Scientific Research Publishing

Open Journal of Business and Management, 2026, 14(6), 3632-3641
https://www.scirp.org/journal/ojbm
ISSN Online: 2329-3292
ISSN Print: 2329-3284

Digital Empowerment and the Low-Altitude Economy: Evidence from Hangzhou, China

Lixu Chi[1], Dalei Song[2], Fangmin Xu[1], Yuhang Zhang[1]

[1]Hangzhou Polytechnic, Hangzhou, China
[2]Hangzhou EAVision Intelligent Control Technology Co., Ltd., Hangzhou, China
Email: chilixu@126.com

How to cite this paper: Chi, L. X., Song, D. L., Xu, F. M., & Zhang, Y. H. (2026). Digital Empowerment and the Low-Altitude Economy: Evidence from Hangzhou, China. *Open Journal of Business and Management, 14,* 3632-3641.
https://doi.org/10.4236/ojbm.2026.146178

Received: October 21, 2026
Accepted: November 15, 2026
Published: November 18, 2026

Copyright © 2026 by author(s) and Scientific Research Publishing Inc.
This work is licensed under the Creative Commons Attribution International License (CC BY 4.0).
http://creativecommons.org/licenses/by/4.0/

Open Access

Abstract

Focusing on Hangzhou, Zhejiang Province, this study examines the current development status, the digital-empowerment foundation, and the challenges of the city's low-altitude economy. Using a descriptive case-study design and document analysis, the paper documents reported local achievements in building an industrial ecosystem, opening application scenarios, and developing digital infrastructure. It also identifies constraints related to the autonomy of core technologies, the release of industrial-chain coordination effects, institutional innovation, and airspace-resource allocation. On this basis, the paper proposes recommendations for Hangzhou and comparable cities developing their low-altitude economies.

Keywords

Digital Empowerment, Low-Altitude Economy, Airspace Management

1. Introduction

The low-altitude economy refers to economic activity carried out in the airspace from the ground up to an altitude of several kilometres. Manned and unmanned aircraft share this layer, and their operation involves materials, electronics, and artificial intelligence; the strategic importance of the sector continues to grow. Commercial drones dominate the field worldwide, and their market is expanding rapidly. Industry estimates put the commercial UAV market at RMB 74.1 billion in 2021 and RMB 133.9 billion in 2025, a compound annual growth rate of 15.9%, with a forecast of RMB 323.5 billion by 2030. The fastest-moving segment is the embodied-intelligent drone: from approximately RMB 0.154 billion in 2021 to about RMB 1.404 billion in 2025 (CAGR 73.8%), with a forecast of RMB 16.933

billion by 2030 and a rising share of the commercial market, from 1.0% to 5.2%. Regulation is maturing in parallel. The US Federal Aviation Administration is advancing beyond-visual-line-of-sight operations; the European Union has established a layered scheme of operational categories, remote identification, and airspace rules; and Singapore and the UAE are designating dedicated drone-logistics corridors. As this regulatory foundation firms up, the sector moves from the pilot phase into scale operation, which provides the space in which digital technology can take root in the low-altitude economy (European Commission, 2021).

Market size, however, is an imperfect proxy for quality. Turning an available technology into a dependable one requires a durable driving force, and digital empowerment supplies such a force. The underlying idea is not complicated: data has become a factor of production in its own right, digital technology clusters form its base, and together, once applied to the real economy, they reshape established industries and create new ones (Liu, 2025; Zhang & Li, 2025). The low-altitude economy is distinctive because of its high technology intensity, long industrial chain, and strongly heterogeneous application settings; a digital system is therefore not an add-on but is embedded in the structure from the outset. Research to date follows two lines. One treats the concept and policy of the low-altitude economy; the other examines isolated technologies, communication protocols, or airspace systems taken on their own. Studies that examine how the two lines evolve together remain scarce.

Hangzhou provides an instructive case. In 2019, it obtained China's first licence for urban drone logistics operations, functioning in effect as an institutional testing ground. Policy advantage, however, is only the background. What makes Hangzhou analytically significant is its industrial base. The city now hosts more than 400 related firms and an output value of RMB 32.9 billion, an increase of 26.54% year on year. Policy supply is also substantial: the Implementation Plan for High-Quality Development of the Low-Altitude Economy (2024-2027) and the city's Several Measures were issued in succession, jointly setting a target of RMB 60 billion in industrial scale by 2027. At the operational level, the city has built 14 public drone take-off and landing sites and more than 400 terminal points, and has opened 249 governance routes and 175 logistics routes (Chen, 2026). These core indicators of Hangzhou's low-altitude economy are summarized in **Figure 1**.

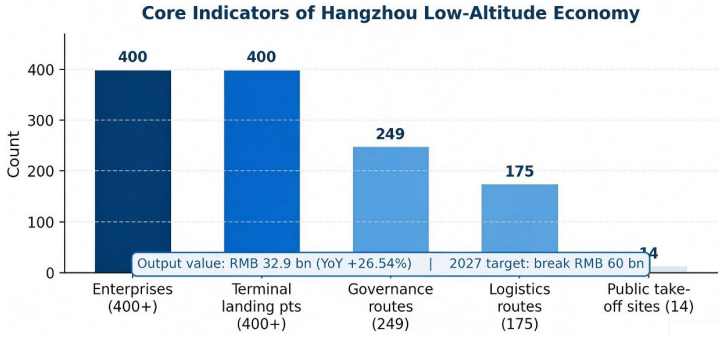


Figure 1. Core indicators of Hangzhou low-altitude economy.

These achievements do not eliminate structural constraints. Core chips and flight-control systems still rely heavily on external supply, and the links between upstream and downstream segments remain loose (Liu et al., 2026). The research question is therefore specific: across technology, factors, subjects, and policy, through what pathways does digitalization advance the low-altitude economy? Hangzhou serves as the empirical sample, and these four dimensions provide the organizing structure for the analysis.

At the first presentation of the analytical framework, the four dimensions are defined as follows. Technology refers to digital and aviation technologies—communication, navigation, surveillance, flight control, chips and sensors, platforms, and data processing—that determine whether low-altitude operations can be conducted safely and at scale. Factors refers to data, capital, talent, and infrastructure as production factors, and to the mechanisms through which digitalization improves their allocation and productivity. Subjects refers to firms, universities, research institutes, government agencies, regulators, operators, and users whose interactions shape coordination and innovation. Policy refers to plans, support measures, regulatory pilots, airspace rules, and standards. These dimensions connect digital capabilities to economic outcomes: technology affects upgrading and safety; factors affect cost and allocation efficiency; subjects affect coordination and knowledge diffusion; and policy affects the institutional space for experimentation and scaling.

2. Methods

This study adopts a descriptive single-case design. Hangzhou was selected because it is an early institutional testing ground for urban drone logistics and has publicly reported policies, infrastructure, and application scenarios relevant to the low-altitude economy. The evidence base comprises four types of sources: 1) municipal policy documents and official plans, including the Implementation Plan for High-Quality Development of the Low-Altitude Economy (2024-2027)and the city's Several Measures; 2) official statistics and public reports on firms, output value, routes, take-off and landing sites, and application scenarios; 3) academic literature on the low-altitude economy, digital empowerment, data as a factor of production, and airspace management; and 4) international policy documents on the EU U-space, the US UAS Integration Pilot Program, and Japan's Level-4 framework.

Sources were selected according to their relevance to the four analytical dimensions and their availability in the public domain. The analysis proceeded in three steps. First, reported indicators and policy measures were compiled from official and academic sources. Second, evidence was coded into the four dimensions of technology, factors, subjects, and policy. Third, Hangzhou's arrangements were compared with international UAM/UTM frameworks to interpret the institutional conditions under which digital empowerment may operate. The study is descriptive and does not estimate causal effects. No primary interviews were con-

ducted; the earlier draft's unsourced statement attributed to "one manager" has therefore been removed. Limitations include reliance on public documents, the absence of a systematic cross-city benchmark, and limited outcome evaluation of regulatory pilots.

3. Literature Review

The academic discourse relevant to this study spans three distinct but intersecting streams: the conceptualization of the low-altitude economy and Urban Air Mobility (UAM), the role of digital factors in economic transformation, and the governance of low-altitude airspace.

Tracing the path from drone applications to UAM and Advanced Air Mobility (AAM) is to trace a shift from narrow industrial tools to integrated urban transport. Early work concentrated on vehicle technology, battery density, and noise certification. More recent writing, much of it in the Journal of Air Transport Management, has turned to whether the surrounding ecosystem can survive, pressing the case for vertiport networks, public acceptance, and business-model innovation. A limitation is that much of this literature takes regulatory maturity as given, when much of the world is still some way from it; the regulatory transition phase itself remains poorly understood (Federal Aviation Administration, 2020).

A second stream concerns digital empowerment and data as a factor of production. Across Technological Forecasting and Social Change and related literature, digital empowerment is increasingly read through the idea of data as a factor of production. Unlike land or labour, data is non-rival and exhibits increasing returns to scale [2 - 3]. Work in this tradition shows digital infrastructure reducing transaction costs and improving allocation efficiency in older sectors. For the low-altitude economy, however, little attention has been paid to how data flows turn airspace into an economic resource that can actually be managed. The crossing from physical airspace to digital airspace is a theoretical hinge on which much depends, and it has received comparatively little theorization.

A third body of writing deals with airspace management and Unmanned Traffic Management (UTM). The European Union's U-space regulation, the US FAA's UAS Integration Pilot Program (UIPP), and Japan's Level-4 framework (Ministry of Land, Infrastructure, Transport and Tourism, 2022) rest on different governance philosophies. Technical standards for UTM are well recorded; far less is known about how digital governance systems and local economic development interact as a socio-technical matter. In particular, empirical work on how institutional sandboxes or pilot zones allow digital technology and low-altitude-economy policy to co-evolve remains limited (Zhao & Chen, 2025).

Read together, these streams point to a clear omission. The technology of UTM and the economics of UAM are each reasonably well understood on their own, yet few studies show how digital-empowerment mechanisms work within a particular regional institutional setting to support low-altitude-economy growth. This paper addresses that gap by examining Hangzhou across technology, factors, subjects,

and policy.

4. Current Development Status and the Digital-Empowerment Foundation of Hangzhou's Low-Altitude Economy

4.1. An Industrial Ecosystem of Preliminary Scale with Emerging Agglomeration Effects

The industrial chain now includes more than 400 firms, and several regionally prominent enterprises have emerged. In spatial terms, Hangzhou has established six demonstration zones—Yuhang, Qiantang, Xiaoshan, Jiande, Tonglu, and Linping—which together form a pattern of several anchors with differentiated roles. Yuhang concentrates on low-altitude data and vision and has advanced the "China Feigu" initiative; Qiantang relies on its aviation park as a manufacturing base for low-altitude aircraft; Xiaoshan, adjacent to the airport-economy zone, emphasizes operational services and air logistics. This division of labour reduces duplication among the zones. However, it has not yet produced deep cooperation between firms, and the extent to which the chain is actually integrated remains an open question (Ouyang & Li, 2026). The industrial spatial layout of the six demonstration zones is shown in Figure 2.

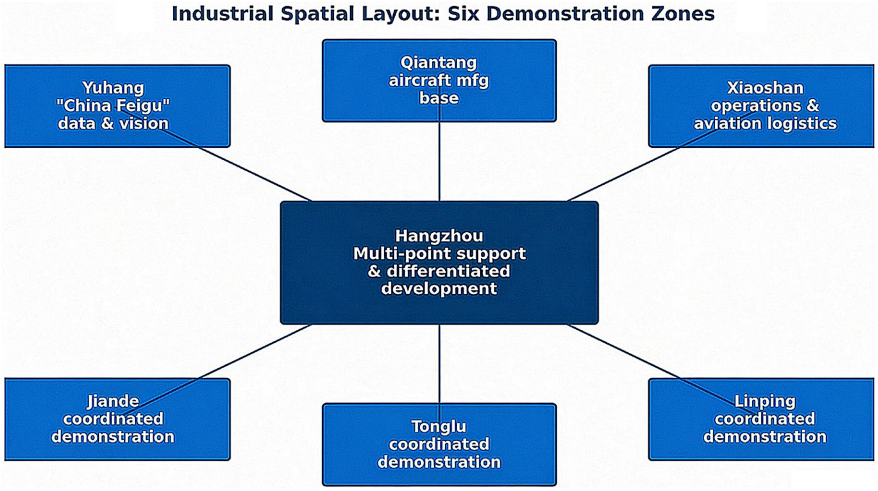


Figure 2. Industrial spatial layout of the six demonstration zones.

4.2. Application Scenarios under the "3 + 1" Model

Hangzhou follows a logic of using applications to draw research and industry forward. A total of 79 application-scenario cases have been staged across ten fields—urban security, emergency rescue, ecological governance, inspection, geographic surveying, logistics, passenger transport, cultural tourism, low-altitude sports, and agroforestry protection. The distribution of these 79 application scenarios is presented in Figure 3.

4.3. Digital Infrastructure and Platform Empowerment

Low-altitude digital infrastructure has been given high priority. The comprehen-

sive management service platform is operational and has been iterated to version 2.0, integrating flight-plan filing, airspace query, weather information, communication-navigation-surveillance, and emergency response—a first step toward unified management of low-altitude flight. Built on multi-source, heterogeneous data, the platform creates a three-dimensional digital-twin base over the airspace, serving both flight safety and operational efficiency. On the network side, 5G-A integrated sensing-and-communication coverage is being rolled out for low-altitude scenarios, allowing aircraft to be detected in real time and handled precisely. Improved infrastructure reduces integration costs and provides the government with a data foundation for supervision and decision-making. The overall layout of low-altitude digital infrastructure and air routes is illustrated in Figure 4.

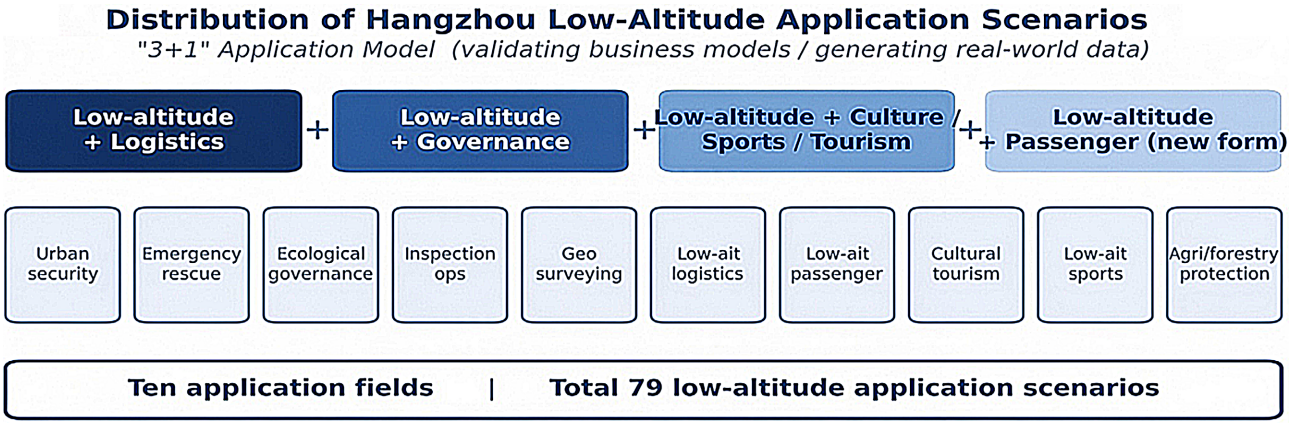


Figure 3. Distribution of the 79 low-altitude application scenarios.

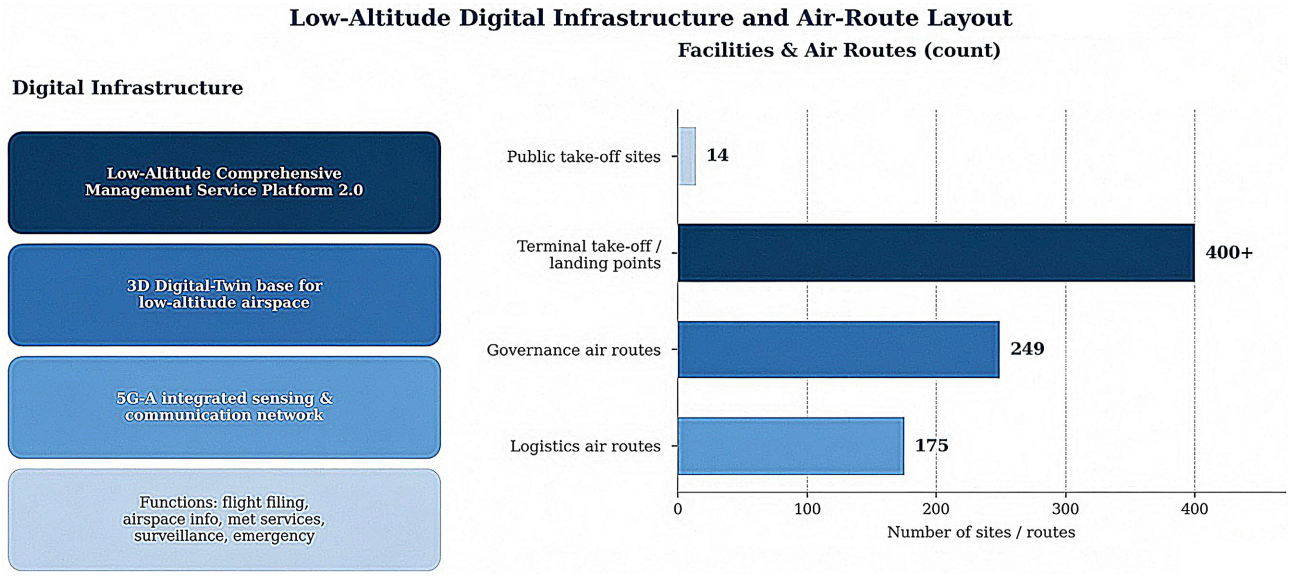


Figure 4. Low-altitude digital infrastructure and air-route layout.

4.4. Policy Framework and Factor Guarantees

A top-level framework of plans, programmes, and supporting policies has been

assembled around a common core. The city's Several Measures lay out 21 support items across four areas—attracting and growing firms, technical innovation, application scenarios, and factor guarantees—and address issues raised by firms, including R&D subsidies, airworthiness awards, route subsidies, and talent recruitment (Liang & Tan, 2026). On the factor side, an industrial guidance fund channels fiscal money to attract social capital into key links, while a university-enterprise-government talent system is taking shape with the city's universities and laboratories. Reform of classified low-altitude airspace management is being piloted in parallel, and a standing coordination channel with the military and civil aviation authorities provides institutional space for low-altitude flight.

5. Discussion

5.1. International Comparative Analysis

To assess the generalizability of the Hangzhou experience, this section compares it with three major international UAM/UTM frameworks: the EU's U-space, the US UIPP, and Japan's Level-4 framework, as summarized in Table 1.

Table 1. Comparison of international UAM/UTM frameworks.

Framework	Governance level and main instrument	Main focus	Implication for Hangzhou
EU U-space	Supranational regulation; Implementing Regulation (EU) 2021/664	Layered airspace services, remote identification, U-space service providers	Suggests standardized service layers and structured sandbox arrangements
US UIPP	Federal waiver and pilot route; FAA-led	Public-private partnerships and shared verification	Suggests bounded public-private testing frameworks
Japan Level-4	National guidelines; MLIT	Beyond-visual-line-of-sight unmanned flights over populated areas	Suggests staged opening of airspace and industry-government-academia coordination; passenger services require separate authorization

5.2. The Institutional Sandbox as a Tentative Mechanism

The Hangzhou case suggests, tentatively, that a municipal-level institutional sandbox may function as a transferable mechanism. This interpretation should be treated as a proposition to be tested rather than an established finding, because the public sources reviewed here document demonstration zones and policy pilots but do not provide formal testing rules or evaluated outcomes. Where the EU pursues a supranational settlement and the US relies on a federal waiver route, Hangzhou has used its status as a national digital-economy pilot to build a local regulatory setting described as permissive and orderly. The six demonstration zones may act as bounded experiments in which new technologies and policies can be tried out without exposing the wider system to risk. If such arrangements are supported by explicit sandbox rules and evaluation, they could offer a reference for other emerging aviation economies. The broader proposition is that digital empowerment in the low-altitude economy requires institutional infrastruc-

ture as much as technological infrastructure, because the binding constraint is the cost of experimentation. By operating a digital platform that serves as a trusted intermediary, Hangzhou may reduce transaction costs between regulators, operators, and the public. This lesson is particularly relevant in developing economies, where trust in autonomous systems may be low and regulatory capacity limited.

5.3. Challenges and Risk Assessment

The gains Hangzhou has recorded coexist with structural problems that cut across technology, industrial organization, institutions, and airspace control. The most fundamental is limited autonomy over core technologies and weak links along the industrial chain. Core chips, high-precision sensors, and flight-control systems are still largely purchased from outside, and the locally sourced share is small. Firms have become proficient in whole-machine integration and application services, but few command the underlying core technology or key components, which weakens the resilience of the chain. A second obstacle is that low-altitude communication, navigation, and surveillance technologies have not yet converged on a single standard, so equipment from one maker does not reliably interoperate with that of another. This constrains scaling and, as industry practitioners have reported, can create an unsteady supply of core chips that disrupts production planning.

This technical fragility is compounded by an industrial ecosystem that has not cohered. More than 400 firms have gathered, yet ties among them rarely extend beyond transactions; chain leaders have not pulled the ecosystem along as they might, alliances form slowly, and the industry-university-research-application loop remains loose. Firms may know one another's names without knowing what each can actually do or need. International experience is instructive. The EU's U-space sorts airspace services into named layers under a single rulebook and, through sandboxes such as EuroUSC, runs R&D, airworthiness, and testing together so that they iterate jointly. The US UAS Integration Pilot Program brought Zipline, Apple, Intel, and FedEx together with local governments and universities within a shared verification framework. Japan has used an industry-government-academia alliance, together with the opening of Level-4 airspace for beyond-visual-line-of-sight unmanned flights over populated areas, to advance logistics and other unmanned operations toward scale; passenger services require a separate regulatory basis. The shared logic is to tie scattered players into a single network through an institutionalized, digitized public base.

Lagging institutional innovation intensifies both problems. Compared with the Guangdong-Hong Kong-Macao Greater Bay Area, Hangzhou still provides less institutional supply: reform of airspace management moves slowly, the dynamic-release mechanism is not yet in place, flight approval remains burdensome, and in newer areas—cross-border data rules, low-altitude commercial insurance, and the allocation of flight-accident liability—norms lag behind practice and constrain new business models. These weaknesses are most visible in airspace control, where

safety risk and inefficient allocation coexist. As a dense megacity, Hangzhou's low-altitude airspace is complex and difficult to manage; the static-zoning model does not suit frequent, small-batch, and mixed-craft flight, so one stretch of airspace may stand idle while another is congested at peak, and the regulatory toolkit remains limited against sudden situations or deliberate jamming. As flights increase, airspace will become tighter, and unless the management model is upgraded accordingly, it may become the bottleneck that constrains the industry.

6. Conclusion and Recommendations

Digitalization is a basic engine behind the high-quality growth of the low-altitude economy. Using Hangzhou as its case, this paper has examined, across technology, factors, subjects, and policy, the mechanisms by which digitalization supports that economy. The Hangzhou record is mixed in an instructive way: on ecosystem, applications, digital infrastructure, and policy the city has made solid gains, while on four counts it still falls short—core-technology autonomy is moderate at best, the coordination ecosystem is immature, institutional innovation lags, and fine-grained airspace control is not yet adequate.

To address technological and industrial blockages, Hangzhou should join with leading firms and universities to establish a "digital technology-low-altitude scenario" integration platform aimed at joint R&D in communication, navigation, and flight control, and support it with local technical standards that lower the R&D threshold for small and medium-sized firms. In addition, the data-factor market needs improvement: a dedicated low-altitude data zone on top of the existing exchange, together with firmer support through targeted industrial funds, IP-pledge financing, and shared university-enterprise training bases, so that capital and talent reach core-technology work on a long-term and stable basis rather than through one-off measures.

The key question is whether Hangzhou can convert digital empowerment into concrete outcomes. If the city maintains technology-integration innovation, market-based allocation of data as a factor, coordinated movement along the chain, and a renewed airspace-management policy, it will improve its prospects of breaking through current blockages and building a low-altitude economy of genuine global standing.

Funding

This work was supported by the 2026 project of the Hangzhou Federation of Social Science Circles, "Research on the Collaborative Mechanisms and Countermeasures of Digital New Quality Productive Forces Empowering the High-Quality Development of Hangzhou's Low-Altitude Economy" (Grant No. 2026SKL-0040).

Conflicts of Interest

The author declares no conflicts of interest regarding the publication of this paper.

References

Chen, L. Q. (2026). Scenario Innovation, Benefit Coordination, and Policy Mechanisms of Low-Altitude Consumption Driving Urban Economic Development. *Decision and Information, 59,* 42-51. (In Chinese)

European Commission (2021). Commission Implementing Regulation (EU) 2021/664 of 22 April 2021 on A Regulatory Framework for the U-Space (pp. 1-20). *Official Journal of the European Union, L 139*.

Federal Aviation Administration (2020). *UAS Integration Pilot Program: Final Report*. U.S. Department of Transportation.

Liang, S., & Tan, Q. M. (2026). Practical Paths of New Quality Productive Forces Empowering the Construction of a Modern Industrial System for the Low-Altitude Economy. *Jiangsu Social Sciences, No. 1,* 68-76. (In Chinese)

Liu, S. L., Wang, F., & Jin, M. L. (2026). Measurement, Spatiotemporal Characteristics, and Trend Prediction of the Resilience of China's Low-Altitude-Economy Industrial Chain. *Statistics and Practice, No. 3,* 5-18. (In Chinese)

Liu, Z. B. (2025). Spatial-Temporal Evolution and Driving Mechanisms of Low-Altitude Economic Agglomeration in China. *Acta Geographica Sinica, 80,* 312-329.

Ministry of Land, Infrastructure, Transport and Tourism (2022). *Level 4 Flight of Unmanned Aircraft: Implementation Guidelines*. Government of Japan.

Ouyang, T., & Li, J. W. (2026). Research on the Diversified Application of the Collaborative Industrial Ecosystem of the Low-Altitude Economy in the Greater Bay Area. *Science Technology and Industry, 26,* 10-15. (In Chinese)

Zhang, X. M., & Li, W. (2025). Logic, Predicaments, and Paths of the Digital Economy Empowering the Development of the Low-Altitude Economy. *Economic System Reform, No. 4,* 88-95.

Zhao, J. G., & Chen, Z. G. (2025). Reform of the Low-Altitude Airspace Management System: A Review and Prospects. *Integrated Transport, 47,* 45-52.