60th CONFERENCE OF DIRECTORS GENERAL OF CIVIL AVIATION ASIA AND PACIFIC REGIONS

Sendai, Japan
28 July - 1 August 2025

AGENDA ITEM 4: AIR NAVIGATION

FROM DIGITALIZATION TO INTELLIGENCE - PRACTICE AND CONCEPT OF A-CDM TO TAM TRANSFORMATION IN CHINA

(Presented by the People's Republic of China)

SUMMARY

From 2015 to 2024, 41 large international airports in China implemented A-CDM operations, and A-CDM has become an important technological means for Chinese airports to achieve digitalization. With the continuous increase in flight and passenger volume, China's large international airports are facing increasingly complex security and operational challenges. They have begun to utilize massive real-time data and AI Agent technology to upgrade A-CDM to TAM, providing safety, efficiency, and environmental protection services to stakeholders.

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1. INTRODUCTION

1.1 Airport Collaborative Decision Making (A-CDM) has helped airports achieve digital infrastructure, while Total Airport Management (TAM) will rely on the digital foundation of A-CDM and the development of AI Agent technology to achieve intelligent upgrades of airports.

1.2 With the increase of flight and passenger, airport operations are becoming more complex, and the challenges of safety and efficiency are becoming more concentrated at airports. Airports that have already achieved digital by A-CDM will play a more important role in addressing safety and efficiency in the future based on intelligent TAM.

1.3 The AN Conf/13 proposed that TAM is the advanced technical stage of A-CDM, which will ultimately serve trajectory-based operations (TBO).

2. DISCUSSION

2.1 From 2015 to 2024, 41 large international airports in China have successively implemented A-CDM operations.

2.2 A-CDM is an important technological means for Chinese airports to achieve digitalization. The practice of Chinese airports has proven that the milestones in the flight lifecycle range from 16 proposed in DOC9971 to 45 proposed by the Civil Aviation Administration of China(CAAC). Through the Digital Capability Indicator (DCI) rules, unified definitions are achieved and data quality is standardized to ensure accuracy and timeliness. These data have been fully automated in China, and A-CDM has become an important digital infrastructure for Chinese airports.

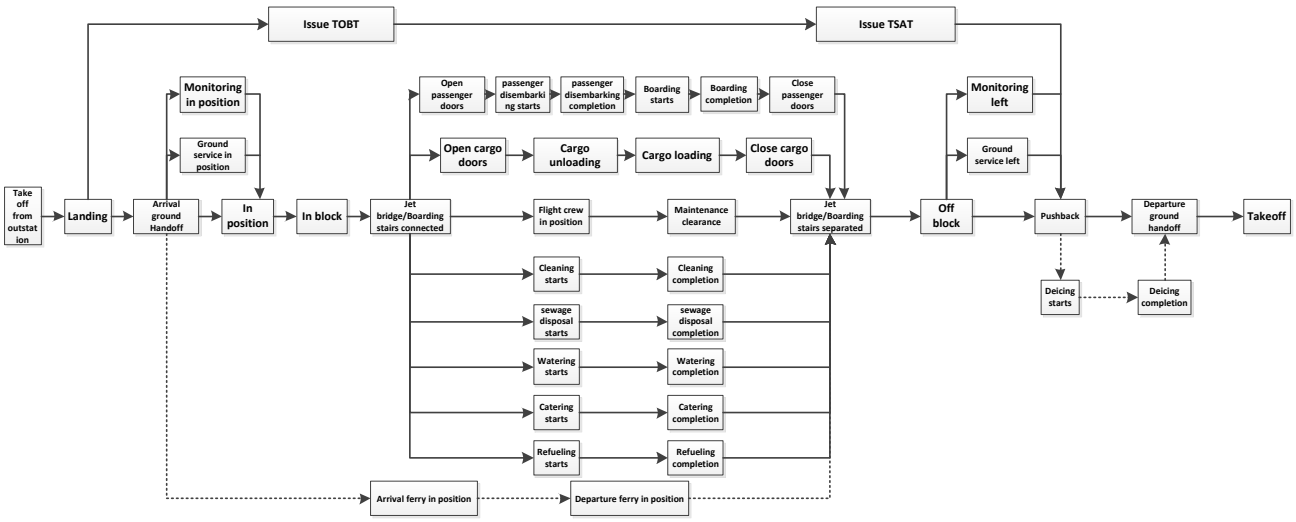

Figure 1: Milestones of A-CDM in China

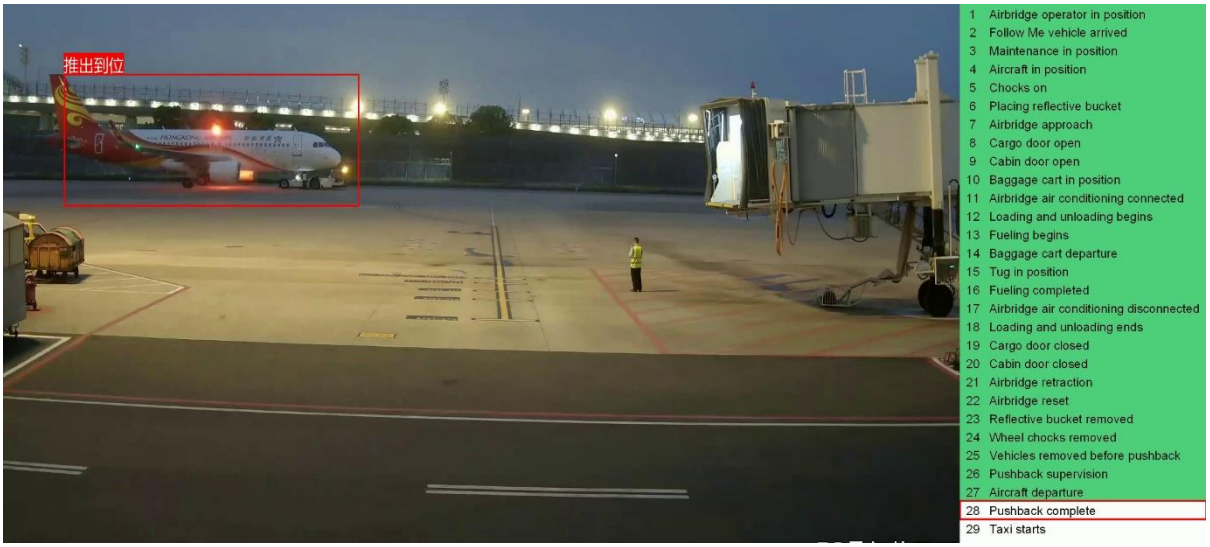

Figure 2: Automatic collection of milestone time based on video analysis

2.3 The operational problems are solved by A-CDM digitization. By utilizing A-CDM milestone data and combining it with processes, airports can establish logical relationships for their processes, quickly identifying the links that cause flight delays. This can provide ATFM with TOBT and TAST, improving the accuracy of CTOT. At the same time, it can achieve peak shaving and valley filling of departure slot, automatic analysis of delay causes, and provide predeparture sequence for DMAN, enhancing capacity flow matching, reducing staff workload, and minimizing flight delay time and passenger waiting times. In 2021, CAAC selected six large international airports, including Guangzhou Baiyun, Kunming Changshui, and Hangzhou Xiaoshan, to collect A-CDM construction costs and operational data. A comparative analysis was conducted on the economic benefits of these airports before and after A-CDM investment, including 11 economic indicators such as passenger delay losses and ground taxi expenses, which were summarized to form indirect benefits. After excluding construction costs, the six airports obtained a total of RMB 141 million in overall revenue in 2019.

2.4 A-CDM enhances the position of airport operators in collaborative operations. The airport operator continuously provides operational data through A-CDM to address the actual needs of airlines, ANSP, and other stakeholders. In the future, in the process of intelligence, airport operators will rely on data to continuously provide stronger digital service capabilities for stakeholders and play a more important role.

2.5 New challenges in operational efficiency. With the continuous increase in flight and passenger, the complexity of airport operations continues to increase. In 2024, Chinese airports have 12.4 million takeoffs and landings, a year-on-year increase of 5.9%, and a passenger throughput of 1.46 billion, a year-on-year increase of 15.9%. Both indicators reached a historical high and exceeded the level in 2019. In addition, the flight on-time rate of domestic passenger flights in China in 2024 was 87.1%, a year-on-year decrease of 0.7 percentage points.

2.6 New challenges in collaborative operation. According to the actual flight statistics in 2024, as many as 82% of the top 100 airports in the world have base airlines accounting for less than 60%. This means that for the vast majority of the top 100 airports, the collaborative operation of stakeholders requires airport operators to provide more comprehensive digital capabilities and data-driven intelligent capabilities.

2.7 AI is gradually maturing. Complex systems are suitable for AI solutions, and airport operations are suitable for AI Agent technologies that focus on solving professional application challenges. Artificial Intelligence Large Language Model (AI LLM) technologies represented by ChatGPT, Gemini, DeepSeek, etc. provide AI Agents with a basic engine, combined with high-quality data brought by digitization to further enhance their decision-making efficiency.

2.8 TAM is an extension and upgradation of A-CDM. From the overall perspective of airport performance management, it integrates the operations of the airfield area, terminal, and ground transportation center, integrates data such as flight, passenger, and baggage, and incorporates stakeholders into a coherent collaborative decision-making process to achieve intelligent and integrated management of the air and land sides, improve the airport's operational efficiency, predictability, and other operational qualities. It relies on the APOC and AOP to achieve operational management.

2.9 In 2025, CAAC will launch a 5-year development plan for TAM. In April 2025, CAAC established a TAM ad-hoc group and released the technical guidelines for TAM in July of this year. CAAC plans to select three large international airports in 2026 to carry out TAM trial implementation, with an expected trial period of over 18 months. By 2028, using these three trial airports as benchmarks, gradually promote TAM at other large international airports. By 2029, a relatively complete technical standard and operational mode for airport management will be established.

2.10 TAM's technical practice in China is based on AI agents, with A-CDM providing data for AI agents. Data trading and exchange are achieved through DataSpace technology upgraded based on SWIM, i.e. TAM=Agents+DataSpace+Digitalization. The core functions of AI agents are perception, decision-making, execution, and feedback.

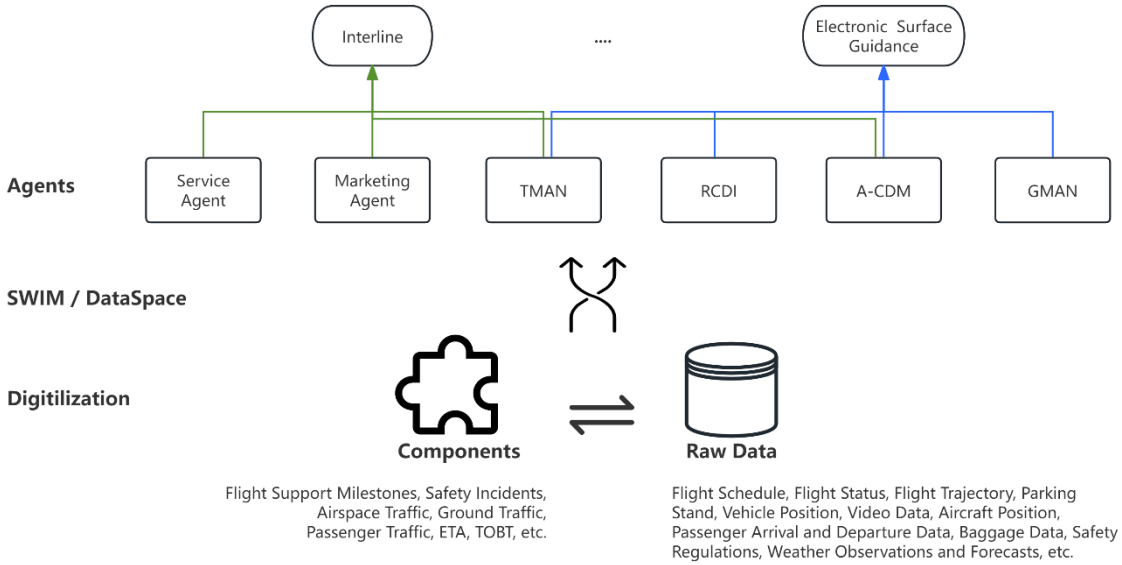

Figure 3: TAM Technology Framework

2.11 In January 2025, Shanghai Pudong Airport launched TAM development, which has now achieved safety event identification VA Agent, resource allocation RM Agent, and surface management SURF Agent.

2.12 Safety event identification VA Agent. In the manuals of Chinese airlines, there are over 200 requirements for flight safety inspections, but in actual operation, there is no technical support, and all rely on manual labor. Now, through VA Agent, 12 types of safety events can be automatically identified, such as vehicle illegal parking, vehicle cut in, not wearing reflective vests, etc., and shared with airlines through data transactions.

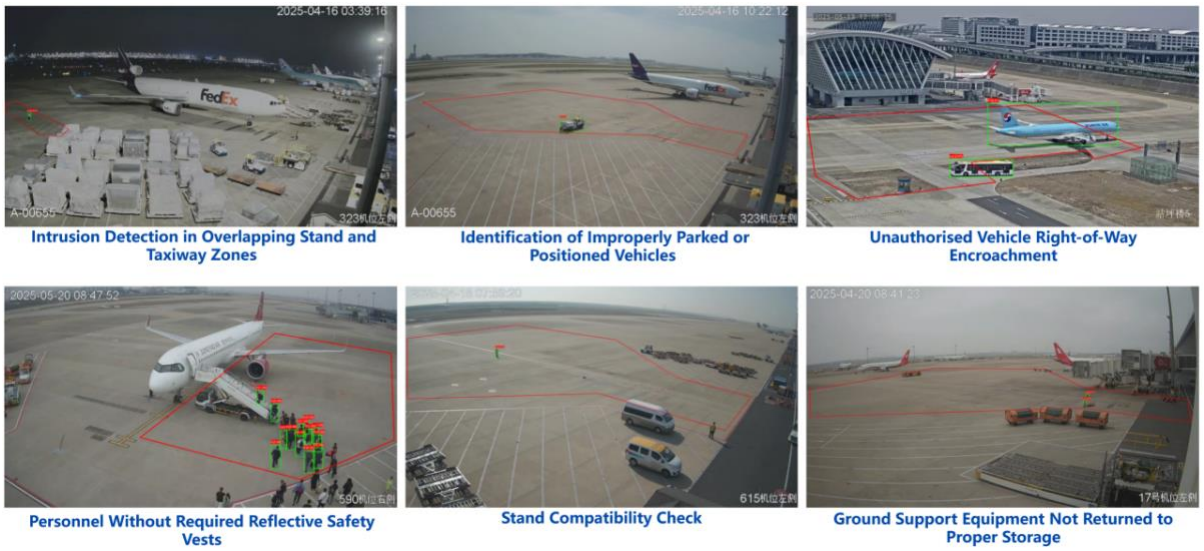

Figure 4: Apron Safety Event Recognition Using VA Agent based on Video Analysis

2.13 Resource Allocation RM Agent. The traditional allocation of parking stands mainly considers factors such as aircraft type and arrival/departure time. With the increasing complexity of airport operations, factors such as taxi time, passenger numbers, and airport business need to be added. At the same time, indicators such as bridge leaning rate and duration of bridge occupation need to be taken into account. RM Agent can quickly integrate complex data to provide staff with a resource allocation plan。

Figure 5: Resource Allocation RM Agent for Stand Allocation

2.14 Surface management SURF agent. By using aircraft and vehicles trajectory planning and monitoring actual trajectories through digital means, the risk of runway intrusion and scratching can be detected and reduced in advance. Provide digital taxi path navigation to achieve low-cost A-SMGCS capabilities. Recommend a short-distance taxiing plan to shorten the time by quickly analyzing the push back status and departure sequence at each parking position. Using digital systems to achieve collaboration with autonomous vehicles, it has the ability to provide task dispatch, trajectory planning, and safety guidance for autonomous vehicles, providing a technical foundation for their wider application.

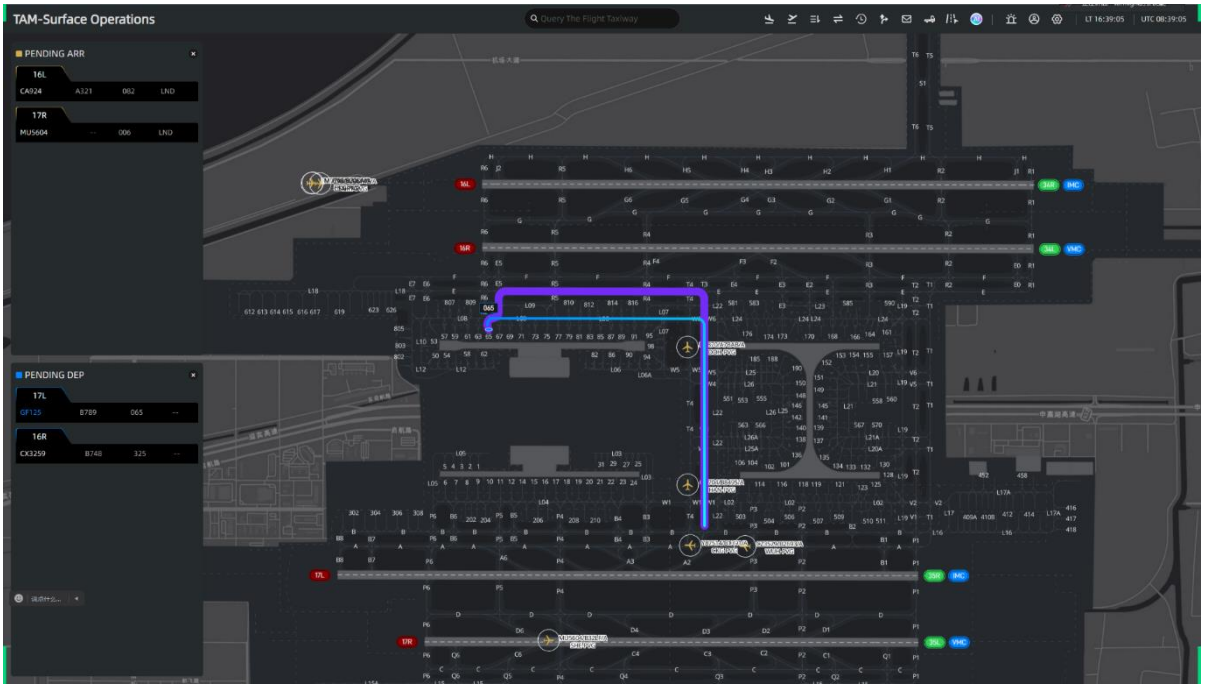

Figure 6: Surface Management SURF Agent

2.15 TAM's professional knowledge challenges. The development of TAM's AI agent requires intelligent training from global experts to achieve high-level capabilities, and an effective mechanism for expert communication and exchange needs to be established.

2.16 TAM will prepare for TBO. The precise departure capability at the minute or even second level will provide a technical foundation for the precise operation of TBO, ultimately achieving the ACDM-B3 task in ASBU.

3. ACTION BY THE CONFERENCE

3.1 The Conference is invited to:

a) Suggest ICAO Asia Pacific Regional Office to develop feasible plans to promote the implementation of TAM at airports in the Asia Pacific region in a coordinated and safe manner; and

b) Encourage more airports in the Asia Pacific region to carry out TAM development based on AI Agent technology.

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