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Research on the Talent Cultivation Model for Flight Test Technology Engineering Under the Background of Industry-Education Integration

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Abstract: Against the background of industry-education integration, characterized by the rapid upgrading of the aviation industry and the continuous iteration of aircraft flight test technologies, the industry has set higher standards for the engineering ability, practical proficiency, and innovative literacy of professionals in flight test technology engineering. Traditional university talent cultivation suffers from problems such as disconnection between teaching and industry, weak practical teaching, and insufficient job adaptability, making it difficult to meet the high-quality development needs of the aviation flight test industry. Based on the concept of industry-education integration, universities and aviation flight test enterprises have collaborated deeply to build a new talent cultivation system adapted to flight test positions. This paper systematically explores the industry-education integration education model from three dimensions—talent cultivation needs, implementation value, and implementation methods—so as to comprehensively improve the quality of flight test technology talent cultivation and provide theoretical and practical support for supplying high-quality application-oriented flight test technology talents to the aviation industry.

Keywords:industry-education integration, flight test technology engineering, talent cultivation, school-enterprise collaboration, aviation practical training

1. Introduction

In the new era, the aviation industry is developing rapidly toward intelligence, precision, and systematization. Aircraft flight testing is a crucial link in the process of developing and certifying aviation equipment. Its technical system has become increasingly complex, and the degree of job specialization has continued to rise. Industry-education integration is the core orientation for the current reform and development of vocational education and engineering majors, and it can effectively connect the education chain, talent chain, industrial chain, and innovation chain. Based on the concept of deep collaborative industry-education integration, promoting the deep alignment of flight test technology engineering teaching content, practical training scenarios, and educational standards with the job standards of the aviation flight test industry is of great practical significance for optimizing the talent cultivation structure, enhancing students' job competitiveness, and serving the development of the aviation industry.

2. Needs for Flight Test Technology Engineering Talent Cultivation Under the Background of Industry-Education Integration

As the updating and iteration of China's aviation equipment continue to accelerate, flight test tasks for various new military aircraft, civil aircraft, and unmanned aerial vehicles are increasing year by year. The flight test technology system is becoming increasingly refined, systematic, and intelligent, and the industry has imposed new and higher-level requirements on the comprehensive qualities of professionals in flight test technology engineering (Gong & Zheng, 2025). At the level of industrial development, modern flight testing is no longer limited to basic flight tests; it also involves multiple aspects such as flight performance verification, flight test data analysis, equipment troubleshooting, aviation safety assessment, and test scheme optimization. These multi-dimensional contents require talents to possess both a solid theoretical foundation and high-level engineering practical ability. From the perspective of job needs, flight test positions have extremely high safety requirements and stringent technical rigor. However, traditional university cultivation models emphasize theoretical instruction, and students lack experience in real flight test scenarios. As a result, students often exhibit weak engineering thinking, insufficient practical experience, weak safety awareness, and a lack of innovation ability, and cannot quickly meet enterprise job requirements. At the level of talent development, new requirements have been proposed for flight test talents in the new era, including continuous learning ability, problem assessment ability, teamwork ability, and engineering innovation

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ability. Therefore, supported by industry-education integration, deepening school-enterprise cooperation, aligning industrial standards, job competencies, and engineering tasks, and reconstructing the talent cultivation system so that education and teaching advance in the same direction as industrial development are necessary for the current reform and development of talent cultivation in flight test technology and engineering.

3. Implementation Value of the Flight Test Technology Engineering Talent Cultivation Model Under the Background of Industry-Education Integration

3.1 Enhancing pertinence through industry-demand orientation

The industry-education integration education model is guided by core factors such as the development needs of the aviation flight test industry and enterprise job competency standards. It fundamentally reverses the educational drawbacks of traditional teaching, which emphasizes theory over practice and remains detached from the industry, significantly enhancing the pertinence and precision of talent cultivation. In the industry-education integration model, enterprises participate in the entire process of core links such as revising talent cultivation plans, setting courses, optimizing teaching content, and constructing practical training systems, fully incorporating new technologies, new standards, new specifications, and new needs of the flight test industry into the entire process of talent cultivation (Yi, 2025). Based on the core competency needs of positions in flight test testing, data analysis, flight verification, and safety control, the model accurately positions talent cultivation objectives and determines the professional skills, engineering literacy, and vocational abilities that students should possess. By using industry demand to reverse-drive teaching reform, teaching content is brought closer to industry, practical training projects are linked to positions, and cultivation objectives match industry needs. This effectively solves the problem of disconnection between talent cultivation and industry demand, enabling students to quickly become competent in flight test technology-related positions upon graduation and fully adapt to the aviation industry's requirements for professional, compound, and application-oriented flight test talents.

3.2 Enhancing practical ability through real tasks as motivation

The flight test technology engineering major is a highly engineering-oriented and practical engineering major. Its various professional abilities need to be trained through actual engineering scenarios, actual flight test tasks, and actual project problems. Simple classroom theoretical teaching cannot shape students' engineering practical ability. The industry-education integration model is based on enterprises' abundant flight test engineering projects, test sites, equipment resources, and technical resources, and uses real flight test tasks to drive students' practical learning, essentially enhancing students' practical ability and engineering literacy (Xia & Luan, 2025). In the school-enterprise collaborative education system, students are no longer limited to on-campus simulated training and virtual case cultivation; they participate more deeply in enterprises' real flight test testing, data collection, and experimental debugging, assist with projects and other project work, personally experience the entire flight test process, and master core skills such as professional equipment operation, data processing, test analysis, and problem troubleshooting. Real and complex flight test engineering scenarios can effectively train students' problem assessment ability, emergency response ability, and rigorous engineering thinking, and enhance the safety awareness, standardization awareness, and responsibility awareness essential for flight test positions. This comprehensively remedies the shortcomings of traditional practical teaching and continuously strengthens students' engineering practical ability and core job competitiveness.

4. Implementation Methods of the Flight Test Technology Engineering Talent Cultivation Model Under the Background of Industry-Education Integration

4.1 Reverse design of teaching based on job competency maps

Given the professional characteristics of flight test technology engineering positions—technology-intensive, strict standards, strong professionalism, and low fault tolerance—schools and enterprises jointly sort out the work content of all flight test positions and construct systematic, hierarchical, and precise flight test job competency maps based on occupational standards and competency requirements. The maps cover six core dimensions: basic theoretical ability, flight test practical ability, data analysis ability, safety control ability, engineering assessment ability, and professional quality ability, and are further subdivided into more than one hundred core competency points for positions such as flight test testing, performance evaluation, data processing, fault troubleshooting, and test control (Li, 2025). Supported by the job competency maps, talent cultivation plans, curriculum systems, and teaching content are reverse-engineered, thoroughly eliminating phenomena such as redundant traditional courses, outdated content, and disconnection between learning and application. According to job competency requirements, original courses are split, reorganized, and integrated; outdated theories unrelated to modern flight test positions are removed;

and cutting-edge teaching modules such as intelligent flight testing and digital testing courses, flight test big data analysis, and new aircraft testing technologies are added. The course teaching sequence is reconstructed according to the logic of job work, and high-frequency job skills, core technical standards, and engineering practice specifications are deeply integrated into daily classroom teaching, realizing the precise education logic of "what positions need, what the classroom teaches, and what students practice." At the same time, based on technological iteration and job competency updates in the aviation flight test industry, the competency maps and teaching content are dynamically adjusted, and a dynamic mechanism of annual course updates and quarterly content fine-tuning is established, continuously ensuring that teaching content remains highly consistent with industry frontiers and job standards and effectively enhancing the precision, adaptability, and professionalism of talent cultivation.

4.2 Reconstructing the practical training system through flight test task chains

Traditional flight test practical training teaching is often fragmented, singular, and verification-oriented. Each practical training project is independent and unsystematic, which is far from the continuous flight test task process in enterprises, making it difficult for students to form holistic engineering thinking within the job work chain. Based on the advantages of industry-education integration, schools and enterprises jointly reconstruct a systematic, process-oriented, and engineering-progressive practical training system around enterprises' actual flight test task chains (Kong, 2025). The system fully aligns with the entire task chain of enterprises, including flight test project initiation, test preparation, equipment layout, flight test monitoring, data collection, data analysis, test review, and report archiving, and divides complex flight test engineering into hierarchical, progressive, and teachable practical training modules. According to students' learning stages and ability development patterns, a four-tier practical training task system is initially constructed: basic cognition tasks, single-skill tasks, comprehensive flight test tasks, and innovative problem-solving tasks. Lower-year students rely on basic flight test cognition tasks to become familiar with flight test equipment, test processes, and safety specifications; middle-year students receive single-skill task training to become proficient in core skills such as flight test parameter testing, data reading, and equipment debugging; upper-year students deeply participate in the execution of enterprises' comprehensive flight test tasks, fully track the entire process of actual flight test projects, and acquire systematic engineering experience. All practical training projects come from enterprises' ongoing flight tests and fully align with the actual working conditions of enterprise positions in terms of task scenarios, operating standards, technical requirements, and safety specifications. By reconstructing the task chain system, students' practical training process is made equivalent to the job work process, effectively solving the problems of fragmentation, superficiality, and disconnection from engineering practice in traditional practical training, and continuously training students' systematic engineering thinking and job practical ability.

4.3 Implementing process-oriented supervision through joint research by dual mentors

In response to the problems of traditional teaching, such as emphasizing results over process, extensive guidance, and lack of personalization, the industry-education integration model constructs a process-oriented supervision mechanism featuring joint research by school and enterprise dual mentors, full-process tracking, and dynamic guidance, so as to achieve precise cultivation of students throughout the entire process from enrollment to graduation. On-campus mentors rely on their disciplinary and professional advantages to undertake tasks such as constructing students' theoretical knowledge, guiding course learning, cultivating basic research thinking, and guiding academic planning. This lays a solid foundation for students' professional theoretical systems, corrects students' cognitive deviations in learning, and develops independent learning and professional inquiry abilities (Gao & Wang, 2025). Enterprise flight test engineers, as off-campus mentors, start from the perspective of frontline positions, take engineering practice as the core, job skills as the focus, and flight test standards and engineering problem handling as the key points, guiding students throughout the process in practical training operations, project participation, skill improvement, and professional quality development. The dual mentors are no longer confined to short-term guidance for graduation projects but run through the entire process of course learning, practical training, scientific innovation research, job practice, and employment preparation. School and enterprise dual mentors regularly conduct joint teaching research, student learning situation discussions, and education reviews, jointly assess students' learning shortcomings, practical weaknesses, and ability deficiencies, and collaboratively formulate targeted improvement plans. In response to students' non-standard practical training operations, inaccurate data analysis, and incomplete engineering thinking, the dual mentors conduct real-time tracking, step-by-step guidance, and item-by-item correction, achieving early discovery, early correction, and early improvement of problems. The process-oriented supervision model effectively bridges the educational gap between

theoretical teaching and engineering practice, integrates knowledge impartation, ability cultivation, and quality shaping throughout the entire process, and comprehensively improves students' comprehensive professional ability.

4.4 Constructing engineering-oriented scenarios through on-site immersion

Flight test technology engineering is highly practical. Classroom teaching on campus alone cannot create a realistic, high-pressure, and rigorous flight test engineering atmosphere, and it is difficult for students to establish standardized and normalized professional project awareness. Based on resources jointly built by schools and enterprises through industry-education integration, an immersive, realistic, and engineering-oriented education scenario is comprehensively constructed at enterprise flight test bases, allowing students to develop through immersion in the scenario (Huang & Yang, 2025). The school organizes students in stages and batches to enter aviation flight test bases, flight test sites, and intelligent test laboratories, where they deeply integrate into enterprises' actual working environments as quasi-employees, combining flight test task scenarios with standardized management systems. Unlike traditional cursory observation and internships, on-site immersion teaching implements realistic training models such as position-based training, project shadowing, and full-process participation. Students are fixedly paired with flight test teams and participate in pre-flight equipment inspection, site layout, instrument debugging, and safety troubleshooting. They also conduct real-time monitoring, data recording, and status observation during the flight test process, as well as a series of post-flight job tasks such as data organization, test review, and report writing. In realistic, rigorous, and high-pressure flight test engineering situations, students intuitively experience industry characteristics such as high precision, high safety, and high rigor, and imperceptibly develop professional qualities such as standardized operation, meticulous rigor, and safety first. Enterprises strictly manage students' on-site management, practical training, and behavioral norms according to job standards, enabling students to adapt ahead of time to enterprises' work rhythm, job requirements, and occupational standards. This effectively shortens the job adaptation period upon graduation and significantly enhances the job adaptability of talent cultivation.

4.5 Promoting innovative practice through micro engineering problems

In response to the shortcomings of traditional innovation teaching, such as vague topic selection, disconnection from projects, weak practicality, and weak implementability, the industry-education integration model, based on actual flight test project scenarios of enterprises, starts from micro-problems, small technical improvements, and small optimizations at the flight test frontline, and constructs an engineering-problem-driven innovative practice education model. Enterprises sort out various small project problems in daily flight test testing, data processing, equipment use, and test processes, such as cumbersome operations, large data errors, redundant processes, and inadequate equipment adaptation, and identify engineering micro-problems that are suitable for undergraduate learning, moderately difficult, and capable of practical improvement, providing core topic sources for students' innovation training, research projects, and graduation designs (Wu et al., 2025). Guided by school and enterprise dual mentors, students study actual problems such as flight test data noise reduction optimization, test process simplification, equipment assistance improvement, parameter fitting optimization, flight test error tracing, and intelligent improvement of test records. Compared with traditional virtual innovation topics, engineering micro-problems are closer to job reality, have clear application value and specific research directions, and can guide students to discover, analyze, and solve problems from an engineering perspective. Students complete innovative practice in links such as literature review, scheme design, simulation verification, comparative testing, and optimization improvement, effectively training engineering innovative thinking, scientific research inquiry ability, and problem-solving ability. While encouraging the transformation of outstanding results into technical improvement suggestions, utility model patents, and scientific innovation competition outcomes, the model effectively uses engineering practice to support innovation cultivation and uses innovation outcomes to feed back into flight test projects.

4.6 Value-added evaluation based on multidimensional profiles

In order to thoroughly eliminate the drawbacks of traditional summative assessment based on a single written test score and a single practical training report, the industry-education integration model constructs a multidimensional learning situation profile and value-added assessment system based on students' full-process learning data, so as to achieve scientific, comprehensive, dynamic, and developmental assessment of education quality. Based on on-campus teaching platforms, enterprise practical training management systems, and scientific innovation practice records, the model collects full-process data on students' course learning, simulation training, on-site practical operation, task participation, research projects, and attendance performance, combines innovation outcomes with other multidimensional data, and establishes an individual learning situation database for each

student. Portraits of students' ability growth are drawn from dimensions such as theoretical literacy, practical skills, engineering thinking, innovation ability, and professional quality, accurately showing students' advantageous abilities and weak shortcomings. The evaluation abandons one-size-fits-all scoring and focuses on the degree of ability improvement, growth trajectory, and comprehensive progress after students enter the school, implementing value-added evaluation. It combines theoretical assessment by on-campus teachers, practical assessment by enterprise mentors, intelligent assessment by system data, and qualitative assessment of students' comprehensive performance, thereby forming diverse and three-dimensional assessment results.

5.Conclusion

As an important pathway for the high-quality development of talent cultivation in flight test technology engineering in the new era, industry-education integration can effectively solve serious problems in traditional education models, such as theory being divorced from practice, talents being divorced from the industry, and cultivation being disconnected from positions. This model can significantly improve students' engineering practical ability, innovation ability, and job competitiveness, promote the alignment of professional construction with industrial development, teaching standards with industry standards, and talent quality with job needs. In future development, the major will continue to deepen the reform of industry-education integration, continue to optimize the school-enterprise collaborative education mechanism, continuously improve the practical training teaching system and enhance the ability of dual mentors to educate students, and continuously cultivate high-quality, high-ability, compound, and innovative professional technical talents for China's aviation flight test undertaking.

Conflict of Interest

The author declares that he has no conflicts of interest to this work.

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