Research on Blockchain Empowering Specialized Air Logistics Innovation and Industry-education Integration from the Perspective of New Quality Productive Forces

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Abstract: Blockchain is a new generation of advanced technology. Developing new productive forces requires timely application of advanced technologies and accelerating the construction of a modern industrial system. Air logistics is an important support for the modern industrial system, and studying the empowerment of blockchain in air logistics service innovation is of great significance. The industry-education integration is an important way to develop new quality productive forces. Deepening the industry-education integration can provide strong support for the accelerated formation of new quality productive forces and the high-quality development of air logistics, and promote the construction of modern industrial systems. This study first analyzes the progress of blockchain application research in the field of air logistics, and then constructs an application model and implementation path for blockchain to empower specialized air logistics service innovation. On this basis, it analyzes the coupling mechanism between the development of new quality productive forces and air logistics industry-education integration, and clarifies the practical challenges faced by deepening industry-education integration. Finally, an industry-education integration model that empowers innovation in air logistics services is constructed.

Keywords: New Quality Productive Forces; Blockchain; Specialized Air Logistics; Service Innovation; Industry-Education Integration

1. Introduction

1.1 The Air Logistics Industry Has an Important Strategic Position

The national "14th Five Year Plan Outline" clearly states: "Actively develop general aviation and strengthen the construction of air logistics and cargo capacity. At the same time, the national "14th Five Year Plan" for the development of air logistics clearly states: "The air logistics industry is a strategic industry in China and an important support for the modern industrial system. It is of great significance in promoting the formation of a strong domestic market, ensuring the stability of the international supply chain, serving the implementation of major national strategies, and high-quality economic development.

1.2 The New Development Stage Requires Addressing the Shortcomings during the Pandemic and Focusing on Improving Air Logistics Services

Since the outbreak of the COVID-19, the air logistics industry has provided a strong logistics support for anti-pandemic materials and made important contributions; However, during the pandemic, various shortcomings of the air logistics industry have also been clearly exposed, with prominent issues such as specialization, lagging service levels throughout the entire chain, and weak main service capabilities. The application level of the new generation of information technology is not high, and the basic support capacity is insufficient, which urgently needs to be improved. However, due to the continuous and widespread impact of the pandemic in recent years, it has been difficult to improve air logistics services and improve their shortcomings. At the end of 2022, the country made significant adjustments to pandemic prevention and control policies, which played a significant role in promoting the gradual recovery of various industries. The air logistics

industry has also entered a new stage of post pandemic revitalization. Standing at a new historical starting point and facing new development opportunities, it is required that the air logistics industry anchor the operational shortcomings and main problems during the pandemic, enhance service capabilities, improve service shortcomings, and strengthen service innovation.

2. The Importance of Studying Air Logistics Innovation and Industry-Education Integration from the Perspective of New Quality Productive Forces

2.1 The New Development Stage Has Put forward Higher Requirements for the Innovation of Specialized Air Logistics Services

The national "14th Five Year Plan" for the development of air logistics clearly states: "Entering a new stage of development, the new development pattern of domestic and international" dual circulation "mutual promotion requires air logistics to adapt to the demand for professional services in the modern industrial system Building a "dual circulation" pattern, as an important national development strategy, has put forward new requirements for the safety and smoothness of modern logistics systems, and higher requirements for air logistics services. The above special plan also proposes: "Accelerate the development of specialized air logistics, focus on improving the specialized air logistics service capabilities of special goods, cold chain fresh products, and cross-border e-commerce products, adhere to innovation and integration, enhance the level of intelligent development, and improve the quality of aviation cargo supply." In the new development stage, the air logistics industry fills the gaps, focuses on the development of specialized air logistics, and better serves the "dual cycle", which is of great significance.

2.2 The Importance of Studying Air Logistics Innovation and Industry-Education Integration from the Perspective of New Quality Productive Forces

Blockchain is an advanced technology in the new generation of information technology. Developing new quality productive forces requires timely application of technological innovation achievements and accelerating the construction of a modern industrial system. Air logistics is a strategic industry and an important support for the modern industrial system. Therefore, from the perspective of developing new quality productive forces, it is of great significance to study how to apply blockchain technology to empower innovation in air logistics services. Industry-education integration is an organic connection point between the industrial chain, talent chain, innovation chain, and education chain. It is an important way to develop new quality productive forces. Deepening industry-education integration can provide strong support for the accelerated formation of new quality productive forces and the high-quality development of the air logistics industry, and promote the construction of a modern industrial system.

3. Research Progress in the Application of Blockchain Technology in the Field of Air Logistics

In recent years, the organic integration of the application of new generation information technologies such as blockchain with the sustainable development of various strategic emerging industries has become a research hotspot in the academic community. Combining closely with the challenges and opportunities faced by industrial structure adjustment and industry transformation and upgrading, adopting new technologies to empower service innovation and solve hot and difficult issues is an important development trend in blockchain application research. The air logistics industry is a strategic industry in China and an important support for the modern industrial system. Analyzing the current status and trends of blockchain technology application research in the air logistics field has important theoretical significance and academic value.

3.1 Current Research Status of Blockchain Technology in the Field of Air Logistics in China

As an emerging cutting-edge technology, the application exploration of blockchain in various fields has become increasingly active in recent years, and the application research of blockchain in the field of air logistics has gradually emerged in domestic and foreign academic circles. Yang (2022) utilized a value model to decompose the value of air freight processes, proposing the use of blockchain technology to build a distributed

accounting air logistics database and information sharing platform, as well as a container resource sharing platform, to address the issue of uneven resource distribution. At the same time, blockchain technology and government regulation were used to ensure the security and authenticity of correct air logistics data.[1] Wang (2021) proposed to use blockchain technology to build a decentralized air logistics platform that addresses the issues of centralized data storage, vulnerability to attacks, and low security in the logistics system of aviation enterprises. He applied information distribution processing, chain storage, authentication mechanisms, and smart contracts to database construction and order status transformation. [2] Chen et al. (2021) proposed utilizing the advantages of blockchain technology to explore the construction of a "one order" service model for air logistics under the empowerment of blockchain technology, achieving full traceability of air logistics services, optimization of service processes, data sharing to promote collaboration and trust among all parties, alleviate financing difficulties, and establish a trustworthy system through electronic storage. [3]

Bai et al. (2020) deeply analyzed the current situation and existing problems of packaging inspection and supervision for export dangerous goods in China, and comprehensively explored the practical path and application advantages of blockchain technology in the entire process of packaging inspection and supervision for export dangerous goods. They proposed an application plan for blockchain technology in packaging inspection and supervision for export dangerous goods, and elaborated on the application mode of blockchain in the Export Dangerous Goods Packaging Work Alliance, The key and difficult points of mode implementation were pointed out. [4] Luo et al. (2020) established a four-module architecture consisting of data storage layer, network layer, business layer, and user layer, and proposed the application of blockchain to design a civil aviation shared logistics platform solution, achieving the circular utilization of air logistics resources in transportation, warehousing, and other links, and achieving decentralized payment. [5] Chen et al. (2019) used fuzzy Petri nets as a tool to construct an analysis model for the impact factors of air logistics blockchain, designed inference rules for the model, quantitatively analyzed and explored the main impact factors of blockchain technology in the field of air logistics, and proposed an air logistics blockchain application path based on fuzzy Petri nets. [6]

3.2 Current Research Status of Blockchain Technology in the Field of Air Logistics in Foreign Countries

In foreign countries, Prajwal et al. (2022) argue that the complex structure of the air cargo service supply chain makes credit risk analysis for creditors difficult, and information asymmetry leads to a lack of trust between enterprises and creditors. They propose building a blockchain based air cargo financing platform and explain how the application of this platform makes the financing cooperation process of the air cargo supply chain more transparent, trustworthy, and efficient. [7] Ersin et al. (2022) analyzed the main requirements of an air transportation safety reporting system, and then constructed an application framework for blockchain in an air transportation safety reporting system. They proposed creating a secure data storage to enhance the transparency of security event analysis and the effectiveness of accountability and feedback mechanisms. [8] Irina et al. (2021) studied and summarized the practical progress of blockchain technology in the field of air cargo information and fund flow management. They developed an implementation model for blockchain technology in the air cargo industry, optimizing airport resource utilization, reducing service delays, and improving information exchange transparency among air cargo participants. [9]

Poleshkina et al. (2020) conducted an in-depth investigation into the prominent issues in supply chain management related to air cargo for many well-known multinational enterprises. They proposed integrating blockchain, smart contracts, and the Internet of Things to enhance the operational capabilities of air cargo and supply chain, simplify file verification procedures, improve customs clearance efficiency, optimize air cargo and supply chain processes, and promote payment and settlement automation. [10] Choi et al. (2019) studied relevant literature from the fields of air logistics operations, demand management, supply management, and supply-demand coordination. Under the conditions of blockchain technology, they proposed a mean variance risk analysis method and its application implementation path for

global supply chain operations based on air logistics, and explored typical application fields with development prospects. [11]

3.3 Review of Research Status

In summary, the academic community at home and abroad has a positive attitude towards the application of blockchain in the field of air logistics. The existing research results have important significance and reference value, and overall, the application mode of blockchain in this field is becoming increasingly clear. However, there are still three shortcomings.

Firstly, there is little literature that provides in-depth analysis of the main shortcomings and causes of current air logistics services, and proposes specific improvement strategies or solutions. Secondly, research on how to apply blockchain technology to empower innovation in air logistics services based on the specific requirements of the new development stage is relatively rare. Thirdly, due to the late start of research on the application of blockchain in the field of air logistics, existing research is relatively scattered and fragmented, has not yet formed a complete system, and there is still significant room for research expansion. The systematic nature of research results needs to be improved and improved.

4. The Model and Implementation Path of Blockchain Technology Empowering Innovation in Air Logistics Services

4.1 Overall Idea of Empowering Innovative Models of Air Logistics Services with Blockchain Technology

Build a new development stage blockchain technology that empowers a specialized air logistics service innovation system, propose typical application models and scenarios for blockchain in the field of specialized air logistics, formulate specific application paths, steps, and a series of implementation measures, thereby improving the level of air logistics services and providing stronger support for the sustainable development of the modern industrial system.

Firstly, taking imported pharmaceutical air freight as a representative application scenario, build an application model of blockchain technology in the field of special cargo air logistics, enhance the traceability and anti-counterfeiting function of imported pharmaceuticals and other special goods, improve the transparency and authenticity of logistics information, and enhance the logistics security guarantee of special goods.

Secondly, taking fresh food transportation as a representative application scenario, construct an application model of blockchain technology in the field of cold chain air logistics, improve logistics efficiency and service reliability, and improve the overall performance of cold chain air logistics.

Thirdly, taking cross-border customs clearance as a representative application scenario, explore the application mode of blockchain technology in the core link of cross-border e-commerce air logistics - cross-border customs clearance, simplify customs procedures, accelerate the speed of cross-border e-commerce logistics customs clearance, reduce the inspection costs of customs inspection agencies, and enhance the credit of enterprise customs clearance.

4.2 Implementation Path of Blockchain Technology Empowering Innovative Models of Air Logistics Services

4.2.1 Analyze the short board of air logistics services during the COVID-19 and the requirements of the new development stage after the pandemic

First of all, in-depth analysis was made of the weaknesses exposed by China's air logistics industry during the COVID-19, and investigation and research were carried out on the outstanding problems and their causes, such as professionalization, the lagging service level of the whole chain, the weak service ability of the main body, the low application level of the new generation of information technology, and the insufficient basic support ability; Then, it elaborates on the urgent requirements for improving the shortcomings of air logistics in the new development stage after the pandemic. Centering on the national "14th Five Year Plan" for air logistics development and its technology innovation leading strategy, it clarifies the new development direction for improving service capabilities and improving service shortcomings, provides a clear policy basis for empowering air logistics service innovation with blockchain technology, and points out the research direction for the project.

4.2.2 Analyze blockchain, core blockchain technologies, and their main advantages

Elaborate the concept of blockchain, study the current application status of blockchain

technology, analyze the development trend of application, analyze the core technologies and advantages of blockchain, mainly including: (1) distributed ledger technology - advantages of decentralization and permanent storage of data; (2) Asymmetric encryption algorithm - security and tamper resistance advantages; (3) Consensus mechanism - advantages of anti-counterfeiting and authenticity; (4) Time series data (timestamp) - traceable and verifiable advantages; (5) Smart contracts - advantages in automated and efficient transaction completion.

4.2.3 Constructing a coupling mechanism model between blockchain and specialized air logistics service innovation in the new development stage

In the new development stage, the organic integration of blockchain application and specialized air logistics service innovation should be studied. Firstly, the coupling mechanism between blockchain technology advantages and air logistics service innovation needs should be systematically analyzed. Conduct multi-dimensional and in-depth research on blockchain technology and its core advantages, as well as the innovative demand for specialized air logistics services. Analyze the coupling relationship between the two in depth, propose main application modes and typical application scenarios, and establish a coupling mechanism model, laying an important application foundation for subsequent research of the project.

4.2.4 The application mode and scenario of building blockchain technology in the innovation of specialized air logistics services

Taking specialized air logistics such as special goods, cold chain fresh food, and cross-border e-commerce as typical application fields, construct an application system of blockchain technology in air logistics service innovation, explore typical application models in various fields, propose representative application scenarios, and use imported pharmaceutical air freight as typical application scenarios to construct an application model of blockchain technology in the field of special cargo air logistics; Using fresh food air transportation as a typical application scenario, construct an application model of blockchain technology in the field of cold chain air logistics; Using cross-border customs clearance as a typical application scenario, construct an application model of blockchain technology in the field of cross-border e-commerce, air logistics.

4.2.5 The implementation path and specific steps of blockchain empowering innovation in specialized air logistics services.

Develop an implementation path for empowering innovation in specialized air logistics services with blockchain technology in the new development stage after the pandemic: firstly, analyze the successful elements of blockchain applications in the main specialized air logistics field, create collaborative relationships and a win-win vision, focus on improving the level of blockchain technology application, and make reasonable blockchain application decisions. The second is to propose scientific principles and ideas that should be followed, and to develop the correct path for the systematic application of blockchain in the field of air logistics. The third is to develop specific implementation steps for blockchain applications in six stages: strategy, planning, technology, experimentation, implementation, and expansion.

5. The Coupling Mechanism between the Development of New Quality Productive Forces and Air Logistics Industry-Education Integration of

5.1 The Connotation and Basic Characteristics of New Quality Productive Forces

New quality productivity is driven and led by technological innovation. It is an advanced productivity formed by choosing a new development path and high-quality growth mode of productivity under the increasingly informationized and intelligent conditions of society, due to the growth rate of innovation and the vigorous development and growth of modern emerging industries. New quality productivity takes "new" and "quality" as the breakthrough point, "productivity" as the foothold, composed of high-quality workers, new media labor materials, and new material labor objects, with technological innovation as the core, strategic emerging industries and future industries as the battlefield, with high-quality development as the goal, and new industries, new driving forces, and new models as the core elements. New productive forces have four characteristics: greater innovation, greater digitalization, greater emphasis on high quality, and greater leapfrog potential. Firstly, unlike general productivity, new quality productive forces mainly target

emerging industries with high technological content. Technological innovation plays a multiplier effect and leading role in building competitive advantages, making new quality productive forces more innovative. Secondly, digital technology, as the dominant technology in the new round of technological revolution, endows workers, labor objects, and labor materials with digital characteristics, thus making new productive forces more digitized. Thirdly, the development of new productive forces is guided by intelligence, greenness, and low-carbon. Through technological innovation, energy consumption and environmental hazards are reduced, achieving an organic combination of economic, social, and ecological benefits. Therefore, new productive forces place greater emphasis on high quality. Fourthly, the rapid iteration of science and technology and the intelligence of production tools have greatly improved production efficiency through deep integration with various industries, making new quality productive forces exhibit a leaping development characteristic, thus making new quality productive forces more leaping.

5.2 The Coupling Mechanism between the Development of New Quality Productive Forces and the Integration of Innovative Industry and Education

5.2.1 Common Carrier Platform: Innovation Community

In July 2023, the first national rail transit equipment industry-education integration community was established in Changzhou, Jiangsu. As a result, a significant step has been taken in the deep integration and innovation of industry and education. Industry-education integration in a community helps to promote a virtuous cycle of education, technology, and talent, enhance the deep industry-education integration, promote the development of new quality productive forces, and better adapt to the needs of high-quality development. Innovation plays a leading role in the formation and development of new quality productive forces, and the innovation community is the main carrier for cultivating new quality productive forces. The essence of the industry education integration community is precisely the innovation community, which provides an important platform for accelerating the formation and development of new quality productive forces. The innovation community has typical characteristics such as regional, organizational, growth, and complementarity, and forms a development direction of consistent governance goals, collaborative innovation behavior, coordinated innovation resources, universal governance rules and systems, and complementary industrial chains.

5.2.2 Common basic characteristics: High technology, high efficiency, and high quality

In addition to governance system constraints, industry-education integration community requires all members to have a consistent innovation concept, cultural cognition, value interests, geographical location, and social foundation, forming an innovation system with inherent cooperation willingness and rigid institutional constraints. It inevitably requires the construction of industry-education integration community with the standards of "three highs" (high technology, high efficiency, and high quality), and "three highs" precisely match the three basic characteristics of new productive forces: high technology, high efficiency, and high quality. Therefore, there is a highly coupled relationship between industry-education integration and the development of new productive forces. The development of new productive forces requires the support of industry-education integration, and the construction of industry-education integration can provide impetus for the development of new productive forces.

6. An Industry Education Integration Model Empowering Innovation in Aviation Logistics Services from the Perspective of New Quality Productive Forces

6.1 Realistic Challenges in Deepening Industry-Education Integration in the Field of Air Logistics

Industry-education integration can achieve an organic connection between the education chain, talent chain, and industry chain innovation chain. Its foundation is the sharing and sharing of innovative resources such as talent, funds, technology, information, equipment, and management among multiple entities. However, due to differences in institutional mechanisms and demands, there are still common problems such as insufficient integration depth, insufficient breadth, and inadequate quality monitoring. Although the deep industry-education integration has entered the

stage of institutional guidance, and a series of supportive policies have been introduced from the central to local levels, the overall effectiveness of industry and education integration practice is not good. There are still many challenges in reducing transaction costs, defining and cultivating property rights, optimizing governance mechanisms, resolving collectivism difficulties, and building integrated platforms. The mechanism of industry and education integration needs to be improved, the momentum of school enterprise cooperation is insufficient, and the efficiency of industry and education integration needs to be improved. Overall, it has not been able to meet the requirements of modern industrial system construction. Under the new situation of developing new quality productive forces, industry-education integration needs to effectively address existing difficulties, establish cross system and cross regional collaborative innovation mechanisms and platforms, and build the community of industry and education integration into a diversified, open, and self-organizing innovation ecosystem.

6.2 Taking Emerging Industries as the Guide, Enhancing Collaborative Innovation and Achievement Transformation Capabilities

Strategic emerging industries connect traditional industries with future industries. Taking strategic emerging industries as the guide, stimulating innovation vitality, improving the ability to transform scientific and technological achievements, accelerating the formation of new formats, models, and driving forces, empowering the development of new quality productive forces, a new model of deep industry-education integration should be constructed. In the past, industrial colleges, innovation bases, practice bases, and other models relied more on the government and industry to provide main resources, and education to carry out practical training and internships; In view of this, the new model of deep industry-education integration should closely follow the trend of technological innovation and industrial development, with the cultivation of strategic emerging industries as the guide, integrating scientific research, talent cultivation, technological development, achievement transformation, and promotion and application, and promoting the organic connection between the education chain, talent chain, innovation chain, and industrial chain. At the same time, it should be recognized that enterprises pursuing maximum economic benefits are prone to exiting industry-education integration when the benefits and risks are uncertain; Therefore, appropriately increasing policy incentives for enterprises and reducing their risks can maintain the stability of industry education integration.

Enhance collaborative innovation and achievement transformation capabilities. Accelerate the formation and development of new quality productive forces, emphasizing the timely application of technological innovation achievements in specific industries and industrial chains. Therefore, while strengthening collaborative innovation, it is necessary to enhance the ability to transform and apply innovative achievements. Only by effectively transforming research results related to emerging industries can it achieve the transformation from technological innovation to industrial innovation, and achieve the transformation and upgrading of industrial and supply chains. Therefore, the relevant parties should continue to promote the improvement and improvement of the new model of deep industry-education integration, cultivate high-level innovative talents, applied talents, and high-quality technical and skilled talents in deep integration on both sides, and achieve organic connection and high-quality transformation between related achievements such as basic research, applied basic research, and emerging interdisciplinary research and emerging industries. Effectively implement the combination incentive model of "finance, finance, land, and credit", and mobilize the enthusiasm of enterprises to participate; Policies such as reducing corporate taxes, increasing rewards for technology transfer, and providing preferential treatment for construction land can enhance the participation enthusiasm of enterprises.

6.3 Taking Talent Cultivation as the Mainstay, Promoting Industry-Education Integration, Digitization, and Improving the Quality of Education

Cultivating high-precision and cutting-edge innovative talents is a key tool for promoting industrial upgrading and forming new quality productive forces. By coordinating efforts to promote the deep industry-education integration, promoting the virtuous cycle and optimized

allocation of the three major resources of education, technology, and talent, and promoting the symbiosis and growth of education and industry on both sides, the relevant parties can jointly shape the advantages of technological innovation and cultivate high-quality talents required for new productive forces.

6.3.1 Enhance industry-education integration, promote digital collaborative development, and explore new digital paths for talent cultivation

Based on the actual situation of education development in our country, in the process of integrating industry and education to cultivate talents, advanced digital technologies can be used such as artificial intelligence, blockchain, cloud computing, and big data to build a talent cultivation system driven by technology and data integration, and explore new digital paths for talent cultivation; Build a high simulation teaching scenario that combines virtual and real, achieve ubiquitous teaching that can be learned everywhere and at all times, and promote the digital transformation and development of industry education integration. For example, by building a digital twin platform that integrates industry and education, a new foundation for talent cultivation can be established; As an important digital technology in the Industry 4.0 revolution, digital twins have technical characteristics such as real-time synchronization, high fidelity, and faithful mapping, which can fully achieve the integration and interaction of the physical world and the information world; By leveraging the digital twin platform of industry education integration, more effective integration of industry education scenarios, collaboration between industry, academia and research, and integration of school enterprise activities can be carried out.

6.3.2 High quality promotion of higher education talent cultivation

In the new stage, higher education should further clarify its mission, actively integrate into the overall high-quality development, implement the strategy of revitalizing the country through science and education, and enhance the ability of universities to serve the development of new productive forces. Guided by leading universities, high-level universities, the classification system of higher education should be improved, optimizing talent training models, innovating the mechanism of industry education integration, optimizing the evaluation system of education and teaching, and the effectiveness evaluation system of industry-education integration, and accelerating the cultivation of talents in various disciplines, categories, and levels that meet the requirements of developing new productive forces. Guiding industry-education integration with high-quality resources, focusing on emerging fields such as new generation information technology, new energy, new materials, and high-end equipment, and catering to the diverse needs of different industries for talents, the parties concerned should carry out high-quality deep industry-education integration, industry university research cooperation, and focus on improving the quality of talent cultivation and enhancing the guarantee of high-quality human resources.

7. Conclusion

The analysis of research status shows that the application research of blockchain in the field of air logistics started relatively late, and the fragmented characteristics of existing research are obvious and have not yet formed a complete achievement system. There is a coupling relationship between blockchain and its technological advantages and innovation in specialized air logistics services. Representative application scenarios include imported pharmaceutical air transportation, fresh food transportation, and cross-border customs clearance. The application models of blockchain technology in specialized air logistics fields such as special cargo air logistics, cold chain air logistics, and cross-border e-commerce air logistics are constructed, and implementation paths and specific steps are formulated to achieve logistics efficiency improvement, service quality improvement, and comprehensive cost reduction. On the other hand, there is also a coupling mechanism between the development of new quality productive forces and the integration of air logistics industry and education. By constructing an industry education integration model that empowers air logistics service innovation, the relevant parties can enhance collaborative innovation and achievement transformation capabilities, promote the digitization of industry education integration and the improvement of education quality, promote the high-quality development of specialized air logistics industry, enhance the support of air logistics for the modern industrial system, and provide impetus for the

development of new quality productive forces.

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