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Synergy between Artificial Intelligence and New Quality Productivity: Research on a New Paradigm for Empowering Scientific and Technological Innovation

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ABSTRACT
Against the backdrop of a new round of technological revolution and industrial transformation, artificial intelligence (AI), as a leading technology, is becoming a core driver of scientific innovation through its synergistic development with new quality productivity. This study delves into the intrinsic mechanisms of how AI and new quality productivity collaboratively empower technological innovation. By analyzing their interactive relationships, operational pathways, and practical case studies, it reveals their pivotal roles in reshaping production factors, driving industrial upgrading, and optimizing innovation ecosystems. Research findings indicate that the synergy between AI and new quality productivity can establish an innovation closed loop encompassing "technological breakthroughs → industrial applications → ecosystem optimization," providing crucial support for China's pursuit of high-level technological self-reliance and robust economic development.

KEYWORDS
Artificial intelligence; New quality productivity; Scientific and technological innovation; Collaborative paradigm

1 Introduction

Currently, global technological competition is intensifying, with scientific innovation becoming a core strategy for nations to enhance their comprehensive national strength. The report to the 20th National Congress of the Communist Party of China explicitly emphasized accelerating the development of new-quality productive forces and promoting deep integration between the real economy and digital economy to inject new momentum into technological innovation. As the core driving force behind the new wave of technological revolution and industrial transformation, artificial intelligence is increasingly becoming a paradigm for empowering scientific innovation through its synergistic development with new-quality productive forces.

Artificial intelligence possesses universal technological attributes that permeate every aspect of productivity. By reshaping the three fundamental elements of labor—workers, work objects, and means of production—it provides critical support for the development of new-type productive forces. These forces are characterized by high technology, high efficiency, and superior quality, breaking free from the path dependence of traditional economic growth models and creating vast application scenarios for AI technologies and industrial implementation. The synergistic development between these two domains not only accelerates technological innovation but also drives industrial structure optimization and upgrading, ultimately achieving effective enhancement of economic development quality.

However, current research on the synergistic empowerment of artificial intelligence and new quality productivity in driving technological innovation remains in its infancy. The intrinsic collaborative mechanisms, operational pathways, and practical models between these two elements have yet to be systematically elucidated. Therefore, in-depth exploration of their synergistic relationship and the establishment of a new paradigm for empowering technological innovation hold significant theoretical value and practical implications.

2 The Interactive Relationship Between Artificial Intelligence and New Quality Productivity

Artificial intelligence and new quality productivity share a mutually reinforcing and synergistic relationship. On one hand, AI serves as the core driving force behind the development of new quality productivity. By reshaping the three fundamental elements of productivity, AI provides technological support for the formation and advancement of new quality productivity. Regarding laborers, AI replaces repetitive and mechanical tasks, freeing workers from tedious processes and facilitating their transition from "physical laborers" and "skilled workers" to "innovators" and "multidisciplinary professionals." In terms of production tools, AI upgrades manufacturing equipment from "mechanical automation" to "intelligent autonomy," achieving intelligent and automated production processes that significantly enhance labor productivity. As for production objects, AI unlocks the value of data elements, transforming data into critical new production assets and expanding the boundaries of productive activities.

On the other hand, the development demands of new-type productive forces exert a reciprocal influence on artificial

intelligence progress. The need for high-performance computing, precise recognition capabilities, and cross-domain collaboration in new-type productive forces drives algorithm optimization and computational power enhancement in AI systems. This accelerates the integration of AI with technologies like the Internet of Things and blockchain, forming more robust technological clusters. Simultaneously, the advancement of new-type productive forces provides extensive application scenarios for AI technologies, expediting their industrialization process and fostering a virtuous cycle between technological innovation and industrial development.

3 The Intrinsic Mechanism of Synergistic Empowerment of Artificial Intelligence and New Quality Productivity on Scientific and Technological Innovation

3.1 Restructuring Production Factors to Activate Innovation Momentum

Production factors form the foundation of technological innovation. The synergy between artificial intelligence and new quality productivity can redefine the essence and forms of production factors, thereby injecting fresh vitality into technological innovation.

First, data has become a critical production factor. Supported by artificial intelligence technology, capabilities in data collection, storage, analysis, and utilization have been significantly enhanced, fully unlocking the value of data. The development of new quality productivity integrates data with traditional production factors, driving deeper application of data elements in production processes and providing abundant resources for technological innovation. For instance, in the medical field, AI-powered analysis of massive healthcare data can assist physicians in disease diagnosis and treatment plan formulation, thereby advancing medical technology innovation.

Secondly, workers 'competencies have undergone systematic enhancement. AI-powered intelligent support systems accelerate skill upgrades among laborers, while smart training platforms enable traditional workers to swiftly master smart device operations through personalized programs. In scientific research, AI-driven literature analysis systems integrate vast academic resources, significantly boosting researchers' knowledge innovation efficiency. The development of new-generation productive forces requires workers to possess digital literacy and interdisciplinary capabilities, driving continuous learning and innovation that provides essential talent support for technological advancement.

Finally, labor tools have undergone intelligent transformation. Artificial intelligence has evolved production equipment from traditional mechanical tools to smart devices and digital platforms, enabling intelligent and automated manufacturing processes. For instance, the widespread application of industrial robots in manufacturing allows for 24/7 precision operations, significantly enhancing production efficiency and product quality while providing technological support for innovation in the manufacturing sector.

3.2 Promote Industrial Upgrading and Expand Innovation Scenarios

The synergy between artificial intelligence and new quality productivity can drive industrial upgrading, expand application scenarios for technological innovation, and achieve deep integration between technological innovation and industrial development.

On one hand, the intelligent transformation of traditional industries is accelerating. The deep integration of artificial intelligence technology with traditional sectors enables them to break free from energy-intensive and inefficient operational patterns, achieving intelligent and green production model transitions. On the other hand, emerging industries continue to emerge. The synergy between AI and new productive forces has given rise to industrial clusters such as smart manufacturing, intelligent healthcare, autonomous driving, and connected vehicles. These emerging industries, characterized by high technological sophistication and added value, provide vast opportunities for technological innovation.

3.3 Optimizing the Innovation Ecosystem and Enhancing Collaborative Innovation

The synergy between artificial intelligence and new quality productivity can optimize the innovation ecosystem, foster collaborative cooperation among innovation stakeholders, and enhance the efficiency and quality of scientific and technological innovation.

First, establish an integrated innovation ecosystem combining industry, academia, research institutions, and practical applications. The advancement of artificial intelligence and new productive forces requires close collaboration among enterprises, universities, and research organizations. Through coordinated innovation efforts, stakeholders can share knowledge, technologies, and talent resources while accelerating the commercialization of scientific achievements. Second, optimize policy frameworks. Governments should implement supportive measures including tax incentives,

financial subsidies, and intellectual property protections to create favorable conditions for technological innovation. Finally, strengthen international collaboration. In the context of globalization, developing AI and new productive forces necessitates enhanced global cooperation to leverage worldwide innovation resources. China actively participates in international AI initiatives, engaging in extensive exchanges with global partners in technology R&D, standard-setting, and talent development to enhance its influence and voice in global technological innovation.

4 Practical Cases of Synergistic Empowerment of Artificial Intelligence and New Quality Productivity for Scientific and Technological Innovation

4.1 Manufacturing Industry: Intelligent Transformation Drives Technological Innovation

As the core carrier of the real economy, manufacturing serves as a critical application scenario where artificial intelligence (AI) and new-quality productive forces synergistically empower technological innovation. Traditional manufacturing enterprises implement AI technologies to achieve intelligent transformation across the entire production process, thereby establishing a data-driven smart production system.

By leveraging sensors and intelligent monitoring networks for real-time production data collection and transmission, combined with AI algorithms to conduct in-depth analysis and data mining, the system achieves precise control and dynamic optimization of production processes and equipment operations. This significantly enhances production efficiency while reducing product defect rates. Additionally, AI applications in quality inspection employ visual recognition and machine learning technologies to enable high-precision defect detection with high efficiency, effectively lowering quality control costs.

The intelligent transformation is compelling enterprises to establish collaborative innovation mechanisms integrating industry, academia, and research institutions. This initiative promotes joint research on applying artificial intelligence technologies in manufacturing scenarios with universities and research organizations, focusing on core technological areas such as intelligent production scheduling and predictive equipment maintenance. By developing a series of proprietary technological innovations, enterprises can achieve a fundamental shift from "experience-driven" to "data-driven" production models, injecting core momentum into the high-quality development of the manufacturing sector.

4.2 Healthcare Industry: Artificial Intelligence Empowers Precision Medicine Innovation

Technological innovation in the medical field is directly related to public welfare. The deep integration of artificial intelligence (AI) and new quality productivity has opened new pathways for the development of precision medicine. By deploying AI-assisted diagnostic and treatment systems, healthcare institutions are driving the upgrading of medical service models toward intelligence and personalization.

Artificial intelligence technology first enables empowerment in healthcare service processes by utilizing applications such as intelligent triage and appointment scheduling to alleviate the core diagnostic workload of medical staff. Meanwhile, medical imaging auxiliary diagnostic systems constructed based on natural language processing and machine learning technologies can perform intelligent analysis of medical imaging data, providing precise quantitative references for clinical diagnosis and enhancing the efficiency and accuracy of disease diagnosis.

At the scientific research level, medical institutions and research organizations leverage artificial intelligence technologies to establish medical big data analysis platforms. These platforms integrate and analyze multi-omics data such as genomics and proteomics, constructing disease prediction models and personalized treatment recommendation systems. Through in-depth mining of patients' genetic characteristics and clinical data, early disease warning and precise genotyping are achieved, enabling the customization of optimal treatment strategies for patients. This drives the transformation of medical services from "standardized treatment" to "personalized precision medicine."

4.3 Energy Sector: Artificial Intelligence Enhances Energy Utilization Efficiency

As a foundational industry of the national economy, the energy sector has seen collaborative applications of artificial intelligence (AI) and new quality productivity emerge as a critical driver for advancing energy revolution and achieving green, low-carbon development. Energy enterprises are introducing AI technologies to establish intelligent energy management systems, enabling smart control across the entire energy production, transmission, and consumption chain.

The energy data analysis platform powered by artificial intelligence technology enables real-time monitoring and prediction of multi-source data including operational status of energy production equipment, grid load fluctuations, and user energy consumption patterns. By leveraging intelligent algorithms to optimize energy production scheduling plans, it enhances the operational stability and energy utilization efficiency of power systems. Meanwhile, the application of AI

technology in renewable energy sectors achieves precise forecasting of renewable power generation capacity (e.g., wind and solar energy) to refine operational control strategies for renewable energy stations, thereby improving grid integration and energy absorption capabilities.

Furthermore, energy enterprises leverage artificial intelligence technologies to establish intelligent equipment operation and maintenance systems. By conducting real-time analysis of operational data, they achieve early fault detection and predictive maintenance, thereby reducing equipment failure rates and operational costs. The intelligent transformation of the energy sector drives companies to focus on innovative research in cutting-edge fields such as renewable energy technologies and energy storage solutions, providing technical support for building a clean, low-carbon, safe, and efficient energy system.

5 Challenges and Countermeasures in Collaborative Empowerment of Scientific Innovation by Artificial Intelligence and New Quality Productivity

5.1 Challenges Faced

5.1.1 Core Technical Bottlenecks as Constraints

While China has made notable progress in artificial intelligence, it still faces challenges in core technologies such as high-end chips, algorithm models, and data security systems. For instance, domestic manufacturing capabilities for advanced chips remain significantly behind international benchmarks, with substantial reliance on imported components that hinder the synergistic development of AI and new-generation productive forces. Additionally, the nation's innovation capacity in AI algorithm models remains inadequate, lacking globally competitive general-purpose large-scale models. These shortcomings have adversely impacted both the practical application outcomes of AI technologies and the pace of industrial upgrading.

5.1.2 Prominent Talent Shortage Issue

The advancement of artificial intelligence and new quality productivity requires a substantial pool of high-caliber innovative talents, including AI technology developers, interdisciplinary professionals, and industry application specialists. However, China currently faces a significant shortage of such professionals. On one hand, university AI programs and talent cultivation models remain relatively outdated, failing to meet market demands. On the other hand, intense competition for talent has led to severe brain drain among top professionals, adversely affecting the coordinated development of AI and new quality productivity in China.

5.1.3 Increasing Pressure on Data Security and Privacy Protection

With the advancement of artificial intelligence and new productive forces, the scale of data collection, storage, analysis, and utilization continues to expand, placing immense pressure on data security and privacy protection. During data processing, AI technologies may inadvertently leak users' personal information and trade secrets, causing losses to both individuals and businesses. Meanwhile, the misuse and improper handling of data could trigger social ethical concerns, potentially hindering the healthy development of AI and new productive forces.

5.1.4 Incomplete Innovation Ecosystem

While China has made notable progress in building an innovation ecosystem for artificial intelligence and new quality productivity, several challenges persist. Key issues include an underdeveloped collaborative innovation mechanism integrating industry, academia, research institutions, and practical applications, insufficient coordination among enterprises, universities, and research organizations, and low efficiency in commercializing scientific achievements. Additionally, inconsistent innovation policies with overlapping regulations hinder effective implementation, while inadequate intellectual property protection and frequent infringement cases undermine the motivation of innovators.

5.2 Countermeasures and Recommendations

5.2.1 Strengthening Core Technology R&D

Increase investment in research and development of core technologies such as high-end chips, algorithm models, and data security technologies, establish higher-level artificial intelligence innovation platforms, and concentrate resources to break through "bottleneck" technologies. Support enterprises in collaborating with research institutions to conduct joint

R&D on key technologies, enhancing China's independent innovation capabilities in artificial intelligence technology. For example, encourage companies like Huawei and Alibaba to increase investment in intelligent chip R&D to drive breakthroughs in China's high-end chip manufacturing technology; support enterprises such as Baidu and iFlytek in developing general large models to elevate the innovation level of China's artificial intelligence algorithm models.

5.2.2 Improve the Talent Cultivation System

Optimize the curriculum design of artificial intelligence programs in universities, strengthen interdisciplinary talent cultivation, and establish a multi-tiered, diversified talent development system. Encourage collaboration between academic institutions and enterprises to implement industry-academia-research-application integrated training models, enhancing the relevance and practicality of talent development. Concurrently, intensify talent recruitment efforts by introducing more favorable policies to attract overseas high-end professionals to return for innovation and entrepreneurship. For instance, establish specialized AI talent funds to provide financial support and incentives for outstanding individuals, while creating performance-based evaluation mechanisms to stimulate innovative potential.

5.2.3 Strengthening Data Security and Privacy Protection

Refine data security and privacy protection laws and regulations, strengthen oversight of data collection, storage, analysis, and utilization, and standardize data usage practices. Increase R&D investment in data security technologies to enhance protection capabilities. For instance, promote blockchain technology applications in data security to ensure traceability and tamper-proof data integrity; strengthen audits and regulation of AI algorithms to prevent algorithmic discrimination and data misuse. Simultaneously, raise public awareness of data security and guide individuals in proper data usage and protection.

5.2.4 Optimizing the Innovation Ecosystem

We will refine the collaborative innovation mechanism integrating industry, academia, research institutions, and application sectors. By strengthening partnerships among enterprises, universities, and research organizations, we will establish joint laboratories and innovation centers to facilitate the sharing of knowledge, technologies, and talent resources. Enhanced policy coordination will be prioritized to develop and implement targeted measures, creating a favorable policy environment for advancing artificial intelligence and new quality productivity. Key initiatives include: increasing support for technology commercialization through dedicated service platforms to boost conversion efficiency; strengthening intellectual property protection with rigorous enforcement of infringement penalties to safeguard the legitimate rights of innovators.

6 Conclusion

Artificial intelligence and new quality productivity maintain a mutually reinforcing and synergistic relationship. AI serves as the core driving force behind the development of new quality productivity, while the demands of productivity growth reciprocally propel AI advancement. Their synergy creates an innovative closed loop encompassing "technological breakthroughs → industrial applications → ecosystem optimization." This collaboration injects fresh vitality into scientific innovation through multiple pathways: reshaping production factors, driving industrial upgrading, and optimizing innovation ecosystems. Data has become a critical production factor, workforce competency undergoes systematic enhancement, and labor tools achieve intelligent transformation. Traditional industries accelerate intelligent transition while emerging sectors continue to emerge. The industry-academia-research-application collaborative innovation system keeps improving, alongside increasingly optimized policy environments for innovation.

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