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Deep Integration of Artificial Intelligence and the Real Economy: Research on Pathways and Framework for Forming New Quality Productive Forces

Jiahua Mu

Business School, Chengdu University of Technology, Chengdu, Sichuan 610059, China

ABSTRACT
This research explores the pathways and framework for forming new quality productive forces through the deep integration of artificial intelligence and the real economy. By analyzing the current status of integration and challenges in technology, talent, data, and management, the study proposes four implementation pathways: strengthening technological innovation, enhancing talent cultivation, promoting data sharing, and deepening industry applications. It constructs a theoretical framework system encompassing technology-driven, demand-oriented, data element, and ecosystem dimensions, revealing the laws of integrated development and providing theoretical support and practical guidance for promoting high-quality economic development.

KEYWORDS
Artificial Intelligence; Real Economy; New Quality Productive Forces; Integration Pathways

With the rapid development of technology, artificial intelligence has moved from theoretical research to widespread practical application, showing enormous potential. The real economy, as the foundation of national economic development, encompasses multiple key areas including manufacturing, agriculture, and service industries. The deep integration of artificial intelligence with the real economy can generate new quality productive forces, inject new momentum into economic growth, enhance industrial competitiveness, and advance the economy toward a stage of high-quality development. Therefore, in-depth research on the pathways and framework of their integration has significant practical implications.

1 Current Status and Challenges of AI Integration with the Real Economy

1.1 Current Status of Integration

Artificial intelligence technology has been widely applied in multiple areas of the real economy in recent years with significant results. In manufacturing, intelligent robots have greatly improved production line efficiency through precise production operations. Machine vision systems can quickly and accurately detect product quality defects and provide real-time feedback to production links, effectively reducing defect rates and detection costs, achieving intelligent quality control upgrades. Agricultural production processes utilize AI technology to conduct deep analysis of massive data on soil components, climate changes, and crop growth states, forming precise planting and breeding guidance plans, gradually transitioning agriculture from experience-based to data-driven. The service industry widely employs intelligent customer service systems and personalized recommendation engines to meet diverse consumer needs, significantly improving service response speed and user experience while reducing operational costs[1]. These intelligent applications have significantly improved production efficiency and resource utilization in different industry scenarios, reduced enterprise operating costs, optimized resource allocation methods, accelerated the digital transformation process of the real economy, and injected new vitality and competitiveness into traditional industries.

1.2 Challenges Faced

1.2.1 Technological Level

AI technology faces severe technical challenges in real economy application scenarios. Data quality issues manifest as noise, missing data, and inconsistencies in the real economy environment, seriously affecting model training effectiveness and prediction accuracy, resulting in poor performance of intelligent systems in practical applications. Model adaptability issues are prominently reflected in the vast differences in requirements and scenarios across industries, making it difficult to directly apply general AI models, requiring significant resources for targeted customization and optimization, increasing application costs and difficulties. Insufficient technology integration is evident in the low level of integration between AI and related technologies such as IoT, big data, and cloud computing, inadequate system coordination, limiting the improvement of overall intelligence levels, and making it difficult to achieve seamless collaboration and efficient data circulation across devices, systems, and platforms.

1.2.2 Talent Level

The severe shortage of compound talents has become a key bottleneck restricting the deep integration of AI and the real economy. The market urgently needs compound talents who both master AI algorithms and technology and have in-depth understanding of various industry-specific knowledge and application scenarios, with the number of such talents far from meeting market demand.

Traditional real economy enterprises are at a clear disadvantage in attracting and retaining AI professional talents, with compensation and development space unable to compete with internet technology companies, leading to serious talent loss. The existing education and training system is seriously disconnected from actual market demands, with relevant majors in universities and vocational colleges lagging behind in curriculum settings, separation of theory and practice, slow updates of teaching content, and weak practical teaching links, making it difficult to cultivate application-oriented talents that meet industry needs[2].

1.2.3 Data Level

Data, as the foundational resource for AI development, faces serious bottlenecks. Data silos are prevalent in the real economy, with data unable to be shared between systems of various departments within enterprises and data barriers between upstream and downstream enterprises in the industrial chain, hindering the formation of a complete data value chain and restricting the effectiveness of AI applications. Data security and privacy protection issues are increasingly prominent, with enterprises concerned that data sharing may lead to commercial secret leaks and user privacy violations. Data ownership is unclear, lacking effective data sharing trust mechanisms and security guarantee technical measures. Basic systems for data rights confirmation, valuation, and trading are imperfect, unable to support large-scale data circulation and sharing, limiting the value of data as a production factor.

1.2.4 Conceptual and Management Level

Traditional real economy enterprises have obvious shortcomings in concepts and management. Some enterprise managers have insufficient understanding of AI technology, unclear recognition of the value and potential of technology applications, lack long-term strategic vision, excessively worry about investment risks and transformation difficulties, and maintain a wait-and-see or even resistant attitude toward intelligent transformation. Enterprise organizational structures and management processes are generally rigid, with obvious departmental barriers, lengthy decision chains, difficulty adapting to production mode changes and management model innovations brought by AI technology, lack of flexible and rapid decision-making mechanisms and market response capabilities, insufficient innovative cultural atmosphere, limited risk tolerance, and low tolerance for failure, inhibiting the enthusiasm for technology innovation and application exploration.

2 Implementation Pathways for AI and Real Economy Integration to Form New Quality Productive Forces

2.1 Strengthening Technological Innovation Investment and Breakthroughs

To promote deep integration of AI and the real economy, it is necessary to greatly enhance technological innovation investment.

At the national level, funding for basic theory research and key algorithm development in AI should be increased, with special scientific research funds established to incentivize universities and research institutions to engage in frontier technology exploration, breaking through existing technical bottlenecks and limitations. Focus should be on supporting core technology R&D in machine learning, deep learning, knowledge graphs, natural language processing, etc., solving difficult problems in real economy application scenarios, and encouraging deep innovative integration of AI with emerging technologies such as IoT, blockchain, and 5G. Actively construct industry-university-research collaborative innovation networks, build technology transformation platforms, shorten the transformation cycle of scientific research results from laboratories to markets, and improve the efficiency of scientific and technological achievement transformation[3].

Support real economy enterprises in establishing professional R&D institutions and innovation laboratories, guide enterprises to increase the proportion of R&D investment, cultivate technological innovation capabilities, accelerate technology iteration and upgrades, form sustained innovation momentum, lead intelligent transformation and upgrading of the real economy through technological breakthroughs and innovation, and lay a solid technological foundation for the development of new quality productive forces.

2.2 Strengthening Cross-domain Talent Cultivation and Introduction

The integration and development of AI and the real economy cannot be separated from the support of compound talents. The existing education and training system must be comprehensively reformed. Universities should proactively adjust professional settings and course structures, offer interdisciplinary courses, strengthen the combination of theoretical and practical teaching, and cultivate compound, application-oriented talents who understand both algorithmic technology and industry knowledge. Vocational colleges need to keep pace with industry development demands, update teaching content, improve skills training quality, and cultivate practical technical talents for enterprises. Vigorously promote deep cooperation between enterprises and universities, jointly build laboratories and research centers, conduct order-based, customized talent training projects, and achieve precise alignment between talent cultivation and enterprise needs. Innovate talent incentive mechanisms, provide competitive salary packages and career development space, create a relaxed innovative cultural environment, and attract and retain outstanding talents. Implement global talent introduction plans, relax talent introduction policies, attract international top AI experts and teams to develop in China, meet the urgent need for high-level talents for integrated development, and build a multi-level talent support system.

2.3 Promoting Data Sharing and Security Guarantees

As a core element of AI development, data is crucial, and it is essential to establish sound data sharing mechanisms. Efforts should be made to construct cross-departmental, cross-industry, and cross-regional data sharing platforms, formulate unified data standards and exchange interfaces, break down data silos, and promote efficient circulation and value mining of data resources. Advance government data opening and sharing, leverage the leading role of public data, drive enterprise data resource opening, and form a data resource sharing ecosystem. Strengthen the research and application of key data security technologies, promote advanced technologies such as cryptography, differential privacy, and federated learning, and solve the balance between data use and privacy protection. Improve the legal and regulatory system for data security, clarify data ownership and usage rules, construct data transaction norms and circulation mechanisms, and protect the legitimate rights and interests of data owners. Establish data security risk assessment and monitoring early warning mechanisms, strengthen data security audits and accountability, prevent data leakage and misuse risks, ensure data circulates and shares fully under the premise of security and legality, and provide rich and high-quality data resource support for AI applications[4].

2.4 Deepening Industry Applications and Demonstration Promotion

Promoting the implementation of AI technology in various fields of the real economy is a direct pathway to forming new quality productive forces. Key industries such as manufacturing, agriculture, logistics, and energy should be selected to support leading enterprises in carrying out AI demonstration application projects, creating industry benchmarks and application models, and summarizing and promoting successful experiences and effective models. Encourage enterprises to actively explore innovative application models: in manufacturing, build intelligent factories and digital workshops to achieve automated and intelligent production processes; in agriculture, construct smart farms and intelligent greenhouses to promote precision agriculture; in the service industry, promote intelligent customer service and personalized recommendation systems to improve service quality and efficiency. Vigorously promote cross-industry and cross-domain integrated innovation, drive the deep application of AI technology in various links of traditional industrial chains, construct digital and intelligent industrial ecosystems, and achieve coordinated development and overall upgrading of industries. Through industry demonstrations, drive the overall improvement of application levels, gradually expand the breadth and depth of AI applications in the real economy, form scale effects, release technological dividends, and construct a new pattern of AI empowering the real economy.

3 Construction of a Theoretical Framework for AI and Real Economy Integration to Form New Quality Productive Forces

3.1 Technology-Driven Dimension

Continuous innovation and iteration of AI technology constitutes the core driving force for intelligent transformation of the real economy. The continuous optimization and breakthrough of machine learning technology, especially deep learning algorithms, has significantly enhanced the ability of models to process complex data, making data mining and predictive analysis in complex scenarios more precise and efficient, pushing production decisions from experience-oriented to data-driven. The rapid development of natural language processing technology enables machines to better

understand and generate human language, greatly improving human-machine interaction experiences and efficiency, enabling widespread implementation of intelligent customer service, intelligent document processing, intelligent contract analysis, and other applications in various fields of the real economy. Breakthroughs in computer vision technology in image recognition and video analysis have given machines the ability to "see," playing key roles in product quality inspection, security monitoring, medical diagnosis, and other scenarios, changing traditional production and service models. The development of frontier technologies such as reinforcement learning and knowledge graphs further expands the capability boundaries of AI to solve complex problems, injecting new vitality into the real economy. These technological innovations continuously expand the application depth and breadth of AI in the real economy, giving rise to entirely new production methods and business models, constituting the technological foundation for the formation of new quality productive forces[5].

3.2 Demand-Oriented Dimension

The digital transformation and intelligent upgrade needs faced by various industries in the real economy are powerful pull forces driving the implementation of AI technology. Manufacturing urgently needs to achieve efficient, flexible intelligent production and precise quality control capabilities through intelligent technology to reduce costs and enhance core competitiveness. The agricultural sector desires to break through the limitations of traditional production methods through smart management systems and intelligent agricultural equipment, improving production efficiency and product quality while reducing resource waste and environmental pollution. The service industry hopes to achieve service process optimization and personalized intelligent services through AI technology, enhancing customer experience and satisfaction and strengthening market competitive advantages. The competitive pressures and transformation needs faced by various industries determine the key directions and depth of AI technology applications, pushing technology to deeply combine with industry characteristics, forming diversified solutions for productivity enhancement. Changes in market and user demands also continually guide adjustments in AI technology R&D directions, forming a virtuous cycle where demand drives technology and technology meets demand. This demand-oriented integration development model ensures that technological innovation can precisely connect with real scenarios in the real economy, avoiding disconnection between technological innovation and market demand, providing a realistic foundation for the formation of new quality productive forces.

3.3 Data Element Dimension

Data, as a key production factor in the intelligent era, constitutes the core support for AI and real economy integration. Various fields of the real economy extensively apply IoT, sensors, RFID, and other technologies to achieve device interconnection and production process transparency, with a large amount of production operation data being collected and stored in real-time, forming a rich and diverse data resource pool. Through systematic data governance and integration, data silos are eliminated, and data quality and consistency are improved, laying a solid foundation for AI model establishment and application. High-quality training data enables AI models to more accurately identify patterns and regularities, providing more precise prediction and decision support, thereby achieving intelligent applications such as production process monitoring, fault prediction, supply chain optimization, and intelligent scheduling. Data-driven AI models can mine potential patterns and associations from massive historical data that are difficult for humans to discover, providing scientific basis for production decisions, significantly improving decision-making efficiency and accuracy. This intelligent production operation management model based on data analysis breaks through the limitations of traditional productivity, greatly improving resource allocation efficiency and overall efficiency of the production system, achieving qualitative changes in productivity, making data truly become a new type of production factor driving high-quality development of the real economy.

3.4 Ecosystem Dimension

The deep integration of AI and the real economy requires the construction of a complete innovation ecosystem as support. This ecosystem encompasses multiple innovation subjects, upstream and downstream of the industrial chain, research institutions, financial institutions, and other participants, jointly constituting the systematic environment for the formation of new quality productive forces. The collaboration of innovation subjects is reflected in close cooperation between enterprises, universities, and research institutions, joint research and development, accelerated technological innovation and application implementation, achieving deep integration of industry, academia, and research, effectively solving technical difficulties and application bottlenecks. The industrial chain coordination dimension manifests in forming an industry ecosystem covering the entire chain of data collection, data annotation, algorithm development, model training, application development, system integration, operation and maintenance services, etc., with various links

developing collaboratively, supporting each other, and enhancing overall efficiency. The financial support system provides necessary funding guarantees for technological innovation and application promotion through various means such as venture capital, technology loans, and industrial funds, accelerating the transformation and application of innovation achievements. At the policy environment level, measures such as improving laws and regulations, establishing industry standards, and optimizing the business environment create favorable external conditions for integrated development. This innovation ecosystem with multiple subject collaboration and multi-level interaction can maximize the potential of AI technology, giving rise to new industries, new business formats, and new models, forming new economic growth points, and promoting the continuous development and growth of new quality productive forces.

4 Conclusion

This research systematically explains the internal mechanisms and implementation pathways of AI and real economy integration, revealing the key roles of technological innovation, demand pull, data empowerment, and ecosystem coordination in the formation process of new quality productive forces, and clarifying the logical relationships and interaction mechanisms between various elements. The research results not only enrich productivity theory research but also provide methodological guidance for solving practical problems in the transformation and upgrading of the real economy. They have important reference value for promoting deep integration of AI technology with various fields of the real economy and provide theoretical basis and practical frameworks for formulating relevant policies and implementing intelligent strategies by enterprises.

About the Author

Jiahua Mu (born November 2003), male, Han ethnicity, from Yibin, Sichuan Province, is currently a sophomore undergraduate student at the Business School of Chengdu University of Technology. Primary research interest lies in Economics.

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