



Quantitative Analysis of China's Low-Altitude Economic Policy Based on LDA Topic Model

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Abstract. The low-altitude economy has emerged as a sector of strategic importance for industrial upgrading and innovative applications, with its policy framework playing a decisive role in ensuring orderly and sustainable development. This paper analyzes 40 national and provincial policy documents issued between 2003 and 2025, applying the Latent Dirichlet Allocation (LDA) topic model to extract latent thematic structures. Five core policy topics are identified: industrial system and application expansion, flight operations and regulatory governance, general aviation services and infrastructure, transportation logistics and hub connectivity, and unmanned aerial vehicle (UAV) standard management. Results show that industrial development and application promotion dominate policy attention (70%), while safety governance and institutional frameworks remain underdeveloped. Thematic coordination across domains is insufficient. The study concludes that LDA provides an effective framework for identifying structural features and gaps in low-altitude economy policies, and recommends strengthening interdepartmental coordination, diversifying policy instruments, and accelerating legislative institutionalization. These findings offer empirical evidence for refining future policy design and advancing the high-quality development of China's low-altitude economy.

Keywords: Low-altitude economy, Policy quantitative analysis, LDA topic model, Policy coordination.

1 Introduction

The low-altitude economy is an emerging economic form that relies on low-altitude airspace, utilizing drones and electric vertical take-off and landing (eVTOL) aircraft to support diverse applications including logistics, emergency rescue, and cultural tourism. Recognized as a representative example of new productivity, it was formally designated a strategic emerging industry at China's Central Economic Work Conference in December 2023, and first listed as a growth engine in the Government Work Report in March 2024. By 2025, 29 provinces had incorporated low-altitude economy targets into local government work reports, forming a coordinated central–local policy framework.

Despite rapid policy expansion, existing research has predominantly relied on qualitative interpretations and case studies [1–3]. Systematic quantitative analyses of poli-

cy evolution and tool distribution remain scarce. Recent advances in text mining have demonstrated the potential of LDA-based topic modeling for policy analysis [4–6], yet no study has applied such methods to the low-altitude economy domain at scale. To address this gap, this paper makes the following contributions: (1) constructing a large-scale corpus of 40 national and provincial low-altitude economy policy texts (2003–2025)[4–8]; (2) applying LDA topic modeling to systematically characterize thematic structures and policy priorities[9,10]; and (3) providing empirically grounded recommendations for optimizing the coordination, tool diversity, and legislative completeness of China's low-altitude economic policy system [17–19].

2 Data and Methodology

2.1 Data Collection

Policy documents were collected from the National Policy Document Database, the Peking University Law Database, and official websites of the Civil Aviation Administration of China (CAAC) and the Ministry of Industry and Information Technology (MIIT). Using core search terms—"low-altitude economy," "general aviation," "low-altitude airspace management," "low-altitude flight," and "unmanned aerial vehicle (UAV)"—and restricting the issuance period to May 2003–May 2025, an initial set of 52 documents was retrieved. After screening to remove general notices and irrelevant materials, the final dataset comprised 40 policy documents: 12 at the national level and 28 at the provincial level.

2.2 LDA Topic Modeling

This study employs the Latent Dirichlet Allocation (LDA) model [13–16], a generative probabilistic framework that represents a corpus as a mixture of latent topics, each characterized by a probability distribution over vocabulary terms. LDA is particularly suited to structured policy texts with standardized language and high readability.

Text preprocessing was performed in Python: documents were cleaned of non-Chinese characters, low-relevance stopwords were removed, and high-frequency policy terms were retained to maximize co-occurrence signals. The optimal number of topics was determined by jointly evaluating perplexity and coherence scores across candidate values. Perplexity decreased monotonically with topic count but plateaued beyond a threshold; coherence scores peaked before leveling off. Setting $k = 5$ topics achieved the highest coherence while maintaining low perplexity, providing both discriminatory power and interpretability. LDA modeling was implemented using the Gensim toolkit in Python. After training, topic–word distributions and document–topic probabilities were extracted. Results were visualized using pyLDAvis, and topics were manually annotated based on keyword semantics and policy context[11, 12].

2.3 Selecting the Number of Topics

The number of topics critically affects the explanatory power and validity of the model. If the number of topics is too large, the model will be over-segmented, resulting in insufficient representation of individual topics and potentially overfitting, weakening the explanatory validity of the results. If the number of topics is too small, different concepts will be merged, resulting in overly broad topics, which will reduce the model's discriminatory power and accuracy. To address this issue, this study used a combination of perplexity and consistency metrics for evaluation. This study calculated perplexity and consistency for different numbers of topics. The results showed that perplexity gradually decreased with increasing the number of topics, but the rate of decline slowed after reaching a certain threshold, indicating that further increasing the number of topics had limited impact on model fit. Furthermore, the coherence score increased rapidly with a small number of topics before leveling off. Combining these two metrics, a setting of $k = 5$ topics achieved the highest coherence while maintaining low perplexity, combining good discriminatory power and explanatory power. Therefore, 5 topics was ultimately determined to be the optimal setting.

3 Results

3.1 Identification of Low-Altitude Economic Policy Topics

This study identified $k = 5$ topics and analyzed them using the LDA model to derive the corresponding "topic-term" distribution. Each circle represents one topic, where the distance between circle centers indicates the similarity among topics, and the circle size reflects the relative importance of each topic within the corpus. Overall, the topics appear relatively independent with minimal overlap, demonstrating that the model provides strong discriminatory and explanatory power. Further illustrates the detailed distribution of terms across topics.

Looking at the thematic distribution (see Table 1), Theme 4 accounts for the largest proportion (70%), with high-frequency terms such as "low-altitude," "economy," "enterprise," "industry," "application," "drone," and "innovation." This indicates that the policy texts primarily emphasize the development of the low-altitude economic industrial system and innovative applications. Theme 5 (12.5%) contains keywords such as "flight," "airport," "airspace," "aircraft," "management," and "operation," highlighting the institutional arrangements for flight activities and operational management. Theme 3 (10%) is characterized by terms such as "aviation," "general," "low-altitude," "airspace," "airport," and "general aviation services," reflecting the important role of general aviation and infrastructure development in supporting the low-altitude economy. Theme 1 (5%) includes terms such as "construction," "transportation," "logistics," "facilities," and "hubs," underscoring the integration of the low-altitude economy with the broader transportation system and logistics services. Finally, Theme 2 (2.5%) is defined by terms such as "aircraft," "unmanned," "operation," "control," "certification," and "grade," pointing to the policy focus on regulatory frameworks and technical standards for unmanned aerial vehicles.

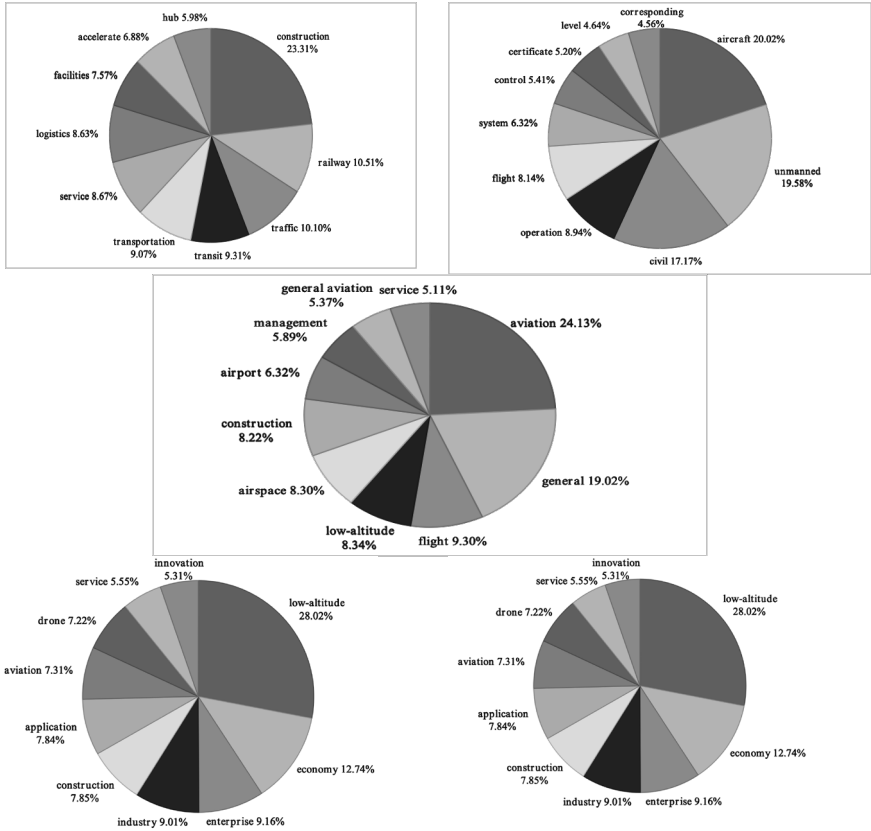


Fig. 1. Detailed distribution of keywords across topic

The LDA model identified five thematically coherent topics, summarized in Table 1. The pyLDavis visualization (Figs.1) confirms that topic clusters are well-separated with minimal overlap, demonstrating strong discriminatory power.

Table 1. Topic-Word List

Topic ID	Proportion	Topic Words
1	5%	construction, railway, traffic, transit, transportation, service, logistics, facilities, accelerate, hub
2	2.5%	aircraft, unmanned, civil, operation, flight, system, control, certificate, level, corresponding
3	10%	aviation, general, flight, low-altitude, airspace, construction, airport, management, general aviation, service
4	70%	low-altitude, economy, enterprise, industry, construction, application, aviation, drone, service, innovation
5	12.5%	flight, airport, airspace, aircraft, general, activity, management, operation, in accordance with, aviation

Overall, the five themes can be summarized into the following categories: “Industrial System and Application Expansion,” “Flight Operations and Regulatory Governance,” “General Aviation Services and Infrastructure Development,” “Transportation Logistics and Hub Connection,” and “Regulated Management of Unmanned Aerial Vehicles.” Collectively, these findings indicate that low-altitude economy policies place primary emphasis on industrial development and innovative applications, while also incorporating infrastructure, operational management, and regulatory oversight. Together, they form a multidimensional and coordinated policy framework that supports the sustainable development of the low-altitude economy.

4 Conclusion

The distribution of policy themes is highly concentrated, with a clear orientation toward industry and application. The LDA results indicate that low-altitude economic policies are mainly clustered around five themes, among which “industrial system and application expansion” accounts for as much as 70%, emerging as the core theme of the policy texts. Representative keywords include “low altitude,” “economy,” “enterprise,” “industry,” “application,” and “drone,” highlighting the country’s strategic emphasis on industry cultivation, application implementation, and enterprise innovation. The remaining themes involve flight operations and regulatory governance (12.5%), general aviation services and infrastructure development (10%), transportation logistics and hub connectivity (5%), and unmanned aerial vehicle standard management (2.5%). This distribution reflects that, while policies cover aspects such as operational governance, infrastructure, logistics, and unmanned systems, their level of attention remains significantly lower compared to industrial development. Overall, while the policies strongly promote industrial development, greater balance across different thematic areas is still required.

Industrial development and application promotion have become the primary driving forces, whereas safety and regulatory measures remain relatively underdeveloped. Most policy documents emphasize advancing the industrialization of the low-altitude economy, expanding scenario-based applications, and fostering demonstration zone construction. The functional orientation of these policies leans more toward facilitating market formation and application expansion. However, the proportion of policies addressing flight operation rules, airspace management, airworthiness certification, and safety supervision is relatively limited. This suggests that system-building efforts are still in their early stages, with governance structures and safety mechanisms insufficiently detailed. Without systematic operational rules and robust safety foundations, the rapid expansion of the industry may face challenges such as regulatory lag and the accumulation of risks.

The synergy among policy themes requires further strengthening. Although the policies encompass multiple dimensions—including industry, operations, infrastructure, logistics, and unmanned systems—the interconnections between themes remain inadequate. For instance, the degree of coupling between industrial applications and logistics hub development is relatively low, hindering the formation of a comprehen-

sive closed-loop system that integrates air and ground transportation as well as multimodal logistics. In addition, the limited proportion of policies dedicated to standardized management of unmanned aerial vehicles constrains the ability to meet the institutional requirements of large-scale commercial applications. This lack of thematic synergy restricts the maximization of overall policy effectiveness in the low-altitude economy.

The overall effectiveness of the policies has begun to emerge, but their degree of systematization and institutionalization remains insufficient. At this stage, low-altitude economic policies are predominantly planning-oriented and guiding in nature, emphasizing strategic direction and industrial promotion. Significant progress has been made in advancing demonstration zones, fostering industrial clusters, and cultivating markets. Nevertheless, from the perspective of policy effectiveness, gaps remain in terms of legislation, regulatory instruments, and binding institutional frameworks. A comprehensive system of operational norms and standards has yet to be established, leaving the authority and enforceability of these policies relatively weak. Moving forward, stronger top-level institutional design and regulatory development will be essential to enhance the systematic and institutionalized character of low-altitude economic policies.

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