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Original Research Article

China's New Materials Industry Exhibits a Significant Structural Imbalance in Talent Supply and Demand, Necessitating an Improved Talent Training System to Support High-quality Industrial Development.

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Abstract: Innovations in new material technologies and the development of the new materials industry hinge on robust talent support. In China, the structural imbalance in the supply and demand of talent in this field has become prominent. The gap between talent supply and demand continues to widen in terms of quantity. Also, there is a relative lack of specialized technical talent in terms of quality. Regionally and age-wise, the distribution of talent remains suboptimal. The primary reasons for this imbalance in China's new materials talent structure are twofold. From the supply side, the training system for new materials talent lags behind industrial development needs. From the demand side, the new materials industry faces challenges, including low salary levels, employment perceptions, and recruitment mechanisms. It's recommended to foster an environment conducive to the growth of new materials talent, establish a multi-tiered talent training system, accelerate the deep integration of industry, academia, and research, optimize the talent development ecosystem in the new materials industry, and expedite the establishment of high concentrations of new materials talent.

Keywords: New materials industry; Talent training system

1. Introduction

The new materials industry in China represents a strategic and foundational sector, a highly contested field of high technology, and an intensely knowledge-intensive industry. The innovation and development of new materials technology and industry rely heavily on talent support[1]. Recently, the rapid growth of the new materials sector has highlighted a structural imbalance in the supply and demand for talent in China. This imbalance weakens the industry's drive for innovation and development, necessitating improvements in the talent cultivation system to support high-quality development in the new materials sector.

2. The Structural Imbalance in Talent Supply and Demand in China's New Materials Industry is Prominent

In terms of total quantity, the talent supply-demand gap continues to widen. China's new materials industry has expanded rapidly in recent years, with the industry scale growing from 650 billion yuan in 2010 to 6.8 trillion yuan in 2022, averaging an annual growth rate of over 20%. This rapid expansion demands an increasing number of skilled professionals. However, the current pace of talent cultivation lags behind, insufficiently meeting the industry's development needs, resulting in a significant talent gap. According to the Guidelines for the Development of Manufacturing Talent jointly issued by the Ministry of Education and other agencies, the total number of talents in China's new materials industry was 6 million in 2015 and 9 million in 2020, reflecting a gap of 3 million. By 2025, the industry scale is projected to reach 10 million, with an anticipated talent gap expanding to 4 million.

In terms of quality, there is a relative shortage of professional technical personnel. The pool of engineering and technical talent in China's new materials field is relatively weak, especially for technical personnel working at the frontline of enterprises. According to data from Zhaopin Recruitment, the job vacancy ratio for technical workers in general Chinese enterprises is about 1.8, while for high-skilled talent in new material enterprises, it exceeds 2, indicating a labor market shortage. The Ministry of Human Resources and Social Security's list of the top 100 most "in-demand occupations" for the third quarter of 2022 showed that positions like metallurgical engineers, heat treatment workers, electronic materials engineers, and plastic product molding workers are ranked high.

In terms of distribution, the regional and age structure of talent is not quite balanced. On one hand, there is a regional mismatch of talent. As shown in the table, among the top ten talent training institutions for new materials in China, six, including Tsinghua University and Northwestern Polytechnical University, are located in northern China. However, among the top ten cities for patent numbers in the new materials industry, only Beijing and Tianjin are included. Therefore, the training of new materials talent in China is not concentrated in the regions where the industry clusters and technology applications are located, leading to a regional imbalance in the supply and demand of talent.

Table: The top ten organizations in terms of the number of talents in the new materials industry and the top ten cities in terms of the number of patents in the new materials industry

Serial No.	Name of Organization	Number of Talents	City	Number of Patents
1	Shanghai Jiaotong University	591	Suzhou	79702
2	Central South University	548	Beijing	78936
3	Tsinghua University	539	Shanghai	58790
4	Northwestern Polytechnical University	532	Ningbo	57310
5	Zhejiang University	525	Foshan	48396
6	South China University of Technology	482	Shenzhen	28856
7	Harbin Institute of Technology	470	Wuxi	28143
8	Tianjin University	438	Wenzhou	25384
9	Xi'an Jiaotong University	416	Hangzhou	24909
10	University of Science and Technology Beijing	393	Tianjin	22133

Data source: Scientistln

On the other hand, talent age distribution remains imbalanced. The research-oriented new materials field, characterized by high technology content and complexity, requires substantial on-the-job training and experience for better talent aggregation effects. According to statistical analysis by BOCOG Big Data, in the global comprehensive materials field, China has a relatively lower proportion of scholars over 40 years old. Scholars aged 41-60 constitute only 21% domestically compared to 79% internationally; those over 60 constitute a mere 2.6% domestically, versus an overwhelming 97.4% internationally. China holds a slight advantage only in the under-40 category, comprising 43.1% compared to 56.9% internationally; however, this cohort lacks sufficient experience accumulation and research reserves in application fields.

3. The Primary Causes for the Structural Imbalance in Talent Supply and Demand in China's New Materials Industry

The competition in the new materials industry revolves around human resources. Cultivating and attracting

talent requires concerted efforts from academia, industry, and research entities[2]. From a comprehensive point of view, the main causes of the structural imbalance problem of talents in China's new materials industry are as follows.

From the supply side, the talent training system lags behind industry development needs. Firstly, the discipline construction is insufficient. University material science programs are categorized based on material properties, which differ from the classifications and actual requirements of the new materials industry. The setup of new materials disciplines in universities lags behind the industry's developmental needs, lacking foresight and dynamic adjustment capabilities. Additionally, the fundamental capacity-building of related disciplines, such as experimental equipment and production facilities, is delayed. Secondly, enrollment scale is inadequate. The scale of enrollment and training for new materials talent in China is relatively limited, significantly lagging behind related fields like computer science. According to statistics from the Ministry of Education, from 2016 to 2023, the number of undergraduate admissions in computer science in China grew by 62%, whereas material science undergraduate admissions only increased by 14%, maintaining a generally stable level over the years. Thirdly, talent cultivation models lack diversity. The interdisciplinary talent training system between material science and other disciplines remains unclear, and cooperation between different disciplines for talent training is insufficient. Furthermore, enterprises fail to play a major role in developing talent for the new materials industry, showing low enthusiasm for participating in talent training. The proportion of new materials talent cultivated within enterprises is relatively low, and a diversified talent supply model has yet to be formed.

From the demand side, the new materials industry faces challenges with low salary, employment concepts, and recruitment mechanisms. Firstly, there is a wage gap. The development environment, supporting policies, and incentive mechanisms in China's new materials industry lag behind other sectors, resulting in lower salary levels. Secondly, there are misconceptions about employment. For a long time, the materials science profession has been associated with "blue-collar" jobs. During the process of choosing majors, parents generally view materials science jobs as dangerous and "low-end", with a job mode similar to steel smelting, and a bleak career outlook. Thirdly, the talent recruitment mechanism is inadequate. Most companies use singular recruitment methods, typically relying on job platforms and headhunting firms. These agencies lack specificity and expertise in the new materials field, restricting the introduction of talent, particularly high-level professionals.

4. To Create an Environment Conducive to the Growth of Talents in New Material Industry

Faced with prominent issues and shortcomings in the development of new materials talent in China, it is urgent to build a system, establish platforms, and strengthen the ecosystem to cultivate and attract talent in the new materials field, laying a solid foundation for industrial development.

4.1. To establish a multi-level talent development system.

Support universities to adapt proactively to the development needs of new technologies, new processes, new equipment, and new materials[3], dynamically adjust and optimize materials science disciplines; promote the integrated development of materials science with other disciplines, cultivating interdisciplinary talent, basic research talent, and innovative talent; strengthen the policy promotion of new materials disciplines, gradually changing society's inherent perception of new materials disciplines. Support vocational colleges in improving

the training system for skilled talent in new materials; leverage the advantages of social training institutions in closely aligning with enterprises and flexible educational mechanisms to conduct short-term large-scale talent training, increasing the talent reserve in the new materials industry. Encourage and guide enterprises to focus on enhancing the professional skills of their employees, using market-oriented operations as the main approach, fully mobilizing enterprises to actively engage in training talent for the new materials industry.

4.2. To accelerate the integration of industry, academia, and research.

Establish mechanisms for the mutual exchange of core enterprise staff, university faculty, and researchers from scientific institutions. Implement a "dual mentorship system" and "project team system" within schools and enterprises. Encourage material science students to participate in cross-disciplinary collaborative innovation training and practical production. Expedite the formation of collaborative industry-academic-research practical bases between universities and new material enterprises. Create new material industry academies to enhance the quality of training for versatile applied talents through precise university-enterprise collaboration. Deepen engineering education reforms. Improve the internship system for engineering students. Focus on fields like smart manufacturing and "Internet+Manufacturing" to strengthen the practical engineering skills of students.

4.3. To optimize the talent development ecosystem for the new material industry.

Plan the strategic layout around key manufacturing sectors. Support manufacturing industry clusters and pilot industrial transfer parks, focusing on developing professional clusters through deep university-enterprise cooperation. Promote coordinated development of "talent and industry" by leveraging new material industrial parks or bases. Perfect the new material industry ecosystem. Optimize talent policies to increase the attractiveness of the new material industry to professionals. Utilize the national new material industry resource-sharing platform to enhance information sharing about industry talents and facilitate matching talent supply with industry demands. Furthermore, improve the salary level and welfare benefits of talents in the new materials industry, establish a systematic performance-based salary system based on their technological contributions to the industry, and provide significant rewards to talents who have made outstanding contributions to the development of the industry.

4.4. To accelerate the construction of talent hubs for the new material industry.

Strengthen top-level design and strategic planning for industry talent. Optimize spatial planning for talent distribution in key regions like Beijing, Shanghai, and the Guangdong-Hong Kong-Macao Greater Bay Area. Establish high-level talent hubs to attract and concentrate industry professionals. Leverage national platforms like the National Technology Innovation Center in the new material field, national production and application demonstration platforms, national scientific institutions, high-level research universities, and leading enterprises. Focus on critical strategic materials and cutting-edge new materials to develop strategic points and echelon formation for industry talent. Carry out international cooperation with key universities abroad, establish international cooperation technology platforms, theoretical platforms, and exchange platforms, and form a circular interaction between domestic industrial development and the development of domestic and international technology cooperation platforms.

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