

Research on Low-Altitude Economic Cooperation Mechanism and Cross-border Logistics Channel Construction Oriented to ASEAN

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Abstract: With the booming growth of the worldwide low-altitude economy and continuous digital integration between China and ASEAN countries, the fusion of low-altitude economic scenarios and cross-border logistics services has become a promising direction for regional cooperative development. Based on the review of relevant theories, this article constructs a theoretical analysis framework of "scenario demand - technical support - institutional collaboration - governance innovation", and systematically explores the internal mechanism of conducting low-altitude economic cooperation towards ASEAN. The study holds that conducting low-altitude economic cooperation towards ASEAN has a solid theoretical foundation and broad application prospects. Multiple scenarios such as border trade logistics, port clearance efficiency, island distribution, and the "last mile" of cross-border e-commerce constitute the spatial basis for the application of the low-altitude economy; key technologies such as unmanned aircraft, eVTOL, 5G-A integrated perception, and Beidou navigation provide technical support for cross-border low-altitude logistics; institutional arrangements such as airspace management, flight permission, data circulation, and safety supervision provide key guarantees for cross-border cooperation. Based on this, it is proposed to systematically exert efforts in areas such as improving top-level design, accelerating infrastructure construction, promoting institutional innovation, innovating regulatory models, and promoting industrial collaboration, to form a six-in-one working pattern, and inject new momentum into the China-ASEAN digital economy cooperation.

Keywords: Low-Altitude Economy; Cross-Border Logistics; ASEAN Cooperation; Drone Logistics; Digital Economy

1. Introduction

As a core carrier of new-quality productive forces, the low-altitude economy has evolved from a pivotal economic growth driver into a strategic emerging pillar industry at the national level, standing alongside integrated circuits, aerospace and other key cutting-edge sectors [1]. The National Development and Reform Commission (NDRC) has launched a dedicated department for low-altitude economic development, which symbolizes the formal strategic elevation of this emerging industry at the national level, aiming to solve deep-seated issues such as airspace management and technical standards. Meanwhile, digital economic cooperation between China and ASEAN has evolved toward institutionalization and systematization, marking a new phase of in-depth regional collaboration. With the substantive progress made in the negotiation of the "ASEAN Digital Economy Framework Agreement" and the release of the "China-ASEAN Comprehensive Strategic Partnership Action Plan (2026-2030)", both sides have established key areas of cooperation in digital and artificial intelligence. Adopted in 2026, the China-ASEAN Action Plan for Building a Sustainable and Inclusive Digital Ecosystem Cooperation explicitly sets up a digital academy and an AI innovation center, shifting the mode of bilateral cooperation from scattered individual projects to regular institutional mechanisms. Endowed with superior locational conditions, Guangxi has accelerated the development of the China-ASEAN Information Port and completed the deployment of multiple cross-border communication infrastructures, including international submarine and terrestrial cable systems. The Nanning International Communication Business Outbound Hub plays a core hub role. Against such a backdrop, the synergistic integration of low-altitude economy and cross-border logistics has emerged as a

pivotal trend for regional economic cooperation and industrial upgrading. Low-altitude logistics can break through the limitations of complex terrain and the "last mile", and the Greater Bay Area has been the first to explore cross-border drone logistics in this field [2]. Based on this, this article explores the cooperation mechanism for low-altitude economy towards ASEAN and the construction of cross-border logistics channels, focusing on answering key questions such as the theoretical basis of cooperation, enabling paths, institutional obstacles, and the construction of governance mechanisms.

2. Concept Evolution and Theoretical Connotation of Low-Altitude Economy

2.1 Concept Evolution of Low-Altitude Economy

Centered on low-altitude aviation activities, the low-altitude economy forms a systematic and comprehensive economic paradigm that promotes industrial upgrading and multi-scenario practical applications [3]. Tracing the conceptual development, the low-altitude economy has realized a theoretical transition, evolving "general aviation" to "low-altitude economy"[4]. Early research mainly focused on the transportation function, tourism function and operation function of general aviation, emphasizing its supplementary role in the transportation system [5]. Recent technological breakthroughs in drones, eVTOL aircraft and smart flight control systems have greatly enriched the implications of the low-altitude economy. Its application scope has extended to urban air transportation, low-altitude logistics, emergency response and aerial cultural-tourism activities, giving rise to a highly dynamic and innovative integrated economic form that boosts coordinated development among various sectors [6].

2.2 Theoretical Connotation of Low-Altitude Economy

From a theoretical perspective, the low-altitude economy exhibits the following notable characteristics. First, it embodies a classic manifestation of new quality productive forces. The low-altitude economy is driven by technological innovation and integrates various new technologies such as new materials, new energy, navigation, satellite internet, 5G, big data, and cloud computing, featuring a

significant characteristic of innovation-driven development [1]. Second, it is a new paradigm for the development of spatial resources in three dimensions. Traditional economic activities mainly take place on the ground and underwater, while the low-altitude economy breaks this limitation and opens up a completely new three-dimensional spatial resource below one kilometer, providing a new spatial carrier for economic and social development [7]. Third, it serves as key backing for traditional industries to accomplish digital transformation. Low-altitude technologies are deeply integrated with traditional industries such as agriculture, construction, energy, transportation, and logistics, significantly enhancing the production efficiency and governance capabilities of these industries [8]. Fourth, it provides a practical vehicle to boost the progress of civil-military integration. When managing and deploying low-altitude airspace resources, authorities must take into account national defense security alongside economic development targets. Promoting the low-altitude economy therefore demands reasonable trade-offs between national security requirements and economic development goals [9].

The "National Low-Altitude Economic Development Plan Outline (2026 - 2030)" has clearly defined five fundamental principles for the advancement of the low-altitude economy: safety first, reform empowerment, innovation-driven, scenario supremacy, and national coordination. These five principles provide important guidance for understanding the theoretical connotation of the low-altitude economy [10]. "Safety first" emphasizes that low-altitude flight activities must be based on safety as the bottom line and a full-process regulatory system must be established; "reform empowerment" emphasizes the release of the vitality of low-altitude economic development through airspace management reform; "innovation-driven" emphasizes the independent control of core technologies and business model innovation; "scenario supremacy" emphasizes that the expansion of application scenarios drives industrial development; "national coordination" emphasizes breaking through regional barriers and building a unified market. These principles jointly constitute the theoretical framework and practical guidelines for advancing China's low-altitude economy.

3. The Inner Mechanism of Low - Altitude Economy Empowering Cross-Border Logistics

3.1 Scenario Requirements

Carrying out low-altitude economic cooperation with ASEAN primarily stems from the diversified demands in cross-border logistics scenarios. From the perspective of demand types, cross-border logistics targeting ASEAN has distinct regional characteristics, forming a unique scenario space for low-altitude economic applications. The first scenario is the logistics demand for border trade. In border trade, low-altitude drone logistics can achieve "point-to-point" delivery at a lower cost, effectively breaking through geographical barriers and time limitations [11]. The second scenario is the efficiency demand for port clearance. Combining low-altitude logistics with smart port construction can significantly enhance the efficiency of port logistics [12]. The third scenario is the distribution demand for islands and remote areas. The logistics channels targeting ASEAN involve islands and remote coastal areas. Low-altitude drones can directly fly from land bases to islands to achieve rapid distribution of emergency supplies, fresh products, medicines, and other goods, filling the gap in island logistics [13]. The fourth scenario is the "last mile" demand [14]. The accelerating proliferation of cross-border e-commerce has generated a large number of "last mile" distribution demands, especially in areas with scattered recipients and inconvenient transportation, where traditional distribution models face challenges. Low-altitude drones can achieve automated delivery of packages, significantly reducing distribution costs and time.

3.2 Technical Support

The realization of scene requirements depends on the maturity and support of key technologies. From a technical perspective, low-altitude cross-border logistics targeting ASEAN involves multiple aspects such as aircraft technology, communication technology, navigation technology, and intelligent control technology [13]. In terms of aircraft technology, unmanned aerial vehicles (UAV) and electric vertical take-off and landing aircraft (eVTOL) are the core carriers of low-altitude logistics. Currently, UAV technology has become relatively mature, with continuous improvements in endurance,

payload capacity, and environmental adaptability. eVTOL, as a new generation of low-altitude aircraft, has advantages such as vertical take-off and landing, low noise, and high intelligence level, and is regarded as an important direction for future urban aerial logistics. In terms of communication technology, 5G-A (5G-Advanced) perception-integration technology provides key technical support for low-altitude cross-border logistics [15]. In navigation technology, the Beidou navigation system provides high-precision positioning services for low-altitude cross-border logistics. The Beidou system integrates with 5G, IoT and other emerging technologies to form a "Beidou+" comprehensive navigation and positioning system, enhancing the safety and reliability of low-altitude logistics. Concerning intelligent control technology, the construction of the national integrated low-altitude flight service platform provides a unified control foundation for low-altitude cross-border logistics, offering unified declaration, approval, and supervision services for cross-border low-altitude logistics, and reducing the institutional costs of cross-border flights.

3.3 System Collaboration

The combination of technology and scenarios cannot automatically translate into the practical implementation of cross-border low-altitude logistics. Institutional coordination serves as a crucial guarantee. The low-altitude economic cooperation targeting ASEAN involves institutional arrangements in multiple fields such as airspace management, flight permits, data circulation, and security supervision [16]. In terms of airspace management, there are differences in airspace management rules among China and ASEAN countries. These differences need to be resolved through institutional coordination to achieve the sharing and utilization of airspace resources [17]. In terms of flight permits, cross-border low-altitude flights require obtaining flight permits from relevant countries. The current cross-border flight permit approval procedures are complex and time-consuming, making it difficult to meet the timeliness requirements of cross-border logistics. In respect to data circulation aspects, cross-border low-altitude logistics accumulates abundant location, flight and transaction data. The transboundary transfer of the aforementioned data must be governed by sound

institutional provisions. For security supervision purposes, the regulatory governance of cross-border low-altitude logistics demands joint efforts from multiple nations [18]. Establishing a cross-border security information sharing mechanism, a joint emergency response mechanism, and an accident investigation cooperation mechanism are the institutional foundations for ensuring the safe operation of cross-border low-altitude logistics.

3.4 Governance Innovation

Based on institutional collaboration, governance innovation constitutes a key driving factor for sustaining low-altitude economic cooperation development alongside ASEAN. The traditional government-led governance model fails to adapt to the development requirements of new cross-border low-altitude economy forms, a multi-subject participatory concept of joint construction and co-governance should be incorporated [19]. First, the regulatory sandbox is an important tool for governance innovation. The regulatory sandbox allows enterprises to test innovative products and services within a specific range, exploring new business models under controllable risks. Second, standard mutual recognition is an important part of governance collaboration. Cross-border cooperation in low-altitude economy requires unified technical standards, operational standards and service standards. Third, benefit sharing is the fundamental driving force for governance cooperation. The low-altitude economic cooperation with ASEAN involves the interests of multiple countries, and a fair and reasonable benefit distribution mechanism needs to be established. Fourth, talent cultivation is the long-term support for governance capabilities. The growth of low-altitude economy requires a large number of professional technical talents and multi-skilled management talents.

4. The Current Situation and Challenges of Cross-border Logistics Channel Construction

4.1 Current Situation

The layout of cross-border logistics channels towards ASEAN has made significant progress, and a three-dimensional logistics channel network system covering land, sea and air has been initially formed. In terms of the land channels, the logistics channel networks between Guangxi and Yunnan provinces and the ASEAN

countries have been continuously improved. Recent years have witnessed growing infrastructure connectivity under the Belt and Road Initiative, which has boosted the capacity of China-ASEAN land logistics corridors [20]. In terms of the maritime channels, the Beibu Gulf Port, as an important outbound channel of the Western Land-Sea New Channel, has increasingly close maritime logistics connections with the ASEAN countries. At the same time, the construction of the Pinglu Canal is being accelerated. In terms of the air channels, Nanning Wuguigang International Airport has opened multiple cargo air routes facing the ASEAN countries, and cross-border air logistics has developed rapidly [21]. At the same time, Guangxi is actively striving to layout and build international communication business entry and exit hubs and national Internet backbone direct connection points to shorten the cross-network delay with the ASEAN countries and reduce data transmission costs. From the perspective of logistics forms, cross-border logistics towards ASEAN has formed a diversified development pattern. Traditional general trade logistics, border trade logistics, and border residents' mutual market trade logistics maintain stable growth, while new forms of logistics such as cross-border e-commerce logistics, cold chain logistics, and bonded logistics have developed rapidly [22].

4.2 Main Challenges

Although considerable headway has been achieved in developing cross-border logistics corridors oriented toward ASEAN, numerous challenges still exist in the new development context, which have hindered the further improvement of cross-border logistics efficiency. Firstly, geographical constraints remain prominent, as the regions traversed by cross-border logistics channels in the direction of ASEAN have complex terrain [23]. Secondly, the "last mile" infrastructure bottleneck is evident. Although the main channels of cross-border logistics have been continuously strengthened, the "last mile" distribution from the main channels to the end users still faces many bottlenecks. In border areas, the poor condition of rural roads and insufficient coverage of the distribution network lead to low distribution efficiency and high costs [24]. In port areas, the connection of customs clearance, inspection, and release procedures for imported

and exported goods is not smooth, affecting the overall customs clearance efficiency. In island and remote areas, logistics distribution is almost non-existent, which makes it challenging to fulfill the basic requirements of local residents. Thirdly, the contradiction between timeliness and cost control is prominent. Multiple procedural links as well as national regulatory regimes are involved in cross-border logistics activities, resulting in a prominent contradiction between timeliness and cost control [25]. Fourthly, the extent of digital and intelligent transformation needs to be improved. The information facilities of some ports are outdated, and the data sharing mechanism is not sound, leading to the existence of "information islands". There is a large gap in digital operational capacities among logistics firms, with SMEs struggling to cope with the hefty financial outlays for digital transition [26]. The data standards and interface specifications for cross-border logistics are not unified, affecting the interconnection of information systems. Fifthly, the cross-border regulatory coordination mechanism is not yet perfect. In terms of information sharing, there is lag and incompleteness in data exchange among regulatory authorities of various countries [27]. In terms of law enforcement collaboration, the handling procedures for cross-border logistics disputes are complex and time-consuming. In terms of standard unification, there are differences in commodity classification, inspection and quarantine standards, and certification and recognition requirements among countries, increasing compliance costs.

5. Suggestions

Firstly, improve the top-level design and strategic planning. During the implementation process of the plan, fully attach importance to the important direction of cross-border cooperation with ASEAN, and incorporate low-altitude economic cooperation into the important contents of the China-ASEAN Comprehensive Strategic Partnership Action Plan. Strategic planning should be leveraged to boost low-altitude economic cooperation, so as to achieve synergy with key strategies such as the Belt and Road Initiative, Western Land-Sea New Passage and China-ASEAN Information Port development. The plan should fully consider the geographical advantages and industrial foundation of border provinces such as Guangxi

and Yunnan, and support the qualified regions to take the lead in conducting pilot demonstrations of cross-border low-altitude logistics. Establish a cross-departmental coordination mechanism to promote cross-border low-altitude economic cooperation, which involves multiple departments such as aviation, communication, customs, quarantine, and security inspection, and establish an effective cross-departmental coordination mechanism.

Secondly, accelerate infrastructure construction and network layout. Plans are underway for the development of multiple low-altitude take-off and landing sites in border areas, port regions and islands in Guangxi and Yunnan and other border provinces, facing cross-border logistics. Lay stress on building low-altitude take-off and landing points at border ports, forming a take-off and landing facility network covering the main border trade routes. Improve the low-altitude communication and navigation network, accelerate the coverage of 5G-A networks in border areas and coastal regions, and provide reliable communication guarantees for cross-border low-altitude logistics. Plan the cross-border low-altitude route network, based on the existing land, sea and air channels, to construct a cross-border low-altitude route network facing ASEAN.

Thirdly, promote institutional innovation and standard alignment. Deepen airspace management reform and, through consultation with Vietnam, Laos, Myanmar, etc., explore the establishment of a cross-border low-altitude airspace sharing mechanism and set up cross-border low-altitude shared airspace in specific areas. Simplify the approval procedures for cross-border flights, establish a rapid approval channel for cross-border low-altitude logistics, simplify the application materials for flight licenses, and shorten the approval time. Promote mutual recognition and cooperation of standards, proactively engage in the standard-setting procedures for low-altitude economy across ASEAN member states, and promote China's technical standards to go international. Through signing standard mutual recognition agreements, reduce duplicate certification costs and lower market entry barriers.

Fourthly, innovate regulatory models and pilot demonstrations. Set up a cross-border low-altitude economic cooperation demonstration zone facing ASEAN in the border areas between China and Vietnam. Conduct pilot trials on a

small scale to explore the regulatory model and development path for cross-border low-altitude logistics. Explore the establishment of a cross-border low-altitude logistics joint regulatory mechanism with ASEAN countries, including information sharing, joint law enforcement, and emergency response. Establish a risk identification, assessment, and prevention mechanism for cross-border low-altitude logistics. At the same time, push forward the building of mandatory insurance mechanisms for low-altitude logistics operations.

Fifthly, promote industrial synergy and market cultivation. Support low-altitude logistics enterprises to increase investment in cross-border business facing ASEAN, and cultivate a cohort of enterprises with robust global competitive capabilities. Encourage the participation of SMEs in the cross-border low-altitude logistics supply chain, leveraging their flexibility and innovation advantages. Efforts should be made to boost industrial-chain coordination and nurture an integrated industrial ecosystem encompassing UAV research-manufacturing, operational services, maintenance support, and talent training and education. Support border provinces such as Guangxi and Yunnan to leverage their geographical advantages and develop low-altitude logistics equipment manufacturing and operation service industries. Relying on platforms such as the China-ASEAN Digital Institute, carry out low-altitude economic talent training projects for ASEAN. Support universities to establish low-altitude economy-related majors, encourage enterprises to conduct unmanned aircraft pilot training, and strengthen talent exchanges with ASEAN countries.

6. Conclusion

This paper focuses on the low-altitude economy, and deeply discusses its cooperation mechanism towards ASEAN and the construction of cross-border logistics channels. The National Development and Reform Commission has set up the Low-Altitude Economy Development Department, which marks the elevation of the low-altitude economy to national strategic status. Its connotation has shifted from traditional general aviation to a comprehensive economic form covering unmanned aircraft, eVTOL, and various application scenarios. The article points out that the intrinsic mechanism by which the low-altitude economy empowers cross-border

logistics lies in the four-dimensional coupling of scenario demands, technical support, institutional collaboration, and governance innovation. Scenarios such as border trade with ASEAN, island distribution, and the "last mile" of cross-border e-commerce, relying on 5G-A, BeiDou navigation, and intelligent control technologies, have the practical foundation to break through geographical limitations. However, the current construction of cross-border logistics channels still faces severe challenges such as complex geographical conditions, infrastructure "last mile" bottlenecks, insufficient digitalization levels, and incomplete cross-border regulatory coordination mechanisms. To address these issues, this article proposes five countermeasures and suggestions: First, improve the top-level design and incorporate the low-altitude economy into the China-ASEAN strategic action plan; second, accelerate the layout of border take-off and landing facilities and communication navigation networks; third, deepen airspace management reform, promote standard mutual recognition and approval simplification; fourth, establish cross-border cooperation demonstration zones and innovate joint supervision models; fifth, cultivate leading enterprises and professional talents.

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