61ST CONFERENCE OF DIRECTORS GENERAL OF CIVIL AVIATION ASIA AND PACIFIC REGION

Kuala Lumpur, Malaysia
7 – 11 September 2026

AGENDA ITEM 3: AVIATION SAFETY

APPLICATION OF ARTIFICIAL INTELLIGENCE (AI) IN CONTACT STAND ALLOCATION TO IMPROVE AIRPORT PASSENGER BOARDING BRIDGE (PBB) USAGE RATE

(Presented by the People's Republic of China)

SUMMARY

In June 2023, CAAC launched a special initiative to improve passenger boarding bridge usage rate, encouraging major international airports to adopt AI technologies to develop intelligent stand allocation systems as a replacement for traditional stand allocation models. This paper introduces the fundamental concept, data sources of China's civil aviation intelligent stand allocation systems and improvements in PBB usage rates brought by the systems. It further recommends that all States consider the safe, accountable, and responsible adoption of intelligent agents for airport ground support resource allocation as a starting point for the implementation of AI technologies within the aviation ecosystem.

APPLICATION OF ARTIFICIAL INTELLIGENCE IN CONTACT STAND ALLOCATION TO IMPROVE AIRPORT PASSENGER BOARDING BRIDGE (PBB) USAGE RATE

1. INTRODUCTION

1.1 Action Item 60/21 from the 60th Conference of Directors General of Civil Aviation (GDCA), Asia and Pacific Region: the Conference noted the potential of artificial intelligence (AI) to enhance aviation efficiency and performance, the Conference encouraged States/Administrations to consider sharing best practices and experiences to support regional innovation.

1.2 Since 2023, the Civil Aviation Administration of China (CAAC) has been promoting AI technologies in airport operations, resulting in six mature applications: the Surface Operations Agent (SURF), the Apron Safety Monitoring Agent (VA), the Resource Management and Allocation Agent (RM), the Departure Clearance and Pushback Sequencing Agent, the Duty Management Agent, and Large-scale Delay Management Agent.

1.3 In accordance with the CAAC work plan, since March 2026, three major international airports—Zhengzhou Xinzheng, Xiamen Xiang'an, and Shanghai Pudong—have successively launched their total airport management (TAM) programmes. These airports leverage AI technologies to support operations, including departure clearance and pushback sequencing, real-time allocation of ground handling resources, and surface operations management.

2. DISCUSSION

2.1 To address the long-standing issue of low passenger boarding bridge (PBB) usage rates at major international airports, CAAC launched a special initiative in June 2023 to improve PBB usage rate. This initiative involved 41 major international airports, which were also the top 41 airports in terms of passenger throughput. The main measures adopted in this initiative included promoting domestic-international swing gates, improving aircraft towing efficiency, enhancing intelligent level of stand allocation systems, and optimizing PBB maintenance operations.

2.2 Statistical data indicates that PBB usage rates at these 41 international airports increased from 82.51% in 2023 to 83.81% in 2024, 85.8% in 2025, and reached 87.4% as of May 2026. The initiative to improve PBB usage rates has yielded positive outcomes.

2.3 Experience gained over the three years since the implementation of the initiative shows that the core lies in the intelligent transformation of stand allocation systems. The operational tasks such as increasing the stand turnover rate, determining the timing for aircraft towing to the contact stands, and the conversion timing for domestic-international swing gates are all highly dependent on the stand allocation system.

2.4 Traditional stand allocation systems utilize flight schedules for pre-allocation. In actual operations, the airport operational control center (AOCC) obtains information from air traffic control (ATC) units, such as estimated time of arrival (ETA) of inbound flights, air traffic flow management (ATFM) measures, and flight pushback sequencing to manually adjust stand allocation schemes. However, with the gradual increase in flight volume, this approach has become difficult to accommodate flight operations at major international airports.

2.5 At the beginning of the initiative, CAAC encouraged major international airports to utilize AI technologies to develop intelligent stand allocation systems, with a view to replacing traditional models.

2.6 The fundamental concept of the intelligent stand allocation system is to aggregate data including flight schedules, filed flight plans (FPLs), real-time aircraft positions, ATFM measures, and stand availability. By leveraging general large language models (LLMs), and taking into account the stand usage rules and runway-taxiway geometries, an intelligent stand allocation algorithm model tailored to the specific airport is trained and optimized.

2.7 The intelligent algorithm model for stand allocation is, in essence, a multi-objective dynamic combinatorial optimization with complex constraints. Flight schedules is used for pre-allocation, while the stand allocation scheme is dynamically adjusted during actual operations based on information such as FPLs and real-time aircraft positions. Its core objective is to maximize PBB usage rate, stand turnover rate, and passenger satisfaction, while minimizing taxiing distance, flight delays, and taxiing conflicts, all under the premise of satisfying hard requirements such as safety, aircraft type compatibility, and PBB usage rules.

2.8 Regarding the data sources for the intelligent algorithm model for stand allocation, flight schedules are provided by airlines; ATFM measures, FPLs, and real-time aircraft positions are provided by ATC units; and stand availability, stand usage rules, and runway-taxiway geometries are managed internally by the airport operators. These are all commonly used data in civil aviation operations and are acquired by airport operators through data sharing. It should be noted that, once airport operators obtain real-time aircraft positions, they can continuously predict the ETA of flights, which serves as a core parameter for the dynamic stand pre-allocation in the algorithm model.

2.9 Following the three years of application and development, China's civil aviation has established a range of mature industrial-grade intelligent algorithm models for stand allocation, including the "Mixed Integer Programming + Rule Engine" model at Guangzhou Baiyun Airport, the "Adaptive Rule Framework + Heuristics" model at Shenzhen Bao'an Airport, and the "Deep Reinforcement Learning (DRL) + Graph Neural Networks (GNN)" models at Beijing Capital and Shanghai Pudong Airports. These industrial-grade models have played a vital role in improving the stability of PBB usage rates and increasing stand turnover rates at large hub airports. For instance, Shenzhen Bao'an Airport recorded PBB usage rate of 83.92% in 2024 and 85.46% in 2025, reaching 86.98% as of May 2026; Shanghai Pudong Airport recorded PPB usage rate of 91.71% in 2024 and 91.56% in 2025, reaching 92.12% as of May 2026.

2.10 It is widely recognized that intelligent algorithm models require substantial volumes of data for training and iteration. From the perspective of data acquisition, compared to other AI agents widely used in China's civil aviation industry, the data required for intelligent algorithm models for stand allocation are the easiest to acquire, because it relies on the mature data that has been extensively generated within civil aviation for many years, without the need to install new data collection equipment for new types of data. Therefore, it is recommended that States in the Asia-Pacific region adopt AI agents for airport ground resource allocation as an entry point for applying AI technology.

3. ACTION BY THE CONFERENCE

3.1 The Conference is invited to:

a) note China's experience in applying AI agents to airport stand allocation and resource management to enhance operational efficiency and passenger service outcomes;

b) encourage States to explore, as appropriate, the safe, secure, accountable and human-centric application of AI technologies in airport operations, taking into account local operational requirements and readiness;

c) promote the sharing of lessons learned, best practices and implementation experiences relating to the use of AI in civil aviation; and

d) invite ICAO to establish a global framework to govern the safe, secure, and accountable integration of artificial intelligence technologies across the aviation ecosystem.

— END —