

THE CONSTRUCTION OF AN EVALUATION SYSTEM FOR ENGINEERING PRACTICE ABILITY OF OUTSTANDING ENGINEERS FROM THE PERSPECTIVE OF SCHOOL-ENTERPRISE COLLABORATION

GuoSheng Li¹, Hui Zhang¹, YongSheng Zheng^{2*}

¹*Institute of Mining Engineering, Guizhou Institute of Technology, Guiyang 550003, Guizhou, China.*

²*Shandong Energy Xinwen Mining Group Co., Ltd., Xintai 271219, Shandong, China.*

**Corresponding Author: YongSheng Zheng*

Abstract: The Outstanding Engineer Education and Training Program is a core initiative in China's higher engineering education reform, aiming to cultivate high-level engineering and technical talents with solid engineering literacy, outstanding practical ability, innovative thinking, and professional competence. As the core component of the key competencies of outstanding engineers, engineering practice ability—and its scientific, systematic, and accurate evaluation—is a critical lever for ensuring education quality, implementing industry-education integration, and promoting school-enterprise collaborative education. At present, the cultivation of outstanding engineers in universities generally suffers from problems such as a single evaluation subject, vague evaluation indicators, disconnection between school and enterprise evaluations, overemphasis on theory over practice, and a lack of closed-loop improvement mechanisms, which seriously constrain the quality of engineering talent cultivation. From the perspective of school-enterprise collaborative education, and in combination with the accreditation standards of engineering education in the new era and the requirements for cultivating outstanding engineers, this paper analyzes the existing dilemmas in the evaluation of engineering practice ability, constructs a multi-subject, multi-level, and whole-process evaluation system for the engineering practice ability of outstanding engineers, and explores the implementation paths and continuous improvement strategies for school-enterprise collaborative evaluation. The study provides theoretical reference and practical support for universities to optimize the education model for outstanding engineers and enhance their practical and innovative capabilities.

Keywords: School-enterprise collaboration; Outstanding engineers; Engineering practice ability; Evaluation system; Talent cultivation

1 INTRODUCTION

With the transformation and upgrading of China's manufacturing industry and the acceleration of the new-type industrialization process, industrial enterprises have put forward higher requirements for the practical ability, innovation capability, and job adaptability of high-level engineering and technical talents [1-3]. As a key strategic deployment of engineering education reform, the Outstanding Engineer Education and Training Program breaks away from the traditional single education model of universities, emphasizing the alignment with industrial demands, deepening industry-education integration, strengthening school-enterprise collaboration, and focusing on the comprehensive cultivation of students' engineering practice, engineering innovation, engineering ethics, and job competency [4]. What it seeks to address are several unavoidable problems in university engineering talent cultivation: disconnection from industrial needs, weak practical education, and insufficient talent-job matching [5].

Engineering practice ability is, in the final analysis, the most critical dividing line between outstanding engineers and ordinary engineering talent. It involves not only solving engineering problems, but also applying engineering knowledge in real practice, teamwork and innovation, compliance with engineering norms, and assumption of engineering responsibility. Whether students can later fit into enterprise positions, adapt to industrial development, and go far in their careers depends to a large extent on this foundation [6-8].

The evaluation system, meanwhile, acts like the “baton” for talent cultivation. Where it points is basically where the educational orientation, training priorities, and quality standards will go. The problem is that traditional engineering talent evaluation is still mostly university-led, focusing on theoretical grades, classroom performance, and written exam results; when it comes to truly critical practical components such as enterprise internships, engineering practice, project-based work, and job adaptability, evaluation is either absent or merely superficial [9-10]. At the same time, a mechanism for deep enterprise participation in evaluation has not really been established. As a result, evaluation outcomes may not reflect students' actual engineering practice ability, and the educational orientation can easily become misaligned with industrial needs [11-12].

It is precisely against this backdrop that reconstructing the evaluation system for the engineering practice ability of outstanding engineers from the perspective of school-enterprise collaboration becomes necessary. More specifically, universities and enterprises should interact in both directions and jointly participate in talent quality evaluation; the

evaluation mechanism should cover the entire cultivation process, align with job requirements, and be both scientifically sound and practically feasible. Going further, it would be best to form a closed loop of “evaluation–feedback–improvement–enhancement.” For deepening engineering education reform, improving the quality of outstanding engineer cultivation, and serving high-quality industrial development, this endeavor has both practical significance and research value [13].

2 CURRENT STATUS AND EXISTING PROBLEMS IN THE EVALUATION OF ENGINEERING PRACTICE ABILITY OF OUTSTANDING ENGINEERS

At present, most domestic universities have preliminarily established practical ability evaluation mechanisms in the process of cultivating outstanding engineers. However, constrained by factors such as traditional educational models, the depth of school-enterprise cooperation, and the development of evaluation mechanisms, the implementation of school-enterprise collaborative evaluation is unsatisfactory, and there are numerous deficiencies in the evaluation of engineering practice ability. These are specifically reflected in the following four aspects.

2.1 Single Evaluation Subject and Lack of School-Enterprise Collaborative Evaluation Mechanism

At the current stage, the evaluation of outstanding engineers is still predominantly conducted by university teachers as the sole evaluators, while enterprises and industries, as the demand side for talents, have not been deeply involved in the entire process of talent evaluation. In most universities, practical evaluation is independently completed by on-campus supervising teachers, while enterprise internship mentors and engineering technical staff are only responsible for students' daily management and do not participate in the formulation of assessment standards, process evaluation, or outcome assessment. University teachers, who have long been deeply engaged in theoretical teaching, do not have a thorough understanding of front-line job requirements, practical operation standards, and industry technical specifications in enterprises. Their evaluation perspective tends to be teaching-oriented, making it difficult to accurately judge students' practical operational capabilities, engineering problem-solving abilities, and job adaptability. At the same time, there is a lack of regular evaluation communication mechanisms between universities and enterprises, and the evaluation standards, content, and results cannot be interconnected, leading to a disconnect between university evaluations and enterprise needs, and insufficient authority and authenticity of the evaluation results.

2.2 Vague Evaluation Indicators and One-Dimensional Assessment of Practical Ability

Currently, the evaluation systems commonly used in universities mostly emphasize summative assessment, with indicator settings that are general and simplistic, lacking systematicity, hierarchy, and specificity. When most institutions evaluate practical ability, when you get right down to it, they still mainly look at internship reports, practice summaries, attendance records, and a final assessment score. The evaluation dimension is fairly one-dimensional, and whether students actually grew during the practice process, or how their abilities changed, often isn't really included. What's more troublesome is that for the abilities that are critical to outstanding engineers—such as engineering practice, project tackling, problem analysis, innovation and optimization, teamwork, engineering ethics, and whether safety regulations are actually put into practice—existing evaluations lack detailed indicators. Different stages naturally have different requirements. For example, basic practice, professional practice, engineering project training, and enterprise on-the-job internships each have their own focus, yet existing indicators barely distinguish among them. As a result, it is difficult to accurately quantify students' practical ability levels at different stages, and hard to see their overall engineering practice literacy comprehensively and objectively.

2.3 Evaluation Methods Are Somewhat Rigid, and What's Missing Is Whole-Process Dynamic Evaluation

As for evaluation methods, they are also rather rigid. Traditional models are basically summative evaluations, with their eyes mainly fixed on the final assessment after practice is over, while dynamic tracking and staged evaluation throughout the whole practice process are often left out. In other words, the process is downplayed, and the result is magnified. The cultivation of engineering practice ability for outstanding engineers runs through multiple stages, including course experiments, course design, on-campus training, enterprise internships, graduation projects, and engineering project R&D, constituting a gradual and continuously improving process. However, current evaluations mostly focus on final outcomes, lacking records and assessments of process-oriented performances such as learning attitudes, operational norms, problem-solving, innovative attempts, and progress made during the practical process. A single summative evaluation cannot capture the trajectory of students' capability development, easily leading to the problems of "emphasizing results over process, and form over substance." It is difficult to precisely identify students' weaknesses in practical ability, and thus cannot provide a basis for personalized cultivation.

2.4 Broken Evaluation Closed Loop and Inadequate Continuous Improvement Mechanism

The core value of evaluation lies in diagnosing problems, optimizing cultivation, and improving quality. At present, the practical ability evaluation in most universities remains at the level of "scoring and grading," lacking a closed-loop mechanism of "analysis of evaluation results – problem diagnosis – optimization of cultivation plans – improvement of

teaching models – re-evaluation of abilities." Universities and enterprises have not established feedback channels for evaluation results. Universities cannot obtain timely feedback from enterprises on students' practical abilities and job adaptability, making it difficult to optimize the curriculum system, practical teaching content, and education models in a targeted manner. Students cannot accurately understand their own weaknesses, making it hard for them to strengthen their practical abilities accordingly. The disconnection between evaluation and cultivation improvement renders evaluation a mere formality, failing to play its guiding, diagnostic, improvement, and enhancement roles, thus restricting the continuous improvement of the quality of outstanding engineer cultivation.

3 PRINCIPLES FOR CONSTRUCTING THE EVALUATION SYSTEM FOR ENGINEERING PRACTICE ABILITY FROM THE PERSPECTIVE OF SCHOOL-ENTERPRISE COLLABORATION

Overall, this system is not something dreamed up on a whim. It has to keep its eyes on the training objectives for outstanding engineers, take into account the requirements of engineering education accreditation, and stay closely tied to the real needs of enterprise positions. The underlying logic is school-enterprise collaborative education. So, in building it, we stick to four principles, and the purpose is very direct: to make the system scientific, standardized, adaptable, and truly implementable.

3.1 School-Enterprise Collaboration and Supply-Demand Alignment

Evaluation cannot be done by universities behind closed doors. Universities and enterprises need to step onto the field together, working as dual subjects, and tear down the wall of single-subject education evaluation. The talent cultivation goals of universities and the competency needs of enterprise positions must truly be merged. Professional teachers from universities, technical mentors from enterprises, and industry experts should all be involved—how standards are set, how indicators are refined, how the process is assessed, and how results are reviewed all need their voices. Only then can the evaluation system both comply with teaching regulations and align with industrial needs and actual job requirements, making precise alignment between talent and industry possible.

3.2 Whole-Process Coverage and Multi-Dimensional Comprehensiveness

Evaluation cannot just focus on the final moment. It should cover all training stages—on-campus basic practice, professional training, enterprise project practice, on-the-job internships, innovative R&D, and so on—and build a whole-process, multi-dimensional framework. Several pairs of relationships need to be well balanced: process-oriented evaluation and summative evaluation, quantitative and qualitative, ability and literacy. What should be looked at? Engineering practice ability, problem-solving ability, innovation ability, professional ethics, and collaboration ability all need comprehensive assessment. Otherwise, evaluation easily becomes one-sided or even a mere formality.

3.3 Scientific Quantification and Practical Feasibility

Indicators should not just look good; they have to actually work. Refine indicators at each level hierarchically, and clearly explain the assessment criteria, scoring basis, and weight allocation for each indicator, so that ability evaluation can be quantified, measured, and well-grounded. At the same time, the actual situation of university teaching management and enterprise practice management must be considered. Simplify processes wherever possible and reduce costs wherever possible, ensuring the system is implementable, executable, and scalable, suitable for the routine cultivation of outstanding engineers. Otherwise, no matter how scientific it is, if it cannot be implemented, it is useless.

3.4 Evaluation-Driven Improvement and Closed-Loop Enhancement

Evaluation is not for evaluation's sake; the key is to diagnose problems and drive improvement. Evaluation results should be tied to the optimization of talent cultivation plans, curriculum reform, upgrading of practical teaching, and personalized student cultivation. Then establish a closed loop of "evaluation feedback—problem rectification—continuous optimization." Through regular evaluation, precisely identify shortcomings in education and weak areas in student abilities, and in turn continuously optimize the school-enterprise collaborative education model, so that cultivation quality can be dynamically improved. This closed loop cannot just be paid lip service.

4 CONSTRUCTION OF THE CORE ARCHITECTURE OF THE SCHOOL-ENTERPRISE COLLABORATIVE ENGINEERING PRACTICE ABILITY EVALUATION SYSTEM

Based on the above principles and in consideration of the characteristics of outstanding engineer cultivation, we construct an engineering practice ability evaluation system featuring "dual subjects, three stages, multiple dimensions, and a closed loop," clarifying the evaluation subjects, evaluation stages, evaluation indicators, and evaluation methods to form a complete evaluation framework.

4.1 Establishing School-Enterprise Dual-Subject Collaborative Evaluation Subjects

Build a trinity evaluation team comprising universities, enterprises, and industry experts, define the evaluation responsibilities of each party, and achieve complementary advantages and collaborative assessment. University professional teachers, for their part, mainly handle on-campus course practice, practical training, graduation projects, and the integration of theory and practice. What do they focus on when evaluating? Whether students have a solid professional foundation, whether they can apply theory, what their learning attitude is like, and whether they show any innovative thinking. The enterprise side is different. Technical mentors and frontline engineers know the positions better, so on-the-job internships, engineering project practice, and job performance are basically evaluated by them. What they watch is practical operational ability, awareness of engineering norms, whether students can solve problems when they arise, and whether they can adapt to the position. Industry experts, meanwhile, are more like “gatekeepers.” They are responsible for reviewing and further optimizing the overall evaluation standards, so that the evaluation system does not become disconnected from industry development standards, and so that the evaluation is more professional and authoritative.

4.2 The Three-Stage Whole-Process Evaluation Hierarchy Must Follow the Cultivation Process

The cultivation of outstanding engineers is not a one-off deal, and the evaluation of practical ability cannot focus on just one point. It can be divided into three stages: basic practice, professional practice, and comprehensive engineering practice. This way, it progresses layer by layer and covers the whole process. The basic practice stage mainly involves lower-grade course experiments, cognitive internships, and basic training. It looks at students’ basic engineering operational ability and whether they have a basic understanding of engineering. In the professional practice stage, the focus falls on professional training, course design, and specialized engineering training, examining whether students can apply what they have learned professionally to engineering. Then in the comprehensive engineering practice stage, enterprise on-the-job internships, participation in engineering projects, innovative practice, and graduation projects all come in. At this point, the focus is on overall engineering practice ability and job competency.

4.3 A Four-Dimensional, Multi-Level Evaluation Indicator System: Indicators Have to Be Implementable

Centering on the core competency requirements of outstanding engineers, the indicators are broken down further, forming 4 first-level indicators and 12 second-level indicators. This provides both quantitative criteria and fairly comprehensive dimensions. The first is basic engineering practice ability, which includes basic experimental operations, engineering cognition, application of professional tools, and the ability to translate theory into practice. The second is professional engineering operational ability, including professional equipment operation, engineering scheme design, implementation of process specifications, and project execution ability. The third is engineering innovation and problem-solving ability, including engineering problem analysis, scheme optimization and innovation, emergency problem handling, and technical improvement and R&D ability. The fourth is comprehensive engineering professional quality, including teamwork, engineering ethics, safety norms, and professional attitude and responsibility. The weights of all indicators are jointly determined by both universities and enterprises, and comprehensive evaluation is completed through a combination of quantitative scoring and qualitative comments.

4.4 Integrating Multiple Evaluation Methods

Ditch the single summative assessment. It just can’t do the job alone. A better approach is to bring four evaluation methods together: process-oriented evaluation, summative evaluation, student self- and peer-evaluation, and two-way school-enterprise evaluation. Process-oriented evaluation runs through the whole practical process, not just a final checkpoint. Attendance records, hands-on operation logs, project journals, and periodic presentations are what capture how students develop along the way. Summative evaluation, meanwhile, looks at practical outcomes, project reports, defense assessments, and job performance evaluations. Student self- and peer-evaluation is about self-awareness and reflecting on how the team performed. And two-way school-enterprise evaluation connects on-campus assessment results with enterprise assessment results, letting them feed into each other and jointly form the final evaluation score. The point is simple: keep the evaluation objective and comprehensive.

5 IMPLEMENTATION PATHS AND CONTINUOUS IMPROVEMENT STRATEGIES FOR THE SCHOOL-ENTERPRISE COLLABORATIVE EVALUATION SYSTEM

5.1 Improving the School-Enterprise Collaborative Evaluation Management System

Universities, in conjunction with cooperative enterprises, shall formulate the Measures for School-Enterprise Collaborative Evaluation Management of Engineering Practice Ability of Outstanding Engineers, clarifying the evaluation responsibilities, evaluation procedures, indicator standards, weight allocation, and application of results for both parties, and solidifying the dual-subject evaluation mechanism. There should be a regular school-enterprise communication meeting system, rather than each side just working on its own. Every so often, both sides should sit down together to talk about education evaluation and hold special seminars. When industrial technology updates and job requirements change, evaluation indicators and assessment criteria need to be adjusted accordingly. Otherwise, the system easily becomes outdated, and there is no real timeliness or adaptability to speak of. Also, evaluation results from enterprises cannot just be something for reference. They should truly be incorporated into students’ practical performance

scores, comprehensive quality assessments, and merit evaluations as a core basis. Only then will evaluation carry more weight and authority.

5.2 Building an Information-Based Collaborative Evaluation Platform

Information technology should also be genuinely put to use. Relying on IT, we can build a school-enterprise collaborative platform for evaluating practical education, starting by breaking down the data barriers between universities and enterprises. What functions should the platform have? Process recording, real-time evaluation, result uploading, feedback push, data statistics, and issue warnings—all of these are necessary. Enterprise mentors can record students' job performance, phased problems, and ability weaknesses at any time, while on-campus teachers can synchronously see how students are doing in enterprise practice. In this way, the practice process becomes traceable, evaluation data can be queried, and feedback can be real-time. Information technology is not for show; it is there to simplify procedures, improve efficiency, and make whole-process evaluation more dynamic and precise.

5.3 Strengthening the School-Enterprise Evaluation Team

The evaluation team also needs attention. School-enterprise evaluators should receive regular special training to raise the professional competence of the dual-teacher evaluation team. For on-campus teachers, the focus should be on industrial technical specifications, enterprise job requirements, and engineering practice standards, since frontline engineering experience is often insufficient. For enterprise mentors, the focus should be on university education objectives, evaluation methods, and teaching standards. They cannot just be good at doing the work but not at evaluating it; their professionalism in educational evaluation needs to keep up. At the same time, a mechanism for mutual appointment and two-way exchange between university and enterprise personnel can be established: on-campus teachers go into enterprises for practice, and enterprise engineers come to campus to teach. In this way, a professional evaluation team with both theoretical grounding and engineering experience can gradually be built, and evaluation quality can be better guaranteed.

5.4 Constructing a Closed-Loop Continuous Improvement Mechanism

Establish a closed-loop improvement system of "evaluation analysis – problem diagnosis – targeted improvement – effectiveness review." After the completion of each semester's or each cohort's student practical evaluation, both universities and enterprises shall jointly conduct analysis of evaluation data, identifying common weaknesses in students' practical abilities and weak links in the education process. Based on the identified problems, precisely optimize cultivation plans, adjust practical teaching content, optimize school-enterprise practical projects, and improve teaching methods. For individual student weaknesses, develop personalized reinforcement plans. At the same time, regularly review the effectiveness of improvements, dynamically iterate the evaluation system and education model, and achieve a spiral rise in the quality of outstanding engineer cultivation.

6 CONCLUSION

Cultivating the engineering practice ability of outstanding engineers is a core task in the current reform of higher engineering education. School-enterprise collaborative evaluation is a key way—arguably the key way—to address the current problems: the disconnect between education and evaluation, weak practical education, and insufficient talent-job matching. From the perspective of school-enterprise collaborative education, this paper systematically analyzes the problems in evaluating outstanding engineers' practical ability, clarifies the core principles for building the evaluation system, establishes a dual-subject, whole-process, multi-dimensional evaluation system for engineering practice ability, and proposes implementation and improvement strategies that are institutionalized, information-based, professionalized, and closed-loop. To put it simply, this system effectively breaks through the limitations of the traditional single-subject evaluation model. It brings university education standards and enterprise job requirements into closer alignment, and balances process growth with outcome effectiveness, as well as ability assessment with literacy cultivation. By improving the school-enterprise collaborative evaluation mechanism, we can more accurately diagnose shortcomings in talent cultivation, continuously optimize the education model, and effectively enhance outstanding engineers' engineering practice ability, innovation capability, and job adaptability. That, in turn, provides solid support for universities to deepen industry-education integration, promote high-quality development of engineering education, and cultivate high-quality outstanding engineering talent.

COMPETING INTERESTS

The authors have no relevant financial or non-financial interests to disclose.

FUNDING

This work was supported by the Educational Teaching Reform Research Project of Guizhou Institute of Technology (Project No.: PX-42611404).

REFERENCES

- [1] Ye Jinxin, Han Yu, Zhang Jianglong, et al. Exploring the Construction of School-Enterprise Collaboration Mechanism for Education and Cultivation of Outstanding Engineers in the New Era: Taking School of Future Aerospace Technology of Beihang University as an Example. *China Higher Education Research*, 2022(6): 50-56.
- [2] Zhang Jixiong, Duan Chenlong. Exploration and Practice of Industry-University Collaboration and Deep Integration of Industry and Education in Cultivating Outstanding Engineers. *Journal of China University of Mining & Technology (Social Sciences)*, 2026, 28(4): 172-186.
- [3] Liu Li, Hu Dexin, Sun Yuhua. Achievements, Challenges, and Future Paths of Emerging Engineering Discipline Construction in China: Analysis Based on Second Batch of Emerging Engineering Education Research and Practice Projects. *Tsinghua Journal of Education*, 2025, 46(3): 119-128.
- [4] Hu Dexin, Ji Minghui, Lin Jiani, et al. Research on Synergy-Driven Grouping Path of Cultivating Engineers of Excellence in China for Emerging Engineering Education. *Research in Higher Education of Engineering*, 2025(6): 39-46.
- [5] Wang Chao, Zhang Xiaoying. From Duty Heterogeneity to Duty Homogeneity: An Analysis of the Reform Path of School-enterprise Dual Tutorial System. *Education Prospects*, 2025(4): 58-67.
- [6] Wei Bing, Shen Jianfeng, Chen Jinfei, et al. Construction of Engineer Technology Center for Cultivating the Practical Ability of Elite Engineers. *Research in Higher Education of Engineering*, 2025(3): 100-106.
- [7] Zhang Wei, Lin Yongchun, Wei Lina, et al. Complex Adaptive System and Operational Mechanism of University-Enterprise Cooperation in Cultivating Outstanding Engineers. *Journal of National Academy of Education Administration*, 2025(7): 30-41.
- [8] Ren Lingtao. The Cultivation of Practice Wisdom of Engineering Students: Values, Goals and Strategies. *Heilongjiang Higher Education Research*, 2023, 41(5): 43-48.
- [9] Zhao D, Fang S, Hai H. Research on the construction and practical path of the collaborative education mechanism for postgraduate outstanding engineers from the perspective of industry-education Integration. *Education Reform and Development*, 2026, 8(2): 248-254.
- [10] Lin Boxian, Lei Fuxian, Chen Bowen. Research on the training mechanism of outstanding engineers under the background of industry-education integration. *Journal of Science and Education*, 2025(12): 50-53.
- [11] Bai Yanru, Zhao Zhiyi. Research and Practice of Excellence Engineer Training from the Perspective of Integration of Production and Education. *Research and Exploration in Laboratory*, 2021, 40(2): 197-200.
- [12] Yuan Xin. Research on the Training of 3D Digital Outstanding Engineers in School-Enterprise Cooperation. *Education and Teaching Forum*, 2025(7): 181-184.
- [13] Han Tong. Undergraduate Engineering Leadership Development Strategies for Outstanding Engineers: Experiences and Insights from the United States. *Meitan Higher Education*, 2025, 43(1): 88-99.