Journal of Electronic Research and Application, 2025, Volume 9, Issue 4
http://ojs.bbwpublisher.com/index.php/JERA
ISSN Online: 2208-3510
ISSN Print: 2208-3502

Exploring the Development Model of UAVs Empowered by the Low-Altitude Economy

Fan Shi[1], Yuyao Zu[2]

[1]The High School Affiliated to Shaanxi Normal University, Xi'an 710062, Shaanxi, China
[2]Nankai University, Tianjin 300071, China

Abstract: The "14th Five-Year Plan" and the Long-Range Objectives Through the Year 2035 propose to strengthen the construction of strategic emerging industrial clusters, promote the deep integration of the internet, big data, artificial intelligence, blockchain technology, etc. with the real economy, facilitate the development of advanced manufacturing, and consider UAVs as an important breakthrough, providing significant opportunities for the development of the UAV industry. Therefore, this article takes the current status of the UAV industry development as a starting point, analyzes the exploration and practice of the UAV development model based on the low-altitude economy, and discusses strategic suggestions to promote the development of UAVs empowered by the low-altitude economy. Through analysis, this article aims to provide theoretical reference and practical guidance for promoting the sustainable development of the UAV industry under the wave of the low-altitude economy.

Keywords: Low-altitude economy; UAV; Development model

Online publication: August 8, 2025

1. Introduction

A UAV (Unmanned Aerial Vehicle) refers to an aircraft that can autonomously complete the entire flight mission, including takeoff, cruising, landing, and recovery, either by radio remote control equipment or devices with radio remote control capabilities, independent of ground personnel. UAV technology originated in the military field but has gradually been applied in the civilian sector due to its advantages, such as easy operation, low cost, high efficiency, and high safety factor. In recent years, with the implementation of low-altitude airspace management reform policies, China's UAV industry has entered a rapid development stage. However, the further development of the UAV industry still faces many bottlenecks. In this context, deeply exploring the development model of UAVs empowered by the low-altitude economy not only helps to break through the development dilemma of the UAV industry but also has important theoretical and practical significance for promoting the high-quality development of the low-altitude economy.

2. Current status of the development of the drone industry

Since 2016, the entire drone industry has ushered in a period of rapid development. By 2024, the total industrial scale had exceeded 200 billion yuan, representing an increase of over 50% compared to the 130 billion yuan in 2023. Civil drones accounted for 76% of the market share. As of August 2024, the number of real-name registered drones in China reached 1.987 million, and the number of pilot licenses issued was 220,000, an increase of 720,000 drones and 139,000 licenses compared to the end of 2023 [1]. Simultaneously, the usage scenarios of drones have become increasingly diversified, including agricultural plant protection (with over 150,000 drones in use in 2024), power inspection, emergency rescue, and emerging areas such as drone lifting (with a predicted global market size exceeding 300 billion yuan by 2025), express logistics (SF Express and Meituan's drone pilots), and medical emergency response. In terms of policies, "drone transportation" has been listed as a key industry supported by the state, with 487 logistics and distribution pilot areas currently planned.

However, despite drones being applied in multiple fields and demonstrating significant potential, they still face several issues and challenges. Firstly, the existing regulatory framework is not sufficiently comprehensive, and airspace management is relatively strict, limiting the widespread use and commercial development of drones [2]. Secondly, there is a homogenization of drone products and services, lacking innovative capabilities and differentiated advantages to meet market demands. Finally, there is inadequate collaboration between upstream and downstream industries in the supply chain, and a lack of unified standards and norms, resulting in an imperfect industrial chain and inefficiencies. Effective measures are needed to address these issues to promote the better development of the drone industry.

3. Exploration and practice of unmanned aerial vehicle (UAV) development models based on low-altitude economy

3.1. Technology innovation-driven model

In the booming development of China's low-altitude economy, technological innovation has become a significant driving force for advancing the UAV industry. For instance, 5G and higher-level communication technologies are revolutionizing UAV control and data transmission methods. Compared to the past, 5G communication technology enables UAVs to possess characteristics such as low latency, high bandwidth, and widespread connectivity. In the low-altitude logistics and distribution environment of urban areas, utilizing 5G technology allows UAVs to stably transmit massive amounts of information, including flight status and cargo details, to the dispatch center in real-time. Additionally, they can receive instructions promptly from the dispatch center, enabling precise obstacle avoidance and enhancing transportation efficiency and safety performance.

High-precision navigation and positioning technologies are also propelling UAV development. In complex terrain conditions such as urban high-rises, valleys, and mountainous areas, conventional GPS positioning is prone to signal deviations or interference. Nowadays, a composite navigation and positioning system that integrates satellite navigation, inertial navigation, visual navigation, and Real-Time Kinematic (RTK) positioning enables UAVs to achieve centimeter-level precise positioning [3]. In agricultural plant protection, this precise positioning allows UAVs to accurately spray pesticides or seeds evenly across fields according to preset routes, preventing repeated operations or missed applications. This not only enhances agricultural production efficiency but also reduces pesticide usage and environmental pollution [4].

With the deep application of artificial intelligence, UAVs have evolved from simple remote-controlled aircraft into intelligent entities with independent decision-making capabilities. Through machine learning algorithms,

UAVs can rapidly analyze and recognize data such as images and videos [5]. In the process of power inspection, adopting artificial intelligence image recognition technology, combined with high-definition cameras and infrared thermal imagers, allows UAVs to automatically detect faults like loose wire screws, damaged insulators, and wire heating. They can promptly issue alarms, enabling monitoring of the safe and stable operation of the power system. Additionally, in security monitoring, artificial intelligence analyzes object tracking and behavior, enabling UAVs to realize real-time monitoring and alarming of suspicious individuals and abnormal activities, improving the intelligence level of urban security [6].

3.2. Industrial integration development model

In the context of the low-altitude economy, the integration of multiple industrial domains has become a prominent feature of UAV development, providing a broad application prospect. The "UAV + Agriculture" model promotes the development of traditional agriculture and accelerates its transition towards smart agriculture. For large-scale field pest monitoring, equipping UAVs with multispectral cameras allows fast and comprehensive acquisition of crop growth status. By analyzing the data, accurate identification of pest species, distribution range, and severity can be achieved, guiding farmers in scientific pest control measures. Additionally, UAVs exhibit high efficiency in plant protection operations. A single plant protection UAV can spray pesticides on over 100 acres of farmland per day, which is more than ten times more efficient than manual methods. This achieves precise fertilization, saves chemical fertilizers, and reduces agricultural production costs [7].

The "UAV + Logistics" model aims to establish an efficient and low-cost air logistics system. In remote or mountainous areas with poor conditions, traditional ground logistics and distribution methods face issues like high transportation costs and low efficiency. UAV logistics can effectively address these problems, providing technical support for precise "last mile" and even "last 100 meters" delivery. For example, in certain situations where time-sensitive materials such as medical emergency supplies and fresh products are required, UAV transportation can significantly reduce delivery cycles, ensuring timely arrival. Furthermore, during major e-commerce promotions, UAVs can be utilized for urban cargo distribution, alleviating ground transportation congestion and improving delivery efficiency and consumer shopping experiences [8]. However, current UAV logistics still faces challenges like short range, limited payload capacity, and complex flight area management, requiring further technological breakthroughs and improvements in related policies and regulations.

"UAV + Culture and Tourism" presents a new opportunity and experience for the development of the tourism industry. At tourist attractions, UAVs can perform spectacular light shows. By programming and controlling the flight paths, light colors, and blinking rhythms of multiple UAVs, colorful patterns and shapes can be displayed in the sky, providing visitors with a visual feast and offering more options for local nighttime tourism [9]. Additionally, UAV aerial photography services offer tourists a brand-new perspective to appreciate scenery, capturing creative and aesthetic photos and videos that meet personalized travel experience demands. For some historical and cultural relics, UAV technology can utilize high-precision measurement instruments to achieve 3D modeling of the sites, providing data support for relic protection and monitoring, and promoting sustainable development in the tourism industry.

3.3. Policy support and guidance model

Policies play a crucial role in guiding and supporting the development of drones in the low-altitude economy. The gradual advancement of low-altitude airspace opening policies has opened up vast opportunities for the widespread

application of drones [10]. In the past, strict airspace regulations limited the flight range and operating time of drones, significantly restricting their development. Nowadays, with China's pilot reform of low-altitude airspace classification management in some regions, low-altitude airspace is divided into controlled airspace, monitored airspace, and reporting airspace, clarifying access conditions and management rules for different airspaces. This allows drones to carry out various operational activities more freely and efficiently, provided they comply with the corresponding regulations. For example, in low-altitude tour projects in some tourist attractions, drones can safely provide air sightseeing services to tourists within the prescribed monitored airspace and along established routes. In the field of logistics and distribution, drones can also successfully complete cargo transportation tasks within the reporting airspace, thanks to the support of low-altitude airspace opening policies.

Industrial support policies have injected strong momentum into the growth of drone enterprises. The government encourages enterprises to increase investment in technological research and development and improve product performance and quality through various means such as financial subsidies, tax incentives, and funding for scientific research projects. For example, for enterprises focusing on key drone technology research and development, the government provides tax incentives such as additional deductions for research and development expenses, reducing enterprise research and development costs. It also establishes special industrial development funds to provide financial support for innovative and potential drone projects, helping enterprises solve funding shortages. Simultaneously, in terms of industrial park construction, the government offers preferential policies for hardware facilities such as land and factories to drone enterprises, attracting enterprises to gather and develop, forming industrial cluster effects, and promoting collaborative innovation and cooperation among upstream and downstream enterprises in the industry chain.

Safety regulatory policies are the cornerstone of ensuring the healthy development of the drone industry. With the rapid growth in the number of drones, flight safety issues have become increasingly prominent. To address this, the government has formulated a series of strict safety regulatory policies to regulate various aspects of drone production, sales, registration, and flight. Drone manufacturers are required to strictly adhere to relevant safety standards to ensure product quality and safety. After purchasing drones, consumers need to register them under their real names, facilitating effective management of drones by regulatory authorities. During flight, clear regulations stipulate no-fly zones, flight altitude limits, and flight qualification requirements for drones. Violations of these regulations are subject to severe penalties according to the law. The implementation of these safety regulatory policies has effectively reduced the incidence of drone flight safety accidents, maintained public safety and air order, and created a favorable environment for the sustainable development of the drone industry.

4. Strategic suggestions for promoting the development of UAVs enabled by low-altitude economy

4.1. Strengthening top-level design

To promote the healthy development of the UAV industry, it is necessary to strengthen the planning and guidance of UAV development from the national level, and formulate corresponding development policies and implementation plans. Simultaneously, a sound legal and regulatory framework should be established to clarify the scope and limitations of UAV flights, and standardize UAV operation behaviors and safety management. Furthermore, successful experiences from other industries, such as intelligent connected vehicles, can be leveraged to provide more convenient and efficient airspace management and services for UAVs.

4.2. Establishing industrial alliance

To promote industrial collaborative innovation and resource sharing, a UAV industrial alliance can be established, integrating resources from upstream, midstream, and downstream enterprises in the industry chain, as well as research institutes and universities, to form a synergistic force. The alliance can organize technical research, product development, and application promotion to enhance the overall level and competitiveness of the industry chain. Additionally, the alliance can build a platform to facilitate communication and cooperation between upstream and downstream enterprises, promoting the transformation of innovation achievements into practical applications.

4.3. Fostering technological innovation and standardization

As an emerging industry, UAVs require continuous innovation in technology, products, and business models. By increasing research and development investment, breakthroughs and upgrades in UAV technology can be achieved, improving their intelligence and automation levels. Simultaneously, cooperation with upstream and downstream enterprises should be strengthened to jointly develop new application scenarios and expand market space. In terms of standardization, a unified set of standards and specifications for UAVs can be established, covering various aspects from design, manufacturing, to usage, to ensure the consistency of product quality and performance.

4.4. Optimizing regulatory environment

To ensure the safe operation of UAVs in public airspace, a scientific and reasonable regulatory mechanism needs to be established, achieving the goal of "effective pre-event management and post-event handling" [11]. Firstly, it is essential to strengthen the access management of UAVs, formulate strict approval processes and requirements to prevent illegal flight incidents. Secondly, routine supervision of UAVs should be enhanced, utilizing satellite positioning, data monitoring, and other means to timely detect and address illegal flight behaviors. Additionally, emergency response plans for UAV accidents should be established to ensure rapid response and proper handling in case of accidents. Finally, publicity and education should be intensified to popularize UAV knowledge and safety awareness, guiding the public to view and use UAVs correctly.

5. Conclusion

With the continuous advancement of technology and the expanding application scenarios, drones have become an indispensable part of modern society. Based on the concept of the low-altitude economy, this article proposes a drone development model that aims to promote the development and application of the drone industry by strengthening top-level design, establishing industrial alliances, fostering technological innovation, and enhancing standardization. Under this model, drones will integrate with other low-altitude sectors to form a complete ecosystem, providing people with more convenient and efficient travel options and services. Simultaneously, through intelligence, digitization, networking, and other means, drones can achieve a wider range of functions and applications, such as smart delivery, smart cities, emergency rescue, and more. In summary, the drone development model based on the low-altitude economy concept is expected to bring broader market prospects and development opportunities to the drone industry, making it an indispensable part of modern society.

Disclosure statement

The authors declare no conflict of interest.

References

[1] Wang L, 2025, Discussion on the Innovation Model of Light and Small Drone Logistics and Distribution in the Greater Bay Area Driven by the Low-Altitude Economy. Logistics Engineering and Management, 47(02): 19–22.

[2] China Energy Network, 2024, The Scale and Level of the Drone Industry Continue to Improve (New Perspective), viewed July 2, 2025, https://www.zhihu.com/question/457765989

[3] Jia H, 2025, Challenges and Responses of Drone Logistics in the Development of Low-Altitude Economy. China Aviation Weekly, (04): 51–53.

[4] Chen H, 2024, Discussion on the Role and Significance of Drone Channel Surveying and Mapping in the Development of Low-Altitude Economic Strategy. Pearl River Water Transport, (22): 11–14.

[5] Zhang J, Chen L, Gao Z, et al., 2025, Research Status and Prospects of Low-Altitude Drone Technology. Engineering Sciences, 27(02): 73–85.

[6] Han Z, Lu W, Wang A, 2025, Application and Technological Innovation of Drones in the Agricultural Low-Altitude Economy. Shanghai Informatization, (06): 35–38.

[7] Zhang M, 2025, Yishui, Shandong: Exploring the Development Model of Plant Protection Drones Empowered by the Low-Altitude Economy. China Rural Science and Technology, (05): 46–47.

[8] Li J, Zhao Y, 2024, The Concept and Practice of the County-Level Drone Government Service Flight System in the Context of the Low-Altitude Economy. China Security, (06): 83–86.

[9] Hu Q, 2025, Media Application of Drones in the Context of Low-Altitude Economy. Shanghai Informatization, (01): 18–21.

[10] Qiao L, Huo D, Gu W, et al., 2025, Research on the Optimization of the Development Path of Low-Altitude Economic Modernization - Based on the Perspective of 3D Drone Flight. Scientific Management Research, 43(02): 29–38.

[11] Chen Y, Yang J, Zhang Y, et al., 2025, Policies, Standards, and Technologies for Drone Communication Spectrum Management for the Low-Altitude Economy. Data Acquisition and Processing, 40(01): 2–26.