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Research on the Fundamental Logic and Mechanism of Scientific and Technological Innovation Empowering the Development of New Quality Productive Forces

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Abstract: *As an advanced manifestation of contemporary social productive forces, new quality productive forces are inherently driven by scientific and technological innovation. The empowerment of new quality productive forces by scientific and technological innovation reflects profound inherent logic, embodies scientific operational mechanisms, and demonstrates distinct practical relevance. Through deep coupling with social productive forces, scientific and technological innovation optimizes and upgrades the constituent elements of productive forces, catalyzes the industrial layout required for the development of new quality productive forces, comprehensively propels the cultivation and utilization of sci-tech talent, and effectively empowers its advancement.*

Keywords: *Scientific and Technological Innovation, Productive Force, New Quality Productive Force, Industrial Upgrading*

1. Introduction

As a significant manifestation of current social productive forces, new quality productive force, which represents a new form of productive force development in the new wave of technological revolution and industrial transformation, is essentially an advanced productive force driven by scientific and technological innovation [1]. However, at present, societal development is hindered by issues such as data dormancy (low data utilization), structural disorder (structural imbalance), and ecological isolation (disrupted ecosystem connectivity) [2], slowing the progress of new quality productive forces. Scientific and technological innovation, as the intrinsic driver of the leapfrogging development of new quality productive forces, promotes the transformation and upgrading of traditional industries through technological advancement and progress, achieves comprehensive development of productive force in the new era [3], and contributes significant momentum to the progress of human society.

2. Innovation-Productivity Deep Coupling: Sci-Tech Advancement Determines Productive Force Development Level

Science and technology are not only a crucial driving force for productive force development, but also the concentrated embodiment of advanced productive forces. The primary impetus for human society's continuous replacement of backward productive forces with advanced ones stems from the progress of science and technology, where the level of technological sophistication serves as a key indicator of productive force advancement. Scientific and technological innovation can drive systematic advancements in technology, institutions, and models, thereby facilitating the development and upgrading of productive forces [4].

2.1 Technological Innovation is a Key Manifestation of New Quality Productive Forces Development

With the continuous advancement of science and technology, traditional industries face the pressure of transformation and upgrading. Scientific and technological innovation facilitates industrial

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upgrading through the introduction of novel technologies and development of advanced processes, thereby enabling enterprises to enhance production efficiency, reduce energy consumption, and ultimately propels industries toward high-tech, high value-added ones. Specifically, scientific and technological innovation translates into actual productive capacities through its application in production processes and permeation across multiple productivity factors, thereby catalyzing profound transformations in productive forces. Particularly, continuous breakthroughs in critical generic technologies, cutting-edge technologies, and disruptive technologies are accelerating the formation of strategic emerging industries such as new energy, advanced materials, and high-end equipment manufacturing, achieving a transition of productive forces from traditional factor-driven to innovation-driven development.

2.2 Institutional Innovation is a Key Factor for New Quality Productive Forces Development

Under the application and popularization of advanced technologies such as the Internet of Things and big data, production factors achieve innovative allocation. In fact, traditional resource allocations are often based on human decision-making, which to some extent leads to deviations in decision-making outcomes. However, scientific and technological innovation enables precise resource allocation through informatization tools and intelligent management. This not only effectively reduces the costs and risks of resource allocation but also promotes the efficient utilization of innovation resources, facilitating the global interconnection of production factors. Simultaneously, new quality productive forces enable production factors to leverage complementary advantages, foster innovative interactions among factors, promote deep integration, and enhance synergistic effects. Grounded in institutional innovation, this innovative allocation of production factors can stimulate latent innovative potential and drive the virtuous development of new quality productive forces.

2.3 Model Innovation is a Key Support for New Quality Productive Forces Development

In the new era, relying solely on product and technological advantages proves inadequate to meet diversified market demands. At the national level, the ongoing Fourth Industrial Revolution represents a grand convergence of physical, cyber, and biological spaces driven by emerging technologies like artificial intelligence, life sciences, and the Internet of Things in essence. This has elevated the difficulty and complexity of scientific and technological breakthroughs to unprecedented levels, transforming technological competition into a contest between national innovation models. From a market perspective, enterprises transform traditional operational models and explore new business and profit models to adapt to rapidly evolving market conditions. Through model innovations, scientific and technological innovation disrupts entrenched national innovation systems and traditional corporate market patterns, enabling cross-boundary integration. This accelerates the permeation of science and technology into socio-economic development, empowering nations to pioneer new frontiers and pathways in global competition while helping enterprises cultivate new growth drivers and competitive advantages in the marketplace.

3. Sci-Tech Innovation: Upgrading Constituent Factors and Accelerating New Quality Productive Forces

Compared with traditional productive forces, new quality productive forces are mainly reflected in the new state of production factors, specifically manifested in new-type labor force proficient in advanced technologies, new means of labor such as intelligent equipment, and immaterial subjects of labor including digital space. In this process, scientific and technological innovation can play a leading role by expanding the production boundaries of knowledge-based resources, thereby achieving a leapfrog advancement in labor force, means of labor, objects of labor, and their optimal combinations.

3.1 Scientific and Technological Innovation Upgrades New-Type Labor Force

One essential component of productive forces is the labor force, with high-skilled workers constituting the primary agents in new quality productive forces. The value creation of new quality productive forces is ultimately realized through labor force. This means that the enhancement of labor forces' competencies and skills directly determines the baseline development threshold of new quality productive forces. Driven by scientific and technological innovation, the labor force attains higher educational attainment, labor skills, and innovative capabilities to adapt to evolving production

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demands, thereby substantially elevating labor efficiency. Under the new production modes, the labor force must possess rapid learning capabilities and high adaptability to drive technological breakthroughs. In this process, scientific and technological innovation can catalyze the rise of new industries such as intelligent connected systems, while mitigating natural constraints on production activities, injecting robust momentum into new quality productive forces.

3.2 Scientific and Technological Innovation Empowers New-Type Means of Labor

The means of labor refer to the material resources or conditions through which laborers act upon the objects of labor during the production process. The distinction between different economic eras lies not in what is produced, but in how production is carried out and what means of labor are employed [5]. From the agricultural economy to the industrial economy, and now entering the digital economy, the means of labor have undergone profound transformations. The current wave of technological transformation, represented by smart terminals, mobile internet, and big data, is driving the transition from traditional productive forces to new quality productive forces. At the core of these new means of labor lies the intellectualization of labor instruments, which profoundly alters labor organization and production modes. The integration and upgrading of traditional and intelligent means of labor have given rise to a new pattern combining industrialization and intellectualization. Under the influence of digital technologies, scientific and technological innovation accelerates resource flows, optimizes factor allocation, enhances collaborative production, and elevates social productivity. This process generates advanced production instruments with high technological sophistication and precision, catalyzing systemic transformation in production modes.

3.3 Scientific and Technological Innovation Expands New-Type Objects of Labor

The object of labor, as both the outcome of the objectified development of human activity and the prerequisite for material production, serves as a critical indicator of social productive forces' developmental level. Labor can create social wealth only when combined with its object. Driven by the Industrial Revolution, humanity has continuously expanded new spheres of production, with synthetic materials, high-performance polymers, and new energy emerging as objects of labor. Scientific and technological innovation propels the pervasive integration of new-type objects of labor such as technologies and data across industrial sectors, making traditional objects of labor demonstrate characteristics like high-tech transformation and dematerialization through conversion into digital spaces, thereby expanding the material scope of objects of labor. Compared with traditional ones, innovation-empowered objects of labor can significantly enhance production efficiency and quality. The application of digital objects of labor such as big data, blockchain, and artificial intelligence can improve production precision, reduce resource waste, and provide crucial momentum for developing new quality productive forces.

4. Sci-Tech Innovation: Catalyzing New Industries and New Layouts and Providing Platform Supports for New Quality Productive Forces

To solidify the material and technological foundation for building a modern country, an independent, controllable, and highly competitive modern industrial system is essential. Industrial system's modernization constitutes not only the core of national modernization, but more critically, the decisive factor for the rise and fall of a country [6]. Scientific and technological innovation can catalyze new industries and layouts, providing platforms for the development and application of new quality productive forces, serving as the engine for economic growth and national rejuvenation.

4.1 Scientific and Technological Innovation Drives Industrial System's Upgrading

Scientific and technological innovation can facilitate the transformation of research and development outcomes into production technologies, enabling them to be integrated into the actual production process, so as to promote the transformation of the industrial system from quantitative changes to qualitative changes. As a reflection of science and technology, traditional productive forces' industrial systems primarily consist of resource-intensive industries, targeting mass production while exhibiting characteristics of high resource consumption and low value-added output. In contrast, the industrial system of new quality productive forces is mainly composed of technology-intensive industries, with intelligent and green production as its goal, demonstrating low resource consumption

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and high value-added output. Today, modern scientific and technological innovations have spawned new industries spanning a broader spectrum, including high-end equipment manufacturing, new energy, and intelligent manufacturing, propelling the transformation and upgrading of traditional industries.

4.2 Scientific and Technological Innovation Spurs Strategic Emerging Industries

To build a modern industrial system, it is imperative to establish an industrial system supported by scientific and technological innovation, with the key focus on cultivating strategic emerging industries. As pillar industries, strategic emerging industries are based on breakthroughs in key core technologies. They are characterized by high technological content, strong market competitiveness and significant driving effects, playing a leading role in the overall economic and social development and long-term progress. Driven by scientific and technological innovation, new quality productive forces have enabled strategic emerging industries to continuously break through technological barriers, enhancing added value of products and market competitiveness. To be specific, under the influence of digital technologies such as big data and artificial intelligence, scientific and technological innovation can establish a full industry chain encompassing industry, academia and research and develop a networked collaborative innovation mechanism, thereby empowering the cluster development of strategic emerging industries and promoting the systematic construction of innovation and entrepreneurship systems. During this process, by integrating scientific and technological resources, strategic emerging industries enhance China's economic and technological strength, and provide support for new productive forces.

4.3 Scientific and Technological Innovation Pioneers Future Industrial Development

As the pioneering industry of new quality productive forces, future industries are driven by cutting-edge technological exploration. From a developmental perspective, they will demonstrate advantages including superior comprehensive benefits and strong driving effects. However, future industries currently face uncertainties in technological pathways, unfixed development models, and unestablished technical paradigms. This necessitates accelerated exploration and practice across multiple dimensions including technology roadmap, underlying logic, standard systems and business philosophy. Scientific and technological innovation, as a distinctive feature of the modern industrial system, promotes the development of new quality productive forces by intensifying scientific research in brain-like intelligence, brain-computer interfaces and other fields, vigorously developing high-tech fields such as quantum information, genetic technology, life sciences, and deep-sea and aerospace exploration. This drives the upgrading and transformation of traditional industries, laying the foundation for the development of future industries, thereby facilitating the development of new quality productive forces.

5. Sci-Tech Innovation: Cultivating Talent for New Quality Productive Forces and Building a Talent Reservoir

The talent factor is a decisive element influencing new quality productive forces. The quantity and structure of innovative talents reflect the level of new quality productive forces while also reacting upon their development. The establishment of an innovative talent cultivation system forms the foundation for nurturing a talent reservoir for new quality productive forces. This system not only relates to the sustained enhancement of a country's scientific and technological capabilities but also directly impacts the cultivation of industries associated with new quality productive forces.

5.1 Scientific and Technological Innovation Accelerates the Cultivation of New-Type Innovative Talents

Government departments optimize the national education system by building high-level sci-tech talent teams aligned with the practical needs of "high-end, precision, advanced, and demanding" fields. This drives flexible adjustments in the disciplinary structures of higher education institutions while enhancing the quality of talent cultivation in fundamental disciplines and emerging academic fields. To advance scientific and technological innovation, it is imperative to strengthen the cultivation of interdisciplinary innovative talent resources and ensure that they possess not only profound expertise in their specialized fields but also the capability to comprehensively utilize cutting-edge technologies across various domains. By breaking through traditional disciplinary barriers, such talent can better

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adapt to and steer the development trajectory of new quality productive forces. Simultaneously, the deep integration of the education chain and industrial chain needs to be advanced. Through the talent cultivation model encompassing industry, academia and research, this effort drives closer collaboration between educational institutions and enterprises, establishes research facilities and practice bases targeting major real-world challenges with efficient technology transfer, and builds a complete talent development ecosystem that seamlessly connects education, research and industrial application.

5.2 Scientific and Technological Innovation Promotes the Reform of Talent Evaluation Systems

With the rapid advancement of technology and industries, talent evaluation standards require dynamic adjustments to accommodate the development needs of new occupations and fields. A flexible talent evaluation and incentive system can better serve the cultivation of talent for new quality productive forces and meet diversified talent demands. The government departments should regard innovation value as the core criterion for talent evaluation. By encouraging talents to conduct in-depth research to solve practical social problems, and scientifically assessing their key capabilities in addressing complex issues, driving technological advancement, and facilitating technology transfer, they can accelerate the process of developing new quality productive forces. Advancing scientific and technological innovation necessitates further dismantling institutional barriers to talent development. This requires persistently deepening the reform to move beyond the “Five Only” metrics (overreliance on academic papers, patent counts, professional titles, educational credentials, and awards), while shifting evaluation focus toward assessing fundamental competencies rather than overemphasizing concrete quantitative indicators. Concurrently, it is essential to improve the talent incentive mechanism by continuously refining policies concerning research support, professional title evaluation, and position promotion. A balanced approach combining universal and targeted incentives, as well as short-term and medium-to-long-term incentives, should be adopted to enhance compensation packages and strengthen talents’ sense of fulfillment. Throughout this process, particular emphasis must be placed on striking a balance between motivation and workload reduction. By minimizing formalistic evaluation procedures, it is ensured that talents are able to devote their primary efforts to scientific and technological advancement.

5.3 Scientific and Technological Innovation Drives the Aggregation and Momentum of Outstanding Talents

On one hand, government departments are establishing a globally competitive talent governance system to articulate national policy orientations for talent recruitment. This involves selectively attracting high-level professionals in fields corresponding to the nation’s industrial bottleneck areas, thereby addressing critical domestic talent gaps and injecting human capital dynamism into new quality productive forces. On the other hand, government departments are creating expedited channels for talent recruitment across regions. By focusing on key fields, important industries and major projects of the local areas, they are systematically attracting specialized innovation talent. This initiative is accelerating the establishment of pivotal research institutions and laboratories, while amplifying the scale effects of innovative talent clusters and knowledge spillover effects, thereby injecting human capital momentum into the development of new quality productive forces. Furthermore, government departments need to facilitate the free flow of innovative talent by progressively relaxing urban residency restrictions, improving settlement policies in major cities, and reforming personnel dossier management systems as well as cross-sector mobility mechanisms. These measures will expand domestic circulation channels for innovators, ultimately creating an ecosystem where “global talents converge in China and all compete freely under the same sky”, thereby empowering the development of new quality productive forces.

6. Conclusions

The current global development faces pressing real-world constraints, including tightening resource and environmental limitations, sluggish international economic recovery, and insufficient vitality in global markets. These challenges have consequently imposed constraints on traditional factor inputs and diminished the driving force of conventional industries on economic growth. Against the backdrop of the rapidly unfolding new wave of scientific and technological revolution and industrial transformation, coupled with the vigorous development of digital information technologies such as artificial intelligence, new quality productive forces have emerged as a crucial manifestation of

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advanced productive forces in contemporary society. Their essence lies in productive forces driven by scientific and technological innovation. New quality productive forces empowered by scientific and technological innovation embody profound internal logic, incorporate scientifically grounded operational mechanisms, and demonstrate distinct practical relevance. Through deep coupling with social productive forces, scientific and technological innovation optimizes and upgrades the components of productive forces, expands the industrial layout required for their development, and holistically advances the cultivation and deployment of sci-tech talent. This drives continuous deep integration and cross-convergence between high-tech industries and technologies, catalyzing emerging industries, business paradigms, and models. These dynamics generate a qualitatively superior form of productive force that transcends traditional ones, ultimately serving as the primary catalyst for high-quality development in human society.

References

[1] Zhan, Y. and Li, S.N. (2024). The Logic, Mechanism, and Path of Promoting the Modernization of Industrial Chain through New Quality Productive Forces. Reform, 5, 54-63.
[2] Yin, J. and Sun, J.Y. (2024). New Quality Productive Forces and New Production Relations: A Political Economy Analysis. Reform, 5, 45-53.
[3] Cao, Y., Kou, F.R. and Zhang, W.J. (2024). Driving the Development of Hunan-Specific New Quality Productive Forces through Sci-Tech and Industrial Integration Innovation. Social Sciences Hunan, 3, 23-30.
[4] Yao, S.J. and Fang, J. (2024). Theory and Practice of New Quality Productive Forces in the New Era. Chongqing Social Sciences, 5, 6-22.
[5] Marx, K. (2004). Capital: Volume I. People's Publishing House, Beijing, 210.
[6] Wang, Q. (2024). Micro-Mechanism of New Quality Productive Forces Generation: Value Orientation, Activity Reconstruction and Coordination Adaptation. Journal of Shanghai Normal University (Philosophy & Social Sciences Edition), 53, 13-21.