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Exploration of Talent Training Models in Mechanical Engineering for Future High-end Manufacturing Demands

Zhikun Wang[1,a], Chunhua Liu[1,b], Zhengcheng Tang[1,c], Bin Hu[1,d], Jiaqian Wang[2,e,*]

[1]Jinjiang College, Jiangsu University, Zhenjiang, Jiangsu Province, China
[2]School of Environment and Safety Engineering, Jiangsu University, Zhenjiang, Jiangsu Province, China
[a]1439737707@qq.com, [b]517669877@qq.com, [c]zctang@ujs.edu.cn, [d]hb070820@163.com, [e]jiaqianwang1@outlook.com
[*]Corresponding author

Abstract: *This article analyses the problems and reasons between the demand for high-end manufacturing and mechanical engineers, explores the development background of high-end manufacturing and its demand for technical talents, and proposes principles for adjusting the training mode of mechanical engineers. Among them, the educational objectives should follow the principle of "people-oriented", and the adjustment of talent training mode should follow the principle of "technology orientation" while meeting the three integration principles. In response to the future demand of high-end manufacturing, this article also puts forward some implementation paths for talent training, such as strengthening school-enterprise cooperation and emphasizing the training of practical ability, and emphasizes the construction of interdisciplinary course. This article aims to provide some ideas and methods for the training of mechanical engineers in China's future high-end manufacturing industry and reforming the talent training.*

Keywords: *High-End Manufacturing Industry, Talent Cultivation, Mechanical Engineering Field, Interdisciplinary*

1. Introduction

As a key step in the cultivation of engineering and technical talents, the mechanical discipline system bears the significant responsibility of providing talents for the engineering and technical fields. Under the background of the current international situation and strategic landscape, the reform of the talent cultivation model in the mechanical discipline of universities must be future-oriented and continuously deepen research and exploration in the field of science and technology. The mechanical discipline system of universities should accurately grasp the future development trends of engineering technology, accelerate the innovation of the talent cultivation model, and ensure the provision of high-quality innovative talent support for the country's long-term development.

2. The current talent cultivation in high-end manufacturing should be improved

The high-end manufacturing has become a key force in driving economic growth. However, there is a contradiction between the cultivation of professional mechanical engineers and the needs of the industry, mainly reflected in the disconnection between teaching content and industrial needs, the mismatch between practical content and actual industrial practices, insufficient cultivation of interdisciplinary abilities, the shortage of developing innovation awareness and capacity building, and insufficient school-enterprise cooperation. In order to adapt to the development needs of high-end manufacturing[1, 2], it is necessary to reform in various aspects such as educational content, teaching methods, curriculum systems, teaching managers, and evaluation mechanisms, and to strengthen school-enterprise cooperation to build a new model for talent cultivation that integrates industry and education completely[3].

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3. Analysis of Talent Demand Characteristics in High-end Manufacturing

3.1. Characteristics of Talent Demand in the New Normal of Economic Development

The new normal of economic development is a new stage of global economic development under the background of global informatization, characterized by the faster growth, structural adjustment, and innovation-driven development. The new normal of economic development poses new challenges to the training of high-end manufacturing and mechanical engineering talents[4]. High-end manufacturing faces the pressures brought by industrial upgrading, fierce international competition, and increased demand for technological innovation under the new normal, necessitating the deep-reform through technological and model revolution. The training of mechanical engineering talents needs to adapt to the new normal, by adjusting the educational models, strengthening the integration of theory and practice, enhancing innovation and problem-solving abilities, as well as cultivating the international perspective and cross-cultural communication skills[5]. Figure 1 has shown the demand ratio for different types of talents in high-end manufacturing under the new normal of economic development.

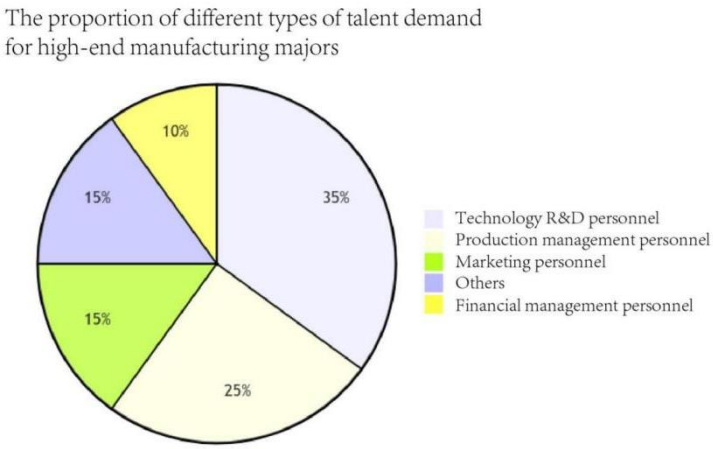

Figure 1: The proportion of different types of talent demand for high-end manufacturing majors. (R&D: Research and Experimental Development)

The diagram indicates that under the new normal of the economy, there is the greatest demand for R&D personnel, reflecting the significance of technological innovation and product upgrading over the high-end manufacturing. Therefore, the mechanical engineering education should focus on developing R&D capabilities. Economic globalization and informatization have driven the higher demands for the comprehensive quality of high-end manufacturing talent, including professional skills, innovative thinking, teamwork, and international perspective[6]. The new economic normal addresses challenges to high-end manufacturing and mechanical engineering education. It is necessary to adjust and optimize the educational model, strengthen practical and innovative abilities, to cultivate high-quality talents that meet the demands of future market[1, 3, 5, 7].

3.2. Characteristics of Talent Demand under Social Value Orientation

In the development of high-end manufacturing, social value orientation is crucial. With the globalization and technological innovation, the society expects that manufacturing could complete more among social responsibility, environmental protection, and sustainable development. This requires mechanical engineering talents not only to possess professional skills but also build a sense of social responsibility and environmental awareness.

Social value orientation is reflected in:

1) Environmental protection: High-end manufacturing must consider the impact of production on the environment, master green manufacturing technologies, and reduce resource consumption as well as waste emissions[2].

2) Social responsibility: Enterprises should be responsible to society, provide a safe working

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environment, ensure the rights and interests of employees, and generate positive social impacts through products and services[8].

3) Innovation and collaboration: High-end manufacturing needs to continuously innovate and collaborate with other industries and fields[9]. Mechanical engineering talents should have an open mind and interdisciplinary knowledge to leverage their innovative and collaborative abilities.

4) Global perspective: In a globalized world, high-end manufacturing competition and collaboration transcend national borders, which means mechanical engineering talents need to have an international perspective, understand different cultures and markets, and seek global cooperation and market opportunities[10].

The following chart shows the proportion of the demand for mechanical engineering talents in high-end manufacturing influenced by social value orientation.

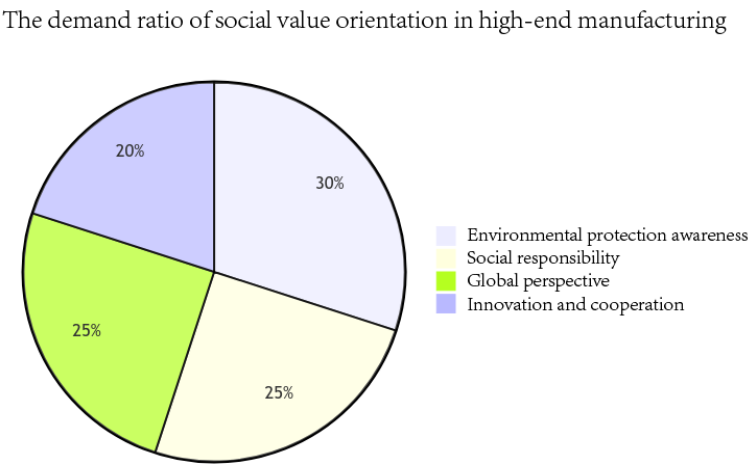

Figure 2: The demand ratio of social value orientation in high-end manufacturing.

The Figure 2 shows that environmental protection and social responsibility are extremely important in high-end manufacturing, meaning apart from being an expert, mechanical engineering talents should take social responsibility, especially among environmental awareness. This training model is able to guide the young generation to characterize themselves to be more appealing in high-end manufracturing[11].

3.3. Characteristics of Talent Demand under the Integration and Development of New Generation Information Technology

In the global economy, the advanced information technologies such as artificial intelligence, big data, cloud computing, and the Internet of Things have profoundly affected the development of high-end manufacturing. In addition to change the mode of production, these technologies redefined the innovation models for products and services[11, 12]. The integration of new generation information technologies has enhanced the efficiency of resource allocation and the accuracy of market positioning in high-end manufacturing[13]. Big data analytics helps companies understand market demands, predict trends, and make precise production and sales decisions. Cloud computing and Internet of Things technologies have promoted the interconnectivity of equipment, significantly improving production efficiency and product quality[8].

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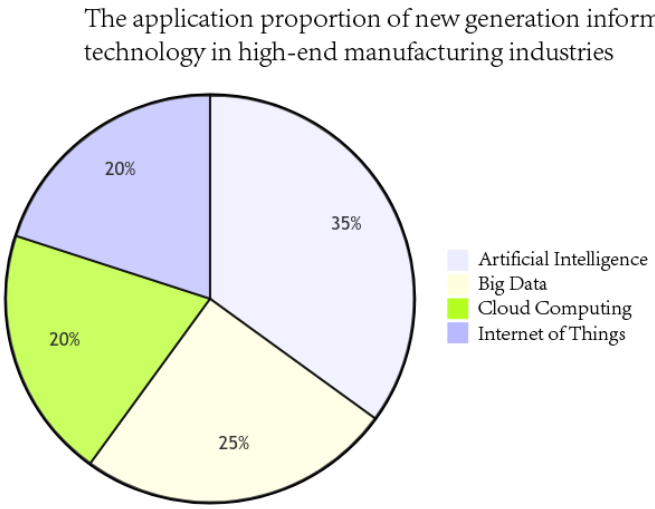

Figure 3: The application proportion of new generation information technology in high-end manufacturing industries.

The Figure 3 shows that the application proportions of artificial intelligence, big data, cloud computing, and the Internet of Things in high-end manufacturing vary a lot, with artificial intelligence occupied the highest ratio[9]. These results indicate that artificial intelligence has been widely applied in high-end manufacturing, significantly contributing to the enhancement of production efficiency, design optimization, and the improvement of customer experience. The full integration of new-generation information technologies has driven technological innovation, optimization of industrial structure, and rapid transformation of economic growth models in high-end manufacturing[3].

4. Principles for adjusting the talent cultivation model responding to mechanical engineering disciplines

4.1. The educational goal of talent cultivation should follow the principle of "people-oriented".

When cultivating future mechanical engineering talents, educational goals should be people-oriented, which encompasses professional skills as well as a comprehensive enhancement of personal development and social adaptability[14]. Except the international perspective, mechanical engineers need to possess a technical foundation, innovation capabilities, and the skill to communicate across multiple cultures to adapt to global competition well[6]. There are four cores to shape the education goals:

1) Educational goals should guide a lifelong learning, encouraging students to continuously update their knowledge and skills to meet technological improvements.

2) Educational goals should cultivate innovative thinking and problem-solving abilities, including critical thinking and innovation, to propose and implement effective solutions.

3) Educational goals should enhance international cooperation and competitiveness awareness, practice the new employee's effective communication and cooperation in multicultural environments.

4) Educational goals should strengthen practical operational capabilities, ensuring that knowledge and skills are applied in actual work through industry internships, corporate training, or by other methods[5, 11].

4.2. The adjustment of talent cultivation models for mechanical engineer follows the key of "technology-oriented"

Educational content and methods should be designed around technological advancements and industry demands, ensuring that students master the cutting-edge technological knowledge and can apply it in practice. They should track technological trends, update curricula to include emerging technologies such as artificial intelligence, big data, and cloud computing, and expand students' knowledge to

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stimulate their interest in self-exploration. Training managers should popularize the interdisciplinary knowledge to enhance students' ability to understand the complex systems[13]. Therefore, the training lecture should pay attention to cultivating students' innovative thinking and the lifelong learning abilities, encouraging their participation in scientific research projects and competitions, while the teachers could plan the lecture by applying the reflective and critical thinking teaching methods, which is useful on establishing habits of proactive learning of new employees. Moreover, universities should collaborate with high-end manufacturing companies to build the practical teaching projects, providing some real engineering cases and the latest technological management experiences, because the optional interdisciplinary courses and projects can cultivate the adult's ability to solve problems comprehensively[11].

The adjustment of talent training models for mechanical engineering should focus on the principle of "technology-oriented". By updating teaching content, strengthening practical teaching, interdisciplinary learning, industry-academia-research cooperation, along with fostering innovative thinking and continuous learning abilities, the demand for high-end manufacturing can be met, and high-quality technical talents can be practiced.

4.3. The adjustment of talent cultivation model for mechanical engineers follows the principle of "three integrations"

When cultivating mechanical engineering talents for future high-end manufacturing industries, the educational way needs to follow the principle of "three integrations": the integration of theory and practice, traditional and modern technology, domestic and international aspects. This aims to ensure that talents fully master the basic skills and knowledge, obtain innovative abilities with an international perspective[1].

The integration of theory and practice is primary, while the educational model should strengthen experimental teaching and engineering practice[11]. Meanwhile, by listing the case study and project-driven learning, students can understand the theory in real practice and solve practical problems more fluently[9].

The training model needs to incorporate core concepts of modern technology, enabling students to master basic knowledge and skills and apply technology to industry production. These technologies are sparing workers from repetitive, dangerous tasks like assembly line manufacturing and, in the process, increasing productivity and enabling workers to pursue more meaningful roles[5].

The integration of multiple culture background is key to enhancing international competitiveness. Under the challenge of globalization, mechanical engineers should possess an array of technical skills that no robot could replace, not to mention the creativity and imagination they bring to the table. Consequently, the talent cultivation model needs to incorporate the international advanced educational concepts and methods, encourage students to adapt regulations from other countries, enhance cross-cultural communication skills, and broaden their international perspective through international exchange programs or research[7]. The introduction of foreign teaching resources and faculty is also an effective way to achieve internationalization in education[6].

In summary, the implementation of the "three integrations" principle has the profound significance for the cultivation of mechanical engineering professionals[10]. It can promote the comprehensive development of students, enhance practical and innovative abilities, strengthen international competitiveness, and contribute to the development of high-end manufacturing industries[2].

5. Analysis of the Implementation Path of Training Models of Mechanical Engineering Talents based on Future High-end Manufacturing Demands

5.1. Adjustment and optimization of talent cultivation models

When facing the challenges and demands of future advanced manufacturing, the training model for mechanical engineering talents needs to be adjusted and optimized accordingly. Here is a detailed analysis of the implementation path:

1) Strengthen the integration of basic education with cutting-edge technology education. Students in mechanical engineering disciplines not only need to master solid foundational knowledge but also need to understand the latest technological trends and industry development directions[7]. By introducing more

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cutting-edge technology courses, such as artificial intelligence, the Internet of Things, big data analysis, etc., students can adapt to the needs of future advanced manufacturing much better.

2) Implement project-driven learning. Through college-enterprise cooperation, design projects that combine with practical working scenarios, allowing students to learn and apply knowledge while solving real problems. This approach can improve students' practical and innovative abilities, in order to meeting the needs of advanced manufacturing for the complete and creative talents[2].

3) Enhance the cultivation of an international perspective and cross-cultural communication skills. With the development of globalization, mechanical engineering talents need to possess an international perspective and good cross-cultural communication skills. International exchange programs, overseas internships, and other methods can effectively enhance the abilities of students.

4) Strengthen the cultivation of lifelong learning skills. In the rapidly changing environment of advanced manufacturing, the lifelong learning is essential[15]. Educational institutions should encourage students to form the habits of proactive learning, by providing the online learning resources and platforms to help students continuously update their knowledge and skills[1, 11].

By strengthening the integration of basic and cutting-edge technology education, implementing project-driven learning, enhancing the cultivation of an international perspective and cross-cultural communication skills, and strengthening the cultivation of lifelong learning skills, the overall quality and competitiveness of mechanical engineering talents can be effectively improved, better meeting the needs of future advanced manufacturing[7].

5.2. Strengthen college-enterprise cooperation, focus on the cultivation of practical abilities

In the talent cultivation model for mechanical engineering aimed at meeting the future demands of high-end manufacturing industries, school-enterprise cooperation, and practical abilities are key components. Through school-enterprise cooperation, theoretical knowledge can be effectively integrated with practical operations, providing students with real work scenarios and challenges, thereby enhancing their ability to solve practical problems. Moreover, the school-enterprise cooperation helps students better understand the industry development trends and technological frontiers, laying a solid foundation for their future careers[2, 3].

The forms of school-enterprise cooperation are diverse, including but not limited to joint research and development, internship training, and project collaboration[16]. According to these methods, students can actively participate in the corporate R&D projects, experience the product development processes firsthand, and learn advanced production technologies and management methods. At the same time, companies can absorb fresh talent through these means, cultivating individuals with practical experience, achieving a win-win situation[1].

To ensure the in-depth development of school-enterprise cooperation, the following points should be noted:

1) Clarify cooperation goals: School-enterprise cooperation should focus on improving students' practical and innovative abilities, clearly defining specific goals to ensure the effectiveness of cooperative projects[14].

2) Optimize cooperation mechanisms: Establish and improve school-enterprise cooperation mechanisms, including cooperation agreements, project management, and outcome evaluation, to ensure the effective progress of cooperation.

3) Strengthen the construction of teaching staff team: The higher education institutions should enhance the construction of teaching staff, recruit teachers with rich practical experience, and improve teaching quality[8].

4) Focus on outcome transformation: Encourage students to transform the outcomes obtained from school-enterprise cooperation projects, enhancing their scientific research and innovative abilities through applying for patents and publications[7].

Through the implementation of these measures, school-enterprise cooperation can be effectively strengthened, and the cultivation of practical abilities can be emphasized, providing strong support for the training of mechanical engineering talents and meeting the demand for technical personnel in the future high-end manufacturing industries[4].

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5.3. Follow the principle of "integrating education with teaching", and strengthen the construction of interdisciplinary courses

In the talent cultivation model for mechanical engineering tailored to the future demands of high-end manufacturing industries, the integration of education and teaching is key to improving the quality of talent development[7]. Due to establishing the interdisciplinary courses, students' knowledge horizons can be broadened, and their comprehensive abilities can also be enhanced, helping break down the knowledge barriers between disciplines in high-end manufacturing[13].

The design and implementation of interdisciplinary courses need to be closely integrated with the development trends and technological needs of high-end manufacturing, focusing on the combination of theory and practice, as well as the cultivation of innovative abilities[14]. Here are several key points:

1) Determine the content of interdisciplinary courses. Interdisciplinary courses should cover knowledge from various fields such as mechanical engineering, electronic information engineering, automation, and computer science, especially emerging technologies closely related to high-end manufacturing, such as artificial intelligence, big data analysis, and the Internet of Things.

2) Strengthen practical teaching. Through laboratory construction, project-driven learning, corporate internships, and other methods, students' practical operation abilities and engineering practical experience can be enhanced, improving their ability to solve real-world problems[2].

3) Promote the construction of teaching staff. Teachers should not only possess solid professional knowledge but also the ability to teach interdisciplinary subjects[8]. Therefore, the higher education institutions should increase investment in interdisciplinary training for teachers and encourage them to participate in the development and teaching practice of interdisciplinary courses.

4) Strengthen school-enterprise cooperation. By cooperating with enterprises, introducing the latest technologies and management concepts, the jointly developing course content would meet industry needs, and enhance the students' employment competitiveness[9].

In summary, following the principle of "integration of education and teaching" and strengthening the establishment of interdisciplinary courses, are of significant importance for cultivating mechanical engineering talents tailored to future high-end manufacturing needs. This approach can effectively enhance students' comprehensive quality and practical abilities, enhancing their ability to solve complex engineering problems[8].

6. Conclusion

The article analyzes the background of future mechanical engineering technology development and the development trend of technical talent cultivation from the perspective of nurturing professionals practically. Based on the developing rules of economic and social development, and the expects about the talents with diverse specialists from different fields, universities should set the aim to boost the development of high-end manufacturing. Meanwhile, the administrative staff on campus need to pay attention to the strategic imperative of China's green transition and thus publish the cultivation aim and curriculum cores which serviced for practicing the mechanical graduates matching to market needs. Consequently, universities could continuously explore, and effectively implement the talent cultivation models focused on future engineering technology, providing the talent support for the development of the country, particularly for the engineering technology.

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