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Research on the Talent Skill Supply–Demand Matching Mechanism for the Five Leading Industries in City S from the Perspective of New Quality Productive Forces

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Abstract: Driven by the growth of new quality productive forces, the five pillar industries in City S are experiencing a widening structural gap between the supply of skilled workers and actual industry demand. Drawing on a survey of 26 firms from these industries and seven local higher vocational colleges, our analysis shows that skill requirements are shifting rapidly—toward digital capabilities, green expertise, and hybrid job profiles. Vocational colleges, however, are struggling to keep pace: program structures are often lopsided, training standards lag behind technological change, and graduate competence does not consistently match what the market now expects. To address these mismatches, this paper outlines a tripartite supply–demand coordination mechanism that brings together policy direction, market forces, and industry–education partnerships. On a practical level, this calls for using policy levers to guide more coherent top-level design, allowing market signals to drive resource allocation, and deepening school–enterprise cooperation to build stronger linkages between training and employment. These insights offer both theoretical value and practical support for easing talent bottlenecks and facilitating industrial upgrading.

Keywords: New quality productive forces; Five leading industries; Skill supply–demand matching; Industry–education integration

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1. Introduction

The global economy is being reshaped by what can be called new quality productive forces—a development driven by breakthrough technologies, novel ways of organizing production factors, and deep industrial transformation [1]. Acemoglu and Restrepo show that the ongoing race between technological automation and human capital creation is reshaping job structures: demand for routine manual tasks is falling, while the need for complex problem-solving and tech-related skills keeps rising [2]. The national strategy of “education, science and technology, and talent” highlights how important it is to match skill supply with demand for regional growth. City S, a key city in the Beijing-Tianjin-Hebei coordinated development region and a traditional heavy industrial base in North China, is upgrading its five leading industries—biomedicine, electronic information, equipment manufacturing, and others. This transformation brings new demands on talents: instead of just operational know-how, what's needed now is a hybrid type of skilled talent that combines digital, smart, and green capabilities [3].

Yet a clear structural tension has appeared. Industrial skills change fast, while the talent supply system tends to stay relatively stable. On the one hand, enterprises have an urgent demand for skilled talent with cutting-edge technical and innovative abilities, making the "talent shortage" phenomenon more acute. On the other hand, vocational education often lags in terms of responsiveness, program structure, and training quality, leading to a mismatch between talent supply and industrial demand [4]. This mismatch has become a major obstacle preventing City S's five leading industries from fully benefiting from new quality productive forces.

This study aims to answer three questions from the perspective of new quality productive forces: What new features mark the skill demand of these five industries? What structural problems exist in the current talent supply system? And how can we build an efficient, accurate, and sustainable mechanism to match skill supply with demand? Addressing these questions is both practically urgent and strategically valuable.

2. Theoretical basis

(1) Core Concept Definitions

The theoretical basis includes three main concept definitions. New quality productive forces are an advanced form of productivity that drives industrial transformation and upgrading, featuring high technology, high efficiency, and high quality. Their driving force is breakthrough technologies, and their content includes the optimized combination of high-quality laborers, advanced tools, and new-type labor objects, with the rise in total factor productivity as the key indicator.[1].

City S's 14th Five-Year Plan for National Economic and Social Development lists five leading industries: biomedicine, next-generation electronic information, advanced equipment manufacturing, modern food, and modern commerce and logistics [5]. The skill supply–demand matching mechanism can be understood as an institutional arrangement that, through the joint workings of market forces and public policy, helps steer the labor market toward a dynamic balance between skill supply and demand. It brings together four main actors—government, enterprises, training institutions, and workers—with the aim of keeping the quantity, structure, and quality of skilled talent in step with industrial development [6].

(2) Review of Relevant Theories

This study draws on three main theoretical perspectives: new quality productive forces, human capital and skill formation, and industry–education integration. The new quality productive forces perspective shows how disruptive advances—above all in digital, green, and intelligent technologies—are altering the way production factors are combined. It stresses that workers' skills need to keep up with new technologies, new processes, and new equipment, an insight that shapes the way this study approaches changes in industrial skill demand and the cultivation of future-ready talent. Human capital theory treats skill accumulation as central to productivity gains, while skill formation theory emphasizes how institutional arrangements and school–business cooperation affect the quality of skill supply [7]. Taken together, these two frameworks offer analytical tools for examining the supply-side challenges. Industry–education integration theory calls for deep alignment between industry and education across planning, program design, curricula, and teaching staff, with the goal of creating an ecosystem where talent and technology flow in both directions [8]; it thus gives direct guidance for designing the collaborative pathways explored in this study.

3. Research subjects and methods

The study draws on data from two sides: industry and the skill supply. For the industry side, we picked six enterprises from each of the five leading industries, sending out 30 questionnaires in total. We got back 26 valid ones, giving an effective recovery rate of 86.7%. Of these, 15 were medium-sized enterprises (57.7%) and 11 were small (42.3%). It matches the distribution of City S's leading industries, which are mainly made up of small and medium-sized enterprises. On the supply side, 8 major higher vocational colleges in City S were selected, and 7 valid questionnaires were returned, with an effective recovery rate of 87.5%. The survey respondents included heads of academic affairs offices, department chairs, and core teachers. The main research method employed was a questionnaire survey. The Industrial Skill Demand Survey Questionnaire was designed around three dimensions—total demand volume and structure, types of skills in short supply, and future trends—with 27 questions in total. The Institutional Skill Supply Survey Questionnaire was designed around three dimensions—program distribution, training quality, and supply problems—with 28 questions in total. The analytical method adopted was descriptive statistics, using indicators such as frequency, percentages, and means to analyze the skill demand structure, the suitability of program distribution, and the degree of matching in training quality.

4. Analysis of the characteristics of skill demand in City S's five leading industries from the perspective of new quality productive forces

The characteristics of skill demand in City S's five leading industries from the perspective of new quality productive forces are reflected in three aspects: total volume and structure, types of skills in short supply, and future trends.

In terms of total demand, it is continuously expanding with significant differences among job categories. 84.6% of enterprises stated that the demand for skilled talent would increase over the next three years, with the biomedicine and electronic information industries seeing an increase of 80%. Medium-sized enterprises (57.7% of the sample) focused on "technological improvement and process upgrading," while small-sized enterprises (42.3%)emphasized "supplementing basic operational positions". Regarding demand structure upgrading,high-skill positions (senior technicians/technical leaders) accounted for 41.2%, mid-level technicians for 36.5%, and junior operators for only 22.3%. In the electronic information industry, demand for positions such as intelligent hardware debugging exceeded 50%,and in the biomedicine industry, demand for R&D positions was 32% higher than that for traditional roles.

Concerning skills in short supply, digital skills have become a universal requirement. Data analysis and visualization capabilities were demanded by 80% of enterprises in the electronic information and modern commerce and logistics industries. Intelligent equipment operation and maintenance was needed by 83.3% of enterprises in advanced equipment manufacturing and by 60% in the modern food industry. Green and hybrid skills are also in acute shortage. 66.7% of equipment manufacturing enterprises and 60% of modern food enterprises listed "green production processes" as a skill in short supply. 80% of biomedicine enterprises reported difficulty in recruiting hybrid talent combining"traditional biochemical experiments with AI-assisted drug design," and 83.3% of equipment manufacturing enterprises urgently needed integrated talent merging "mechanics, electronics, and software". Furthermore, small and medium-sized enterprises (100%) expressed demand for on-site problem-solving skills such as "intelligent equipment fault diagnosis" and "process parameter optimization".

When asked about future trends, 88.5% of the surveyed enterprises believed that technological iteration shortens skill validity periods. In biomedicine and electronic information, that lifespan has now dropped to just 2–3 years. A large majority (92.3%) rated "self-learning and quickly adapting to new tech" as their top concern. Meanwhile, 65.4% of enterprises stressed that human-machine collaboration capability would become a basic requirement, and 53.8% planned to increase positions on "process innovation and workflow optimization".

5. Analysis of the current situation of skill talent supply in City S's vocational colleges

While City S's vocational colleges have established a foundational skill talent supply system, it exhibits numerous deficiencies. The 8 main colleges surveyed deliver approximately 21,000 graduates annually, of which 53.3% are related to the five leading industries. Vocational undergraduate colleges mainly focus on fields such as advanced equipment manufacturing, while associate-degree colleges concentrate on areas like biomedicine, with 60% of their graduates serving the local market. In terms of program distribution, 263 program offerings cover the entire industrial spectrum, but the program orientation is imbalanced and fails to keep pace with technological advancements. Emerging directions account for a low proportion, related curricula lag, and there are only 12 cross-disciplinary programs, representing 4.5% of the total. Regarding training quality, although practical training conditions have improved, most colleges lack intelligent facilities; only 3 colleges have training bases capable of simulating real production environments. This limitation reflects what Fuller and Unwin term a "restrictive" learning environment, where students only get to do basic operational tasks rather than engaging in rich, knowledge-based practices that would help them develop hybrid skills [9]. As for "double-qualified" teachers, the overall numbers meet the standard, but nearly half of them have no frontline experience in enterprises. Moreover, the supply system exhibits obvious problems. The proportion of mid-to-high-end and hybrid talent is low. About 65% of school-enterprise cooperation never goes beyond internships. The curriculum assessment relies mainly on theoretical examinations, with little evaluation of problem-solving abilities. All of this makes it hard to meet the needs of industrial development.

6. Construction of the "policy–market–industry–education" three-dimensional collaborative matching mechanism

(1) Overall Approach

To address core contradictions such as structural mismatch, distribution mismatch, and standard mismatch, this approach follows three principles. These are systematic governance, dynamic adaptation, and collaboration among different actors. The core idea is that policy, the market, and industry–education integration work together as a closed-loop system. Through the flow of information, resources, and talent, this system helps reach a high-level dynamic balance between skill supply and demand.

(2) Policy Guidance Mechanism

(a) Establish a dynamic forecasting and release system for industrial talent demand

A joint office for industrial talent development should be created to guide industrial talent development. It would include the Municipal Development and Reform Commission, the Human Resources and Social Security Bureau, the Education Bureau, the Bureau of Industry and Information Technology, and major industry associations. An intelligent monitoring and forecasting platform for talent demand would also be developed, integrating multiple data sources such as enterprise recruitment, technological patents, and industrial plans to forecast the demand for skilled talent over the next one to three years [10]. *A Catalogue of Industries Facing Talent Shortages* will be regularly compiled and released, specifying skill combinations and proficiency levels. It will then serve as the main reference for approving new programs, allocating enrollment quotas, and evaluating project funding. In this way, demand signals can be passed accurately to the supply side.

(b) Improve fiscal and tax incentive policies for enterprise participation in talent cultivation

The Measures for the Recognition of Industry–Education Integration Enterprises shall be formulated, granting recognized enterprises a combination of incentives. First, a cost-plus deduction policy for educational investment will be implemented, whereby direct costs invested by enterprises are deducted according to regulations, after which an additional percentage of tax deduction is granted [11]. Second, a special fund for industry–education integration will be established. This fund provides one-time rewards to enterprises that cooperate with institutions to carry out talent cultivation and achieve positive results. Third, priority support will be given in areas such as land transfer, government procurement, and innovation project applications.

(c) Build a skill standards system adapted to new quality productive forces

Led by the government, in collaboration with leading enterprises and vocational colleges, a New Quality Skill Standards Development Committee shall be established. A focus on digital and green skills will guide the development of regional skill-level standards. These standards are to be aligned with the national vocational qualification framework and embedded in the specialized curriculum system [12]. At the same time, enterprises are encouraged to link new skill certifications to their internal pay structures and promotion pathways, so that the four steps of cultivation, certification, utilization, and incentive reinforce one another in a closed loop.

(3) Market-Driven Mechanism

Wage signals and competitive forces should be given a stronger steering role. The human resources and social security department will regularly release wage benchmarks broken down by occupation and skill level, with an emphasis on pay in emerging fields. Making market compensation information open and transparent allows workers to see the economic returns on different kinds of skill investment quite clearly [13], which can guide them to invest in skills more rationally and move into higher-value-added areas. At the same time, the specialized skill services market will be steadily cultivated—market access will be eased, and third-party institutions will be encouraged to offer a range of services, from micro-credential certification and skill mapping to precise competency assessments and career planning. An integrated talent service platform combining certification, recruitment, and continuing education will be built, where algorithmic tools help match people and jobs in a smarter, more targeted way [14].

(4) Industry–Education Collaboration Mechanism

School-enterprise integration needs to go considerably deeper if a genuinely collaborative industry–education mechanism is to take shape. Thelen's institutional analysis of skill formation systems is instructive here: effective vocational training rests on a working "governance triangle" where the state, employers and educational institutions negotiate shared norms and mutual obligations, rather than depending on loose market transactions [15]. One concrete move is to set up modern industrial colleges and high-level training bases that are jointly built and run by schools and enterprises. A joint school–enterprise council would be formed to handle the key tasks—program planning, curriculum development, teacher training—together. Companies would bring real production lines, R&D projects and service processes onto campus, turning them into productive practical training [16]. At the same time, curriculum systems and teaching content need to be renewed in a far more collaborative manner. A dynamic updating mechanism would allow course content to be revised each year on an iterative basis, while schools and enterprises jointly develop modular curriculum resources oriented around "digital+" and "green+". Through project-based teaching, enterprises' real technical challenges and innovation needs can be converted into teaching modules that push students to integrate knowledge across disciplines and strengthen their hands-on innovation skills. A further priority is improving the mechanism for co-developing and sharing "double-qualified" teachers—those with a footing in both industry and the classroom [17]. Dual appointment systems for industry professors and visiting engineers will be put in place. High-level technical and managerial personnel from enterprises will be invited to teach. Professional teachers' requirements for enterprise practice will be strictly enforced. Supporting measures such as practice allowances and the establishment of enterprise teacher workstations will also be provided. In this way, two-way talent flow and resource co-construction and sharing between schools and enterprises can be realized [18].

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