WISDOM ACADEMIC

Infrastructure Reports

ISSN: 3080-7271 | E-ISSN: 3080-728X

Volume 1 , Issue 3

Article

Smart Transformation of Zhengzhou's Logistics Industry in the Context of Digital Economy: Present Situation, Dilemmas and Advancement Paths

Ke Bai[1], Rozaini Binti Rosli[1,*], Oyyappan Duraipandi[1], Syed Ahmed Salman[1], Dhakir Abbas Ali[1]

[1]School of Business and Management, Lincoln University College, 47301 Petaling Jaya, Malaysia.

[*]**Corresponding author:** Rozaini Binti Rosli, rozaini@lincoln.edu.my.

CITATION

Bai K, Binti Rosli R, Duraipandi O, Ahmed Salman S & Abbas Ali D. Smart Transformation of Zhengzhou's Logistics Industry in the Context of Digital Economy: Present Situation, Dilemmas and Advancement Paths. Infrastructure Reports. 2025; 1(3): 186.

https://doi.org/10.63808/ir.v1i3.186

ARTICLE INFO

Received: 6 August 2025
Accepted: 8 August 2025
Available online: 4 November 2025

Abstract: This paper focuses on the smart development of Zhengzhou's logistics industry in the context of the digital economy. By analyzing its current status in terms of infrastructure, scale, and employees, it identifies core issues such as imperfect regional coordination mechanisms, uneven distribution of smart infrastructure, shortage of high-level talents, backward supervision and standardization, insufficient somatization of international logistics, weak innovation motivation of enterprises, and lagging green transformation. Considering Zhengzhou's positioning as a national central city and an international comprehensive transportation hub, targeted policy recommendations are put forward, including building a regional collaborative governance framework, strengthening infrastructure and technological empowerment, improving the talent cultivation system, promoting green and smart transformation, and deepening international logistics cooperation. These recommendations provide practical references for advancing the smart upgrading of Zhengzhou's logistics industry and the coordinated development of logistics in the Central Plains Urban Agglomeration.

Keywords: Smart Transformation; Regional Logistics; Zhengzhou Model; Digital Empowerment

1. Introduction

The deep penetration of the digital economy has positioned intelligent transformation as the core direction for the logistics industry's upgrading. President Xi Jinping emphasizes the imperative to integrate emerging technologies such as the internet, big data, and artificial intelligence deeply with the transportation sector, offering a strategic pathway for the intelligent development of logistics. As the capital of Henan Province designated as a National Central City and an International Integrated Transport Hub, Zhengzhou possesses a significant scale advantage in its logistics industry, underpinned by its multimodal "air-rail-road-sea" transport system. However, the city faces numerous practical challenges during its ongoing intelligent transition. Conducting an in-depth analysis of the current status and obstacles hindering the intelligent transformation of Zhengzhou's logistics sector, and exploring targeted improvement strategies, is crucial not only for the high-quality development of Zhengzhou's own logistics industry but also for advancing the coordinated development of the Central Plains Urban Agglomeration and strengthening strategic hub functions in the national logistics network. Accordingly, this paper focuses on the current status, challenges, and policy recommendations for the intelligent development of Zhengzhou's logistics industry, aiming to provide practical guidance for the sector's transformation.

2. Literature Review

2.1. Connotation Definition and Theoretical Framework

As a product of the in-depth integration of digital technology and the logistics industry, the conceptual connotation of logistics intelligentization has not yet formed a unified understanding in academic circles. Che (2016) proposed from a technical perspective that smart logistics realizes the system's autonomous decision-making and learning capabilities through technologies such as the Internet of Things and big data, emphasizing its intelligent characteristics; He (2017) constructed a supply chain integration model of "Internet + logistics" from an ecological perspective,

highlighting the ecological benefits of smart logistics. Li (2019) further expanded the collaborative attribute of smart logistics, pointing out that it realizes efficient operation of the supply chain through information sharing and resource integration .Theoretically, the logistics cost center theory, the theory of trade-off in benefits, and the supply chain management theory constitute the traditional theoretical basis, while the configuration theory provides a new perspective for the analysis of multi-factor interaction through set theory methods (Du and Jia, 2017).

2.2. Influencing Factors and Mechanism of Action

Research on influencing factors shows interdisciplinary characteristics. At the technical driving level, Feng et al (2013) found that customs efficiency and government support have a significant positive impact on port intelligentization; Zhang and Ru (2021) identified the key role of resource integration capabilities through grounded theory. In terms of policy regulation, environmental regulations promote intelligent transformation by forcing the application of green technologies, but may increase enterprise costs in the short term (Du, 2022). The application of configuration theory has broken through traditional linear analysis. Lian et al (2022) found that the “policy-driven + infrastructure” combination path has a significant effect on improving air logistics efficiency. Spatial econometric models have revealed the internal mechanism of regional differences. Dagum Gini coefficient analysis shows that the east-west difference is the main structural contradiction (Wang et al., 2022).

2.3. Improvement Paths and Practical Directions

Existing studies have proposed three typical paths: the technology integration path emphasizes the application of technologies such as the Internet of Things and blockchain, such as Gunasekaran (Gunasekaran et al., 2017) proposing an RFID-based intelligent logistics monitoring system; the policy coordination path advocates promoting transformation through financial subsidies and tax incentives, and Lin and Zhang (2022) verified the leverage effect of policy support on smart logistics development; the sustainable development path focuses on the application of green technologies, and Li and Bao (2020) constructed a two-way promotion model of environmental regulation and logistics efficiency .Innovative studies have begun to

explore new models of digital and intelligent transformation, such as Du (2022) proposing multiple paths to improve logistics efficiency combined with the BBC efficiency model.

2.4. Literature Critique

Existing studies explore logistics somatization from multiple dimensions. Theoretically, it is interpreted via technology, ecology, collaboration, etc., forming a system based on traditional theories like logistics cost center theory, with configuration theory as a new perspective, but no unified concept exists. Research on influencing factors, interdisciplinary in nature, involves technological drive and policy regulation, using configuration theory and spatial econometric models. Promotion paths include technology integration and policy coordination, with digital transformation models explored. While a foundation exists, unified concepts and regional adaptability are lacking.

3. Current Situation and Problems in the Intelligent Development of Zhengzhou's Logistics Industry

3.1. Logistics Infrastructure in Zhengzhou

As an important national central city and a national comprehensive transportation hub in China, Zhengzhou has built an extensive and efficiently connected three-dimensional transportation network relying on the "air-rail-land-sea" multimodal transport system.

Zhengzhou boasts a comprehensive transportation network: as a key railway hub, it hosts Asia's large Zhengzhou North Railway Station (24,000 daily marshalling vehicles) and major high-speed rail hub Zhengzhou East Station, forming a "rice"-shaped network that covers central/western cities in 1 hour and Beijing-Tianjin-Hebei and Yangtze River Delta in 3 hours, while the China-Europe Railway Express (Zhengzhou) connects 40 countries with over 2,000 annual trains, serving as a core Eurasian node. Its highway system, with "three vertical and five horizontals" expressways as the skeleton, forms an "eight-radiation" passage to the Central Plains Urban Agglomeration (over 800km), integrating "transportation +

logistics + commerce" via hubs like Zhengzhou South China City and achieving over 50 billion ton-kilometers in annual cargo turnover. Inland waterways (Jialu, Shayang Rivers) handle over 30 million tons annually, with Zhengzhou Port (5 million tons/year capacity) planning expansion via Wohe, Tuohe Rivers to build a "one vertical and three horizontals" network, boosting multimodal transport efficiency. Xinzheng International Airport (4F-class) recorded 29 million passengers and 700,000 tons of cargo in 2023 (topping central China), operating 48 international cargo routes and housing an airport industrial cluster, with post-third-phase expansion expected to reach 100 million passengers by 2035.

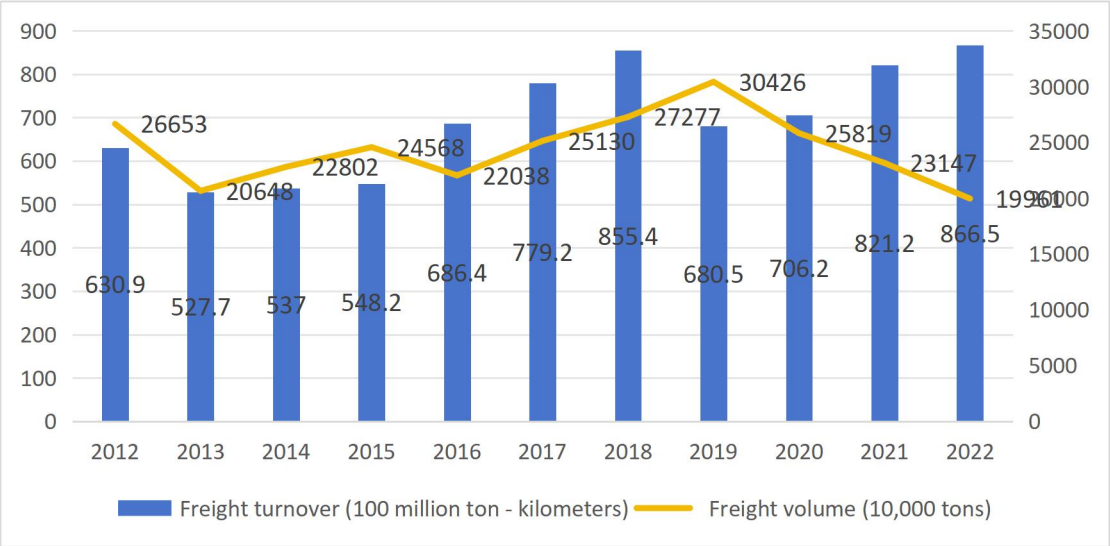
3.2. Scale of Zhengzhou's Logistics Industry

3.2.1 Cargo Turnover and Freight Volume in Zhengzhou

As shown in **Figure 1**, Zhengzhou's cargo turnover (100 million ton-kilometers) trended "decline, rise, fluctuation" from 2012-2022: 63.09 in 2012, 52.77 in 2013, rebounding yearly with 29.2% growth in 2016 (53.7→68.64), peaking at 85.54 in 2018. Epidemic-driven drops in 2019-2020 reversed to a new high of 86.65 in 2022. Freight volume (10,000 tons) fluctuated down from 266.53 million (2012) to 199.61 million (2022), a 34.4% peak drop. While freight volume declined post-2019, turnover grew fluctuating, reflecting longer average transport distance per ton.

Figure 1

Freight Turnover and Freight Volume in Zhengzhou

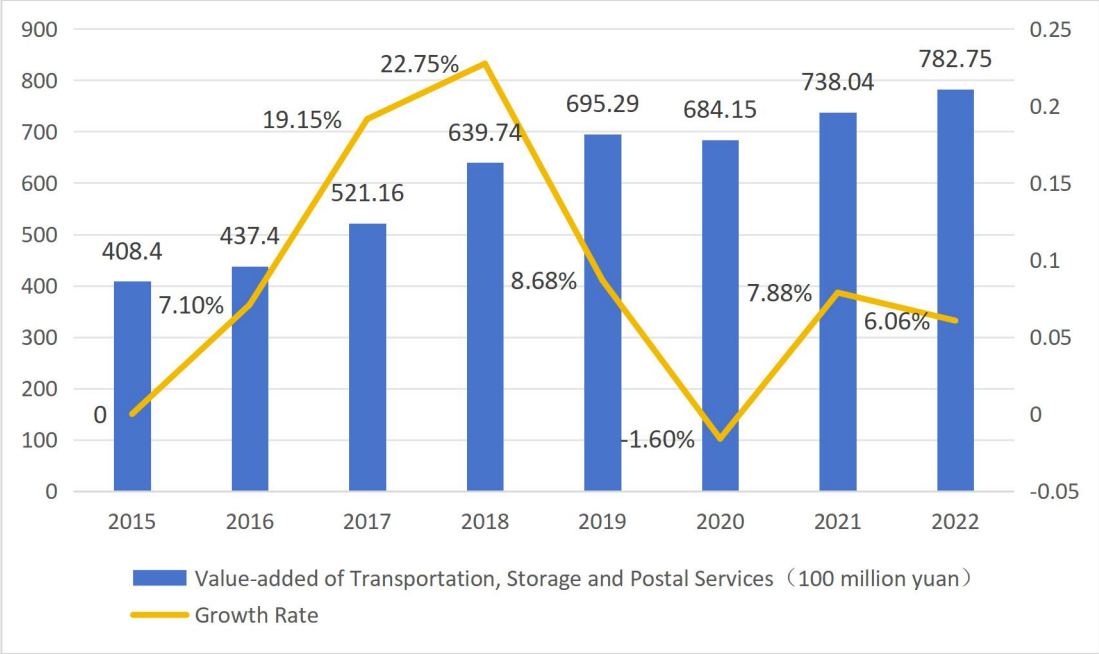


3.2.2 Added Value of Transportation, Storage and Postal Industry

As can be seen from **Figure 2**, as a national central city and a national comprehensive transportation hub, Zhengzhou's added value of transportation, storage and postal industry has continued to grow, showing strong development momentum, increasing from 40.84 billion yuan in 2015 to 88.252 billion yuan in 2023, with a cumulative increase of 116% over nine years.

Figure 2

Value-added of Transportation, Storage and Postal Services in Zhengzhou



Notably, growth fluctuated significantly: 2017 saw 19.15% growth, exceeding 50b yuan; 2018 hit a peak 22.75%, with leapfrog development in these two years. The 2020 epidemic caused first negative growth (-1.60%), but 2021 rebounded 7.88%. Recent growth stabilized at 6.06% (2022), then accelerated to 12.75% (2023), surpassing 88b yuan. This trajectory shows strong industry resilience, confirming Zhengzhou's key role as a national central city in transport and logistics, with sustained momentum.

3.2.3 Employees in Transportation, Storage and Postal Industry

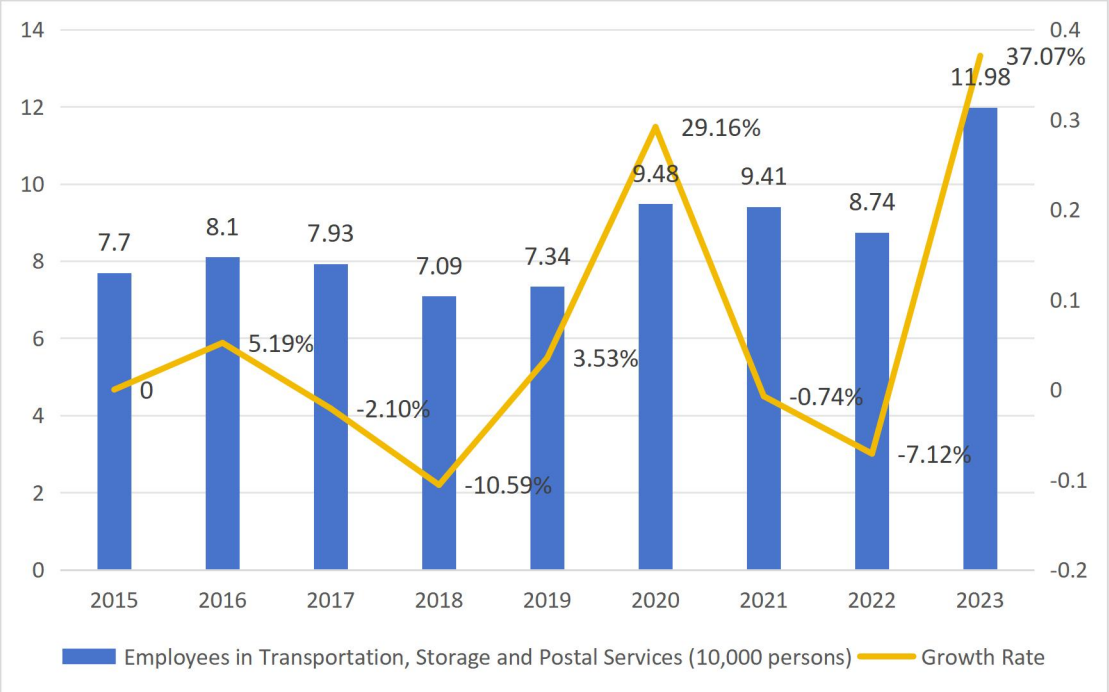
As shown in **Figure 3**, Zhengzhou's logistics workforce has undergone substantial expansion and qualitative enhancement over the past decade. Employment in the transportation, storage, and postal sectors surged from 77,000 in 2015 to 119,800 in 2023, reflecting a cumulative growth of 55.6%. This growth exhibited significant volatility: after a minor increase in 2016, numbers declined consecutively

in 2017–2018, hitting a low of 70,900. A brief recovery in 2019 preceded a remarkable surge in 2020 (29.16% growth, exceeding 90,000 employees), likely driven by post-pandemic logistics demand. Following slight fluctuations during 2020–2022, 2023 witnessed the most dramatic increase (37.07%), reaching a historic peak of 119,800 employees.

Concurrently, workforce qualifications improved substantially. The proportion of employees holding college degrees or higher rose from 25% (2015) to 40% (2022), underscoring the impact of industry-academia collaboration through joint training base development. These trends highlight phase-specific industry dynamics, particularly the accelerated growth in 2020 and 2023, which correlate with evolving regional economic structures and external disruptions. The dual expansion in both scale and expertise signifies Zhengzhou's strategic positioning as an emerging logistics hub in Central China.

Figure 3

Employees in Transportation, Storage and Postal Industry in Zhengzhou



3.3. Problems in the Intelligent Development of Zhengzhou's Logistics Industry

As a national logistics hub city and the core of the Central Plains Urban Agglomeration, Zhengzhou has made some progress in smart logistics in recent years

but still faces many challenges. Drawing on the experiences and lessons from the intelligent development of the logistics industry in the Beijing-Tianjin-Hebei region, Zhengzhou has revealed the following prominent issues in its intelligentization process:

(1) Inadequate regional coordination mechanisms and lack of top-level design

Despite its central location in the Central Plains, Zhengzhou has not fully leveraged logistics synergy with surrounding cities (e.g., Luoyang, Kaifeng, Xuchang). There is no unified smart logistics development plan within Henan Province, leading to inconsistent standards for logistics infrastructure across cities and redundant construction of information platforms that waste resources. Administrative barriers persist, logistics data sharing mechanisms are lacking, and the problem of data silos among various departments is prominent, hindering regional logistics integration. In contrast, regions like Beijing-Tianjin-Hebei have clarified their division of labor through planning, while Zhengzhou's metropolitan area coordination remains superficial.

(2) Unbalanced distribution of smart infrastructure and prominent structural contradictions

Zhengzhou's smart logistics facilities are concentrated in core areas (e.g., Airport Economy Zone, Zhengzhou East Railway Station) with intelligent warehouses and unmanned sorting centers, while logistics networks in counties and rural areas remain dominated by traditional models. Multimodal transport is underdeveloped, with poor connection between railways, highways, and aviation. In contrast, the Beijing-Tianjin-Hebei region has made progress in smart port linkage, while Zhengzhou lacks intelligent layout in logistics corridors.

(3) Shortage of high-level talents and weak technological innovation capability

Zhengzhou's logistics industry faces difficulty in attracting and retaining talents. Local universities offer logistics management programs, but curricula are insufficiently integrated with smart logistics technologies (e.g., blockchain, IoT), resulting in a shortage of interdisciplinary talents. Local logistics enterprises have insufficient R&D investment, with few applying AI for path optimization. In contrast, the Beijing-Tianjin-Hebei region has formed an innovation ecosystem relying on scientific and technological resources, which Zhengzhou lacks.

(4) Backward intelligent supervision system and insufficient standardization

Zhengzhou's logistics supervision still relies on traditional methods, with

insufficient application of intelligent supervision tools. Logistics standardization lags, with inconsistent implementation of pallet standards. In contrast, the Beijing-Tianjin-Hebei region has unified standards through a "Green Logistics Standard System", while Zhengzhou lacks unified norms for smart logistics equipment interfaces and data exchange.

(5) Insufficient intelligentization level of international logistics and weak cross-border collaboration

As the starting point of the China-Europe Railway Express (Zhengzhou), Zhengzhou has shortcomings in international logistics intelligence. The intelligent dispatching system has not yet achieved real-time data connection with countries along the route, and customs clearance efficiency is lower than hubs like Chongqing and Chengdu. In contrast, the Beijing-Tianjin-Hebei region has achieved paperless collaboration through customs integration reform.

(6) Environmental pressures and lagging development of green smart logistics

Zhengzhou's logistics industry faces growing carbon emission issues, with traditional fuel trucks accounting for over 70% and slow promotion of new energy distribution vehicles. The application rate of green packaging materials is lower than the national average, and intelligent means for energy conservation and emission reduction are insufficient. In contrast, the Beijing-Tianjin-Hebei region has made progress in "smart logistics + new energy" models.

4. Policy Recommendations

(1) Build a regional collaborative governance framework to promote the integration of smart logistics standards

Establish a collaborative mechanism for Zhengzhou metropolitan area logistics intelligent development, unify facility standards, and break administrative barriers. Build a Zhengzhou-Luoyang-Kaifeng data sharing platform for real-time warehousing/distribution info interconnection, cutting empty load rates by over 15%. Promote Xuchang, Xinxiang to undertake Zhengzhou's logistics spillover, build smart distribution centers, and form a "core hub + satellite node" network. Formulate the Smart Logistics Data Exchange Standards for the Central Plains Urban Agglomeration, focusing on standardizing platform interfaces (Zhengzhou-Kaifeng-Xuchang interconnection by 2025), co-building a "Zhengzhou-Luoyang-Xi'an" multimodal

corridor, and developing a cross-border electronic document system (Zhengzhou Airport links to “Belt and Road” ports by 2026).

(2) Upgrade infrastructure, strengthen technological empowerment, and build a smart logistics innovation ecosystem

Upgrade infrastructure and boost technology by building a 3D “air-railway-road-waterway” network: regulate Jialu River waterway (500-ton ships, 5m tons/year by 2025); expand Zhengzhou Airport (smart security, 60 international routes) to build a “global 123 logistics circle”. Establish a smart logistics fund for R&D (autonomous driving, blockchain) and labs; apply “5G + industrial internet”, AGV systems, “paperless customs + smart security”; build a digital twin platform, “5G + AI” parks, and a logistics super brain. Goals: 30% higher warehouse turnover, 40% better sorting efficiency, <8% fresh loss rate in 3 years.

(3) Improve the talent training system and build a highland for innovative talent agglomeration

It can be constructed through school-enterprise cooperation, talent introduction, and innovation incubation. Implement the “Zheng Talent Plan”, jointly set up an interdisciplinary “Smart Logistics and Supply Chain Management” program with Zhengzhou University and Henan University of Technology, and build 10 school-enterprise joint training bases; establish a “talent service green card” system, providing 18 supporting policies such as housing subsidies and children’s education for introduced international top logistics experts; set up a logistics innovation incubation fund to support technology-based small and medium-sized enterprises in carrying out smart logistics technology transformation, aiming to incubate 50 enterprises within three years.

(4) Promote the development of green and smart logistics, and build a path for sustainable development

Formulate relevant policies to promote new energy logistics vehicles, and construct charging stations, hydrogen refueling stations, etc., so that the proportion of new energy distribution vehicles will reach 40% by 2028; implement a recyclable packaging standard system, increase the utilization rate of recyclable boxes for e-commerce express items to 50%, and save 100,000 tons of packaging materials annually; establish a logistics carbon emission rights trading market, connect to the national carbon market by 2025, and achieve an annual trading volume of over 5 million tons.

(5) Deepen international logistics cooperation and build a hub node of the "Belt and Road"

Enhance the level of China-Europe Railway Express, increase the frequency of Zhengzhou-Luxembourg routes to 120 flights per week, and build an overseas distribution center for China-Europe Railway Express (Zhengzhou); construct a smart port system to realize "7×24-hour" customs clearance services, and shorten the processing time of cross-border e-commerce packages to 48 hours.

Conflict of interest: The authors declare no conflict of interest.

Funding: This study was supported by the Henan Provincial Education Science Planning Project (Project No.: 2024YB0388; Project Name: Research on Innovation and Practice of Collaborative Education Mechanism for Logistics Management Major under the Background of New Liberal Arts)

References

[1] Che, Z. (2016). Study on the development strategies of China's smart logistics under the new strategy of "the Belt and Road". *Logistics Technology*, 39(10), 112–114.

[2] Du, H. (2022). Discussion on diversified paths to improve the efficiency of China's logistics industry under the "dual carbon" goal. *Journal of Commercial Economics*, 4(4), 110–113.

[3] Du, Y. Z., & Jia, L. D. (2017). Configurational perspective and qualitative comparative analysis (QCA): A new path for management research. *Management World*, 33(6), 155–167.

[4] Du, Y. J. (2022). Analysis of influencing factors for the development of rural smart logistics systems. *Co-operative Economy & Science*, (16), 79–82.

[5] Feng, M., Li, P., & Zhang, J. (2013). Port logistics efficiency benchmarking in China. *Maritime Policy & Management*, 40(3), 267–286.

[6] Gunasekaran, A., Subramanian, N., & Ngai, E. W. T. (2017). Internet of Things (IoT): A revolutionary driver of integrated and sustainable supply chain performance in the logistics industry. *International Journal of Production Research*, 55(16), 4742–4761.

[7] He, L. M. (2017). Development trends of smart logistics in China. *China Business and Market*, 31(6), 3–7.

[8] Li, H., & Bao, J. J. (2020). Research on the development level and influencing factors of smart logistics. *Logistics Engineering and Management*, 42(9), 10–12.

[9] Li, J. (2019). Reconstruction of smart logistics model based on big data and cloud computing. *China Business and Market*, 33(2), 20–29.

[10] Lian, W. H., Chu, Y. C., & Yan, Z. C. (2022). Research on configuration and path of influencing factors of high-quality development efficiency of China's air logistics industry. *Resource Development & Market*, 38(12), 1468–1474.

[11] Lin, Y., & Zhang, X. J. (2022). Research on the digital transformation path of manufacturing enterprises. *Forum on Science and Technology in China*, (6), 123–132.

[12] Wang, S. J., Gao, S., Huang, Y., & Li, Z. G. (2020). Spatiotemporal evolution pattern and prediction of urban carbon emission performance in China based on super-efficiency SBM model. *Acta Geographica Sinica*, 75(6), 1316–1330.

[13] Zhang, T., & Ru, X. Y. (2021). Analysis of influencing factors for the transformation and upgrading from traditional logistics to smart logistics based on grounded theory. *Market Modernization*, (20), 51–53.