



ICAO

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Planning Sub-Group (AOP/SG/5)

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**Agenda Item 4: Provision of AOP in the Asia/Pacific Region**

**APPLICATION OF DIGITAL TOWER AND SURVEILLANCE TECHNOLOGY FOR  
APRON EFFICIENCY AT HONG KONG INTERNATIONAL AIRPORT**

(Presented by Hong Kong, China)

**SUMMARY**

To prepare for Interim Two-Runway System (2022) and Three-Runway System (2024) operations at the Hong Kong International Airport, Airport Authority Hong Kong is partnering with Hong Kong Civil Aviation Department and going full steam ahead on a Digital Transformation Roadmap. This paper shares the experience in implementing an integrated digital platform, named Digital Apron and Tower Management System, from preliminary design to trial, and from concept to implementation. The system aims to adopt a holistic approach in controlling and monitoring ground movements and apron activities, with a view to (1) enhancing safety, (2) optimizing capacity, (3) improving decision making progress and (4) increasing efficiency for the Hong Kong International Airport.

**1. INTRODUCTION**

1.1 Traditionally, Air Traffic Control (ATC) services to aircraft arrivals, departures and ground movements at an airport are provided by controllers stationed at an aerodrome control tower, which is typically a tall and windowed infrastructure overseeing the whole airfield. Capitalizing on the latest smart digital video technology, the concept of Digital Tower has emerged to overcome physical constraints, supplement the tower's out-of-window view via digital cameras and displays with essential aircraft information overlay, and ultimately enhance ATC's visual surveillance.

1.2 To prepare the Hong Kong International Airport (HKIA) in moving forward as a "Next-generation Digital Airport", digital transformation roadmap encompasses a wide scope of digitalized activities and comprehensive business strategies. Through mature technology and innovations, operational integration in airport community can be improved across multi-facet applications, including airport operations, capacity management and stakeholder engagement. Such digital transformation will break silos, increase predictability and unleash latent capacity which are core to airport operations.

1.3 Despite the tumble of global traffic caused by COVID-19 with severe impacts across the industry, momentum has not been derailed in preparing HKIA to move towards a Three-Runway System (3RS) in phases, i.e. commissioning the new North Runway by 2022 and commissioning the 3RS operations by 2024. This paper highlights the advanced digital technologies to be applied at HKIA under joint development by Hong Kong Civil Aviation Department (CAD) and Airport Authority Hong Kong (AA).

## 2. DISCUSSION

2.1 Digital Apron and Tower Management Systems (DATMS) is a project being developed jointly by CAD and AA with an aim to enhance the aerodrome safety and operational efficiency at airfield, apron and tower. The DATMS comprise of two systems, namely (1) Digital Apron Management System (DAMS) and (2) Digital Tower Facilities (DTF). Both DAMS and DTF leverage optical sensors (video cameras) installed at the airport and an Augmented Visual Presentation integrated with essential flight information and real-time operational data.

2.2 The adoption of high quality (4K / UHD) live visual images and Augmented Visual Presentation will significantly improve operators' experience to monitor airfield safety and enable predictive alerts to enhance efficiency of air traffic and apron control. Their potential benefits also include:

- 2.2.1 Increase visibility on runway and apron traffic, especially under the constraints of limited direct line-of-sight, night time conditions and adverse weather;
- 2.2.2 Enhance monitoring and control of aircraft movements with essential flight data tagged on each aircraft under Augmented Visual Presentation;
- 2.2.3 Enable real-time predictive alerts of conflicting situation or intrusion to airfield restricted areas, as well as to monitor Key Performance Indicators (KPIs) continuously (KPIs including on-time-performance, parking stand availability, aircraft turnaround process, etc.) and enhance the airport's contingency response through real-time digital tracking of events and objects;
- 2.2.4 Support post-incident investigations with recordings on runway and apron operations.

### **Digital Apron Management System (DAMS)**

2.3 To support airport transformation and large-scale expansion plans at HKIA, DAMS serves to provide aerodrome surveillance and anomaly detection functionalities. The solution will provide personnel in the new Integrated Airport Centre (IAC) with brand new automated digital experience and increase their situational awareness on both apron(s) and critical aircraft manoeuvring area(s), and hence facilitate safety assessment and operational planning.



Figure 1. Mock-up panoramic view of North Runway (07L/25R) and South Runway (07R/25L) on video wall panels of DAMS installed at IAC, HKIA.

2.4 Tailored functionalities to be developed under DAMS are as follows:

- 2.4.1 Through data integration with various AA's technological platforms and operational databases, DAMS shall provide a wide array of rule-based automated alerts to monitor KPIs and operational readiness status of facilities around-the-clock; and

2.4.2 With use of ground surveillance and video analytics for aircraft position tracking and route prediction, apron traffic safety and efficiency will be enhanced by automated control of back-of-stand roads vehicle stop signs, which stop apron vehicles before aircraft enter a parking stand.

2.5 AA envisaged that the DAMS shall enhance communication, improve information exchange between the airport operational personnel and ATC, foster tighter collaborations, and benefit the whole airport operation. With such strong ambition to connect stakeholders, DAMS will be a pivotal tool in strengthening airfield safety, operational resilience, interoperability and collaborative decision making<sup>1</sup>.

**Digital Tower Facilities (DTF)**

2.6 On the other hand, DTF will reinforce the provision of safe and efficient ATC services by providing visual augmentation, situational awareness enhancement and early alerts to conflicting situations. The system overcomes the physical constraint of traditional ATC tower and eliminates sight-obstructed apron/taxiway areas/runway ends under all weather and all day-light conditions, in particular low visibility operations and heavy rain which are commonly seen in Southeast Asian weather.

2.7 Panoramic view of the airfield with real-time situation of aircraft and vehicle movements on the runways and taxiways together with the essential aircraft information is provided to the ATC Officers (ATCOs) to facilitate the provision of ATC services. Besides, artificial intelligence can be applied to the digitized video to provide additional safety alert functions, such as early detection of conflicting situation or intrusion to airfield restricted areas.

2.8 Tailored functionalities will be developed under DTF using ground surveillance and video analytics, including runway occupancy indication, runway incursion alert and the parking stand occupancy will be provided to ATCOs to enhance their situation awareness. Statistical report of runway occupancy time at landing will also be provided for performance monitoring.

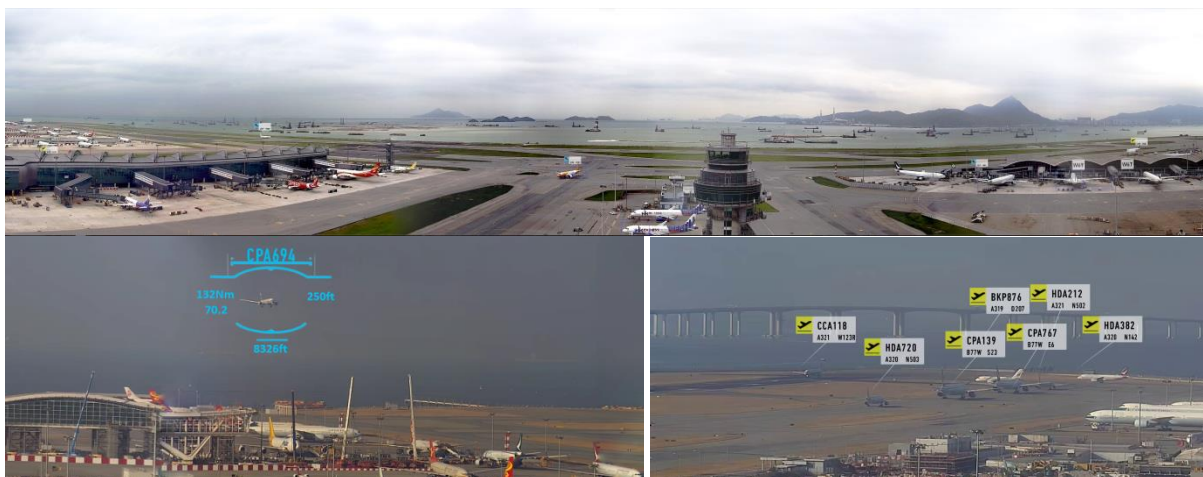


Figure 2. Mock-up panoramic view of North Runway (07L/25R) and hot spot views on ATCOs working positions of DTF at HKIA.

<sup>1</sup> HKIA introduced Airport-Collaborative Decision Making (A-CDM) Phase 4 including Target Start-up Approval Time (TSAT) on 1 November 2018.

2.9 Riding on the successful trials conducted between July and October 2019, which covered the adverse weather conditions in the summer period, CAD has confirmed to develop DTF as part of the essential ATC systems for supporting both the Interim Two-Runway System (I-2RS) and 3RS operations.

### **Implementation and Project Timeline of DATMS**

2.10 Further to the successful trials conducted at HKIA in 2019, a Digital Apron and Tower Working Group (DATWG) was formed to group the expertise and experiences of CAD and AA. The first milestone of DATWG was the formulation of a preliminary design, including the sensor locations and supporting structure. Locations of sensors are illustrated in Figure 3. It aims to provide full aerodrome coverage without any blind-spot to support the I-2RS operational operations in 2022 and the full 3RS operations of HKIA in 2024.

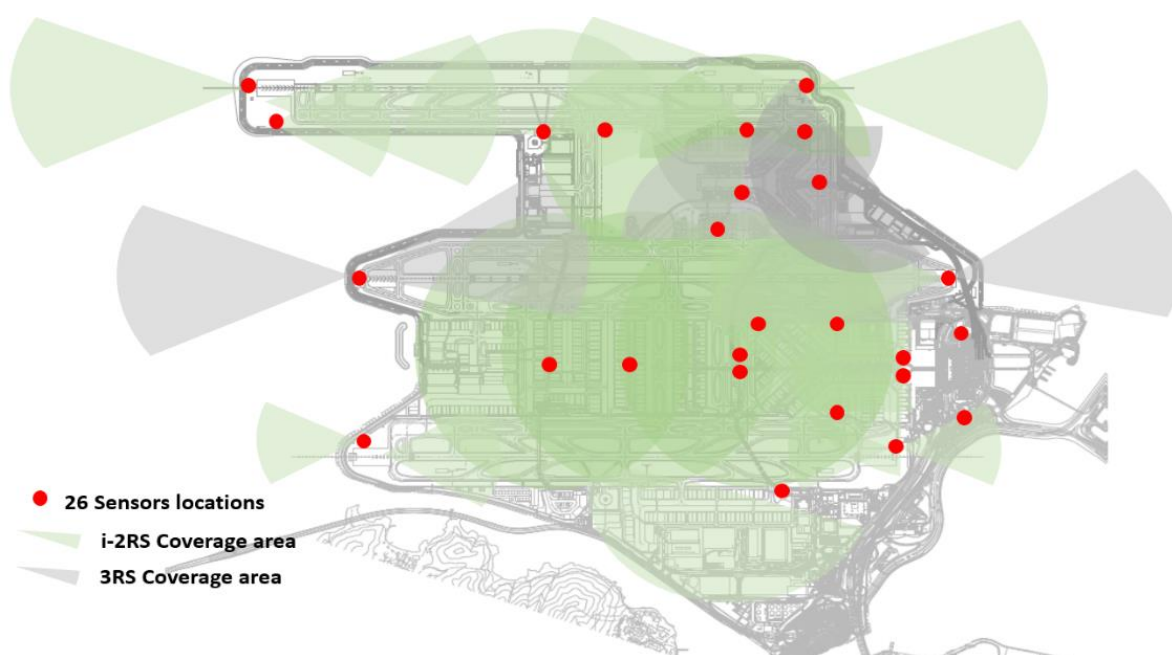


Figure 3. Indicative installation locations to support I-2RS and 3RS operations.

2.11 The project will involve physical installation of 280 cameras at 26 strategic locations spreading across existing aerodrome and the newly reclaimed land. Extensive communication cabling and power supply network are also essential to be routed through every location to provide hardwired connection. Milestone phases are therefore set precisely for constituting gradations of achievements:

DTF and DAMS Phase 1 – 2022 (for I-2RS); and  
DTF and DAMS Phase 2 – 2024 (for 3RS).

2.12 Throughout various stages of the DATMS project, CAD provided advices on the system design, trial and implementation. The DATWG, being chaired by CAD, will continue to oversee the progress on DATMS implementation and transition to support I-2RS and 3RS operations at HKIA.

## **3. CONCLUSION**

3.1 Envisioned targets and goals of the DATMS project include: (1) Enhanced safety – safety-related solutions not only relying on improved information sharing and stakeholder collaboration but also on sophisticated support tools that facilitate the human operators to make the right decision; (2)

Optimized capacity for the future – optimal flight sequencing for arrivals, departures, turnarounds and ground movements will equip the Airport to make maximum use of facilities / resources; and (3) Increased operational efficiency – when physical expansion is not an option, operational process improvement leveraging innovative resources deployment will be the solution.

3.2 Applying mature and advanced technology, implementation of DATMS also enables (1) reduction of on-site operations, (2) de-centralization / remote operation to provide resilience and safety assurance, (3) preparedness for future contingency and (4) scalable scope for expansion.

3.3 In a nutshell, digital connotations of screens and data on tower and apron management help to transform airport operations, attain a solid coordination network, facilitate informed decisions amongst stakeholders, and hence improve on-time performance together with passenger experience. This digital transformation project will further equip HKIA to embrace the global aviation dynamics, which transforms HKIA to a more autonomous, connected and intelligent future-ready airport.

#### **4. ACTION BY THE MEETING**

4.1 The meeting is invited to:

- a) note the collaborative efforts by CAD and AA in enhancing the airport operational safety and efficiency, with an objective to build a future-ready airport;
- b) share experience and lesson-learnt on design, planning and procurement for the application of new technologies to enhance operational safety and efficiency; and
- c) discuss any relevant matters as appropriate.

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