues, transforming students’ learning environments and identities, and redirecting their motivation from completing external academic requirements to generating intrinsic value through the resolution of practical engineering challenges. This essential reorientation of goals effectively resolves the systemic problem of superficiality in practical training elements.

### **2.1.2 Reconstructing the rationale for business engagement to establish strategic alliances centered on “value co-creation”**

According to resource dependency theory analysis, pre-reform firms regarded student internships as social responsibility efforts, devoid of an intrinsic desire for substantial engagement. This reform mechanism restructures the resource exchange dynamics between universities and corporations by connecting student projects with corporate technological issues that are considered “bottlenecks”. Within this framework, corporations evolved from passive beneficiaries to proactive investors motivated by strategic imperatives to get essential intellectual resources and surmount technological obstacles. To enhance R&D efficacy, corporations freely opened core production environments, allocated superior mentoring resources, and offered genuine project platforms, ultimately effecting a strategic transition from unilateral resource provision to reciprocal value creation.

### **2.1.3 Facilitating the Redesign of the Training Process to Attain Comprehensive Transformation Throughout the Entire Chain**

At the curriculum level, a course structure that thoroughly integrates theory and practice must be designed to effectively enable systematic solutions for complex engineering challenges. This entails the systematic integration of project-based learning and innovative multidisciplinary courses to attain a cohesive unity of knowledge acquisition and skill development. At the mentor mechanism level, improvements in graduation standards have imbued the “dual-mentor system” with significant value. Institutional mandates necessitate the complete involvement of enterprise mentors throughout the phases of topic selection, research, and evaluation, thereby assuring that research projects directly tackle the fundamental challenges of engineering practice. The university has implemented a quality assurance system for process management that includes various checkpoints, such as mid-term reviews and prototype testing, to facilitate comprehensive monitoring and goal-oriented management of long-term industry placements. This sequence of interconnected reforms constitutes a systematic educational response to graduation standard reform, providing a new outcomes-oriented training paradigm.

## **2.2 Establishing a Closed-Loop Framework Focused on “Outcome-Oriented” Reform**

This reform initiative at Huadian University substantiates a new theoretical framework: strategically aligning changes with “graduation outcomes” to provide a multifaceted evaluation system that equally prioritizes practical accomplishments and academic publications. This framework significantly enhances the intrinsic motivation of both students and enterprises, the two principal stakeholders, thereby facilitating a thorough reorganization of the curriculum system, teacher distribution, and talent development management. Ultimately, it fulfills the training goals of “accurate demand alignment and robust competency development”, while concurrently strengthening the “profound university-enterprise integration” training environment, as shown in Figure 2.

This paradigm departs from the conventional linear perspective of “process preceding outcome”. It innovatively utilizes “preset outcome standards” to facilitate “process reengineering”, establishing a self-validating, self-reinforcing high-quality closed-loop system. This embodies the fundamental innovation that differentiates North China Electric Power University’s reform strategy from comparable projects and facilitates its exceptional efficacy.

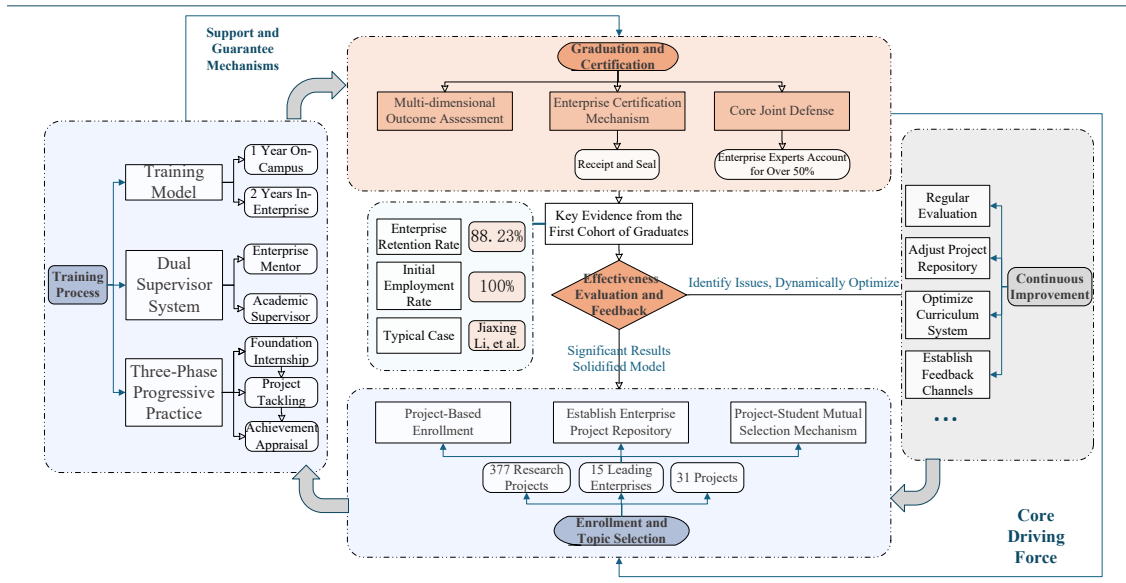


Figure 2 Closed-Loop System of Huabei Electric Power University's Training Program Reform

### 3 Evaluation of Reform Results and Experiences Synopsis

#### 3.1 Examination of Reform Results

Presently, North China Electric Power University's specialized reform effort for engineering master's and doctorate programs has developed collaborative educational platforms with 15 prominent energy and power firms, including State Grid and China Huaneng, as shown in Table 5. This initiative aims to address frontline engineering difficulties in organizations, directing students to confront industry-critical bottleneck technologies via practical research. This strategy maximally utilizes its "traction" function to enhance the reform of professional degree graduate education. The successful advancement of projects such as the "Self-Powered Micro-Detection Device for Rotating Components in New Energy Stations" has not only transcended the conventional assessment framework for doctoral theses but also catalyzed significant progress in the reform of engineering master's education.

Table 5 Employers of 2025 Professional Master's Graduates

No.	Employer Name
1	State Grid Corporation of China
2	China Datang Corporation Limited
3	State Power Investment Corporation Limited
4	China General Nuclear Power Group Co., Ltd.
5	China Power Engineering Consulting Group Co., Ltd.
6	China Huadian Corporation Limited
7	Beijing Energy Group Co., Ltd.
8	Harbin Electric Group
9	Hubei Energy Group
10	China Southern Power Grid Co., Ltd.
11	China Three Gorges Corporation

This year signifies a crucial milestone following the execution of the “Special Pilot Program for Reforming Engineering Master’s and Doctoral Education”, as it witnesses the graduation of the inaugural cohort of engineering master’s students. This milestone highlights the program’s incremental accomplishments. Evidence illustrates its significant efficacy in thoroughly improving the quality of graduate education and employment competitiveness.

The first batch of specialized engineering master’s graduates attained a 100% employment rate. Of these, 88.23% of graduates continued with their collaborative training organizations. Moreover, State Grid, China Datang, China Energy Engineering Group, and other corporations collaboratively recruited students from the joint training program, thereby developing effective talent mobility channels across key industrial entities. The notable results of this reform have attracted significant coverage and extensive attention from major media outlets, including China Education Television and China Education Daily.

Significantly, within the inaugural group of graduates, 67 students (Zhang, 2025) successfully obtained their degrees through various practical accomplishments, including product design, solution design, and case analysis reports, thereby exemplifying the creativity and efficacy of the reformed training approach. Li, a master’s student in engineering at North China Electric Power University, successfully defended his thesis in 2022 and earned his degree for his product design titled “Self-Powered Micro-Detection Device for Rotating Components in New Energy Stations”. The student acquired a notable competitive advantage in the job market relative to peers, building on this performance. By early July, they obtained employment at China Datang Corporation Limited, a state-owned energy behemoth. This accomplishment mostly derives from their involvement in the specialized program three years ago. Upon enrollment, the student engaged in studies and research under the dual mentorship of academic and industrial professionals, achieving technical advancements in the power sector as their career goal. The research topic, “Online Monitoring System for New Energy Stations”, was collaboratively established by the student, academic adviser, and industrial mentor. This collaborative methodology established a research-practice continuum focused on practical issues and defined by the “integration of learning and application”, emphasizing the institutional benefits of industry-education partnerships in talent development.

### 3.2 Synopsis of Reform Experiences

This research examines the educational system of North China Electric Power University as a case study for the cultivation of well-rounded individuals. To tackle practical issues in contemporary engineering master’s programs, the institution incorporated theories such as “industry-education integration” to develop a reverse system design methodology based on graduation outcomes. The institution consistently examines and refines each training element, establishing a closed-loop continuous improvement system of “problem identification-solution optimization-effectiveness evaluation-re-identification”. This facilitates dynamic optimization and iterative enhancement of the engineering master’s training system, as shown in Figure 3. This initiative offers a groundbreaking framework for regional universities to develop exceptional graduate students endowed with both inventive skills and engineering proficiency, capable of tackling intricate scientific and engineering problems. It not only promotes the intrinsic development and ongoing enhancement of engineering master’s education but also provides essential guidance for regional institutions to further reforms in professional degree education and increase the quality of high-level applied talent supply.

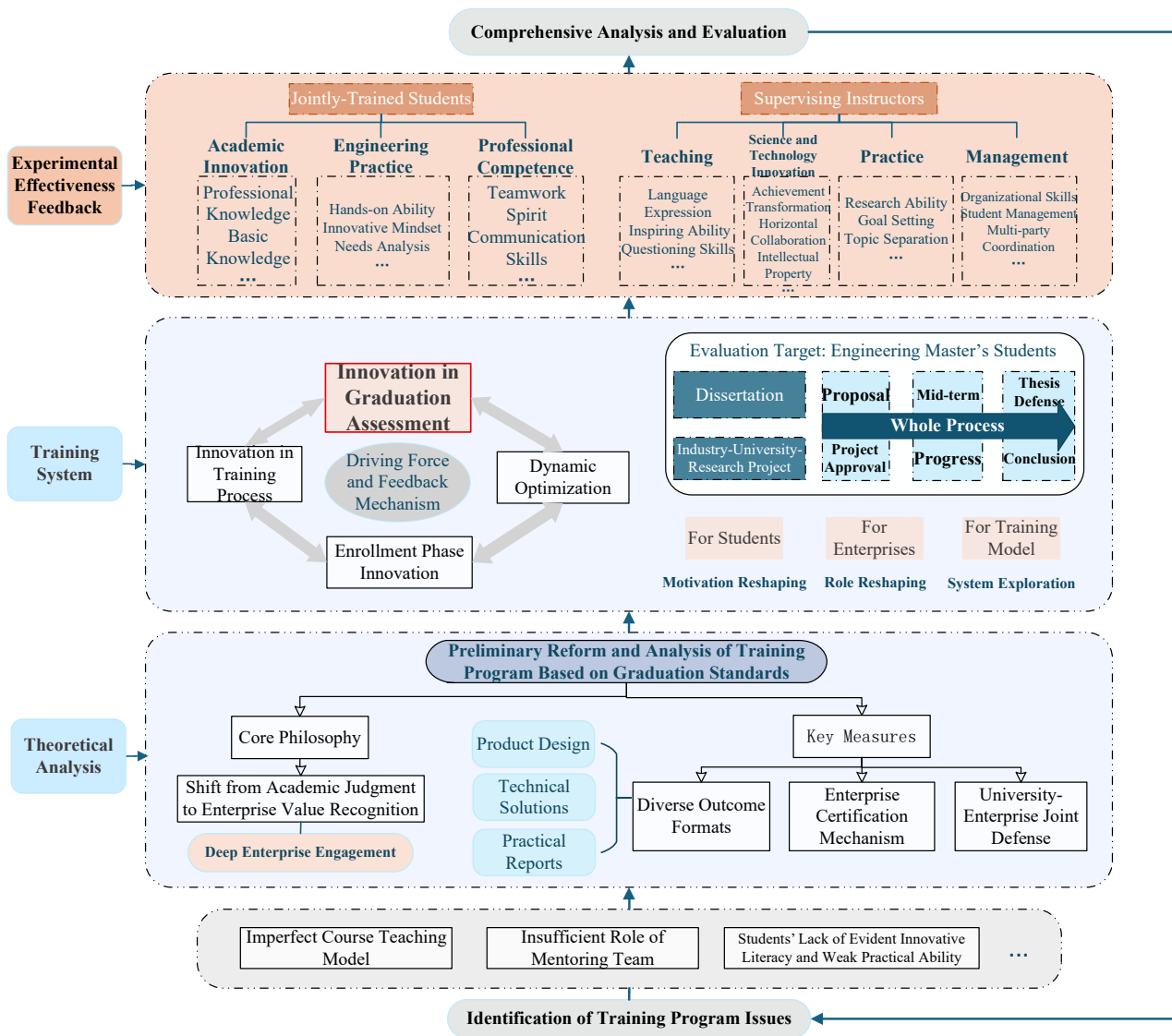


Figure 3 Core Framework of Program Reform at North China Electric Power University

## 4 Conclusion and Scalability

This exploratory practice indicates that revamping the engineering master’s training system requires the establishment of an open, inclusive, and collaborative educational ecosystem beyond the capacities of individual universities. It is imperative to cultivate a “reform practice community” that allows all stakeholders to exchange reform experiences, collaboratively undertake exploratory risks, and collectively address shared difficulties, so as to systematically improve the overall efficacy of engineering talent development. North China Electric Power University’s program is valuable not just for its current results but also for offering a measurable, verifiable, and repeatable framework for future reforms. Collective wisdom can only be used to further the high-quality development of China’s engineering master’s training system through rigorous peer review, ongoing practical validation, and dynamic

optimization.

Engineering education reform confronts enduring and intricate issues moving forward. We can construct a new paradigm for nurturing high-level engineering talent that supports an innovation-driven development strategy only by committing to collaborative evolution and transforming talent cultivation from “knowledge transmission” to “capability generation”. This transition is essential for improving educational quality and possesses significant strategic importance for developing a modern industrial system.

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