

Airbus subsidiary NAVBLUE plans to deliver its final capacity-enhancing airspace redesign and airside improvement recommendations for two Shanghai airports to their Chinese partners early next year.

Funded by the European Union Aviation Partnership Programme under the leadership of the European Union Aviation Safety Agency, NAVBLUE developed a concept of operations with the ATMB of the Civil Aviation Administration of China (CAAC) using new technologies to optimise the use of the airspace that aims to handle 150 million passengers per year in the Shanghai terminal manoeuvring area (TMA).

This compares to the 120 million passengers expected to transit the TMA in 2020, making it one of the leading air hubs in the world. Thales, which has decades of experience in China, also contributed to workshops on the possibility of using technologies such as ADS-B In and arrival and departure managers (AMAN/DMAN) for a future concept of operations.

The team has already been working on its third version of its concept of operations following three workshops with stakeholders, the completion of both fast time and real time air/ground simulations, and exercises with air traffic controllers. Fast time simulations were carried out at a laboratory in Toulouse and real-time radar simulations in Shanghai with local controllers. Flight trajectories were tested in an Airbus simulator for the A320, A330 and A350 and in a Boeing 737 simulator.

Work started in July 2018 setting the stage for an operational rollout that will be directed by the ATMB and its Chinese partners including CAAC's East China Air Traffic Management Bureau.

Just how much will be done how quickly is yet to be determined.

The improvements will benefit Pudong, Shanghai's main international airport located 30 km east of the city, and Hongqiao International Airport that is closer in and handles more of the domestic traffic flow. Pudong has four runways and a fifth is in development in a \$3 billion construction project while Hongqiao has two. In September, Pudong opened what it dubs the world's largest standalone satellite terminal with more than 600,000 sq ft of space and 90 boarding bridges. This project adds to two existing terminals at the international hub.

"The objective of the airspace and airport management project is to improve safety, efficiency and capacity of these two airports both for surrounding airspace and ground operations," says Wang Rui, deputy director of the international department at ATMB. "ATMB has worked with NAVBLUE to baseline the current operations, define an implementation plan to then develop a reference concept of operations which will be used to support the evolution of airport operations."

While the project is part of a larger CAAC and EASA aviation partnership, the plans developed by NAVBLUE and China call for completely new performance-based Standard Instrument Departure (SID) and Standard Terminal Arrival Route (STAR) procedures which will reshape lateral and vertical flight paths.

As a result, sector boundaries will be realigned to complement the new arrangement. These changes aim to reduce carbon emissions, fuel burn and noise. The overall contours of the TMA will not change and planners of the new sector configuration avoided impinging on any military airspace in the area.

Thales and Airbus examined the possible benefit of adding ADS-B In capability to aircraft so they could be sequenced using interval management during arrival. The technology could be applied to a future upgrade of procedures for the Shanghai airports as per the proposal put forward by the European companies. UPS experimented with ADS-B In interval management for arrivals at its Louisville hub a decade ago but did not implement it and it is not in use anywhere else in the US.

Taxi-In

NAVBLUE project manager Xavier Outters cites a goal of Pudong runway throughput being increased by six to eight departures per hour. Aircraft landing at Pudong won't have to wait long, if at all, to cross a runway and departure taxi time should be reduced with queue management and the use of integrated departure and arrival management. The objective is to decrease taxi-in time by four minutes and taxi out time by eight minutes.

These improvements aim to enable a 20 per cent increase in departure and arrival traffic and a 35 per cent increase in peak hours. Air traffic controllers trained in the use of the new CONOPS were able to manage up to 60 arrivals per hour and more than 60 departures compared to the currently declared capacity of 48 arrivals and 48 departures

At Hongqiao, controllers demonstrated how they could handle ten per cent more peak hour traffic using the new operational concept in simulations. The four main airside improvements there allow for aircraft to engage in simultaneous runway crossings, line up for departure while an aircraft is crossing the runway, use an end-around taxiway and benefit from departure management.

Ready to Roll

David Hughes reports on how European airspace expertise is helping redesign operations at Shanghai's airports



The changes only enable three additional departures per hour during peak times at Hongqiao but additional runway capacity may be added if separation is reduced in the future.

The new CONOPS will use the European Point Merge system for sequencing arrival flows. This approach was developed by the Eurocontrol Experimental Centre in 2006.

“The Point Merge system provides a way to blend different traffic flows arriving at the Shanghai TMA to a single point,” says Outters. This system is used around the world but not in the United States. At Shanghai, the entry points to the TMA are the same as before, about 40 nautical miles from the runway threshold at 15,000 feet.

From the entry points, newly designed RNAV STARS will enable aircraft to conduct continuous descent arrivals into Shanghai, avoiding the use of fuel-wasting radar vectors to step down bit by bit into the terminal area.

In addition, Required Navigation Performance Authorization Required (RNP AR) approaches will be implemented though no ILS precision approach systems will be decommissioned. RNP AR provides precise and repeatable flight tracks over the ground and can utilise highly accurate radius to fix (RF) turns to avoid noise sensitive areas. The Shanghai project includes a noise assessment.

Thales is providing Shanghai with its TopSky automated ATC system with integrated flight sequencing and optimisation capability which is used by 85 other countries. Thales’ Maestro arrival and departure system includes AMAN that is now providing controllers with automated sequencing support. Once the tool is adapted, the sequencing will be more accurate with the newly designed Performance Based Navigation (PBN) procedures that provide well defined lateral and vertical trajectories.

Maestro’s DMAN is yet to be put in operation at Shanghai to integrate departure flight sequencing. AMAN and DMAN together will enable greater runway and approach capacity,

reduced delay, improved predictability and exploitation of PBN procedures. Thales DMAN will allow controllers to anticipate taxi delays so that aircraft can be kept at the gate with engines off rather than pushing back to wait in line with engines running.

New RNAV SID procedures at Shanghai are designed to enable continuous climbs and use RF turns to reduce the number of track miles flown. With no altitude constraints, aircraft will be able to climb quickly. The interleaving of PBN arrival and departure procedures aims to enable the arriving and departing traffic to separate naturally without ATC intervention.

Shanghai

Shanghai is served by mostly modern aircraft with the predominant models being the Airbus A320 and the Boeing 737. Most are equipped to fly RNAV procedures. The Airbus A380 is also present but only accounts for four flights per day. As of 2018, there were 107 airlines serving Shanghai at its two airports carrying 118 million passengers. This makes the city the fourth busiest air hub in the world for the third consecutive year. The 4.18 million tons of cargo handled makes it third in the world, a spot it has held for a decade.

Airbus and a Chinese consortium conducted a flight test in March of initial 4D (i4D) in China from Tianjin to Guangzhou. This technique lets controllers use the three spatial dimensions plus time to direct an aircraft to arrive at the TMA entry point at a specified time. This allows for dynamic airspace management in a collaborative fashion. i4D is not yet covered in the current CONOPS about to be completed but is covered by a third version being discussed with ATMB.

“In order to implement this type of technology you need to have new avionics onboard or upgrade equipment such as the flight management system,” Outters says. Such capability is at least a decade down the road.

The first European i4D trajectory management flight connecting aircraft and

ground systems to optimise aircraft trajectory occurred in the Maastricht Upper Area Control Centre in 2014.

The new CONOPS also examines the possibility of reducing separation and exploiting Wake Turbulence Recategorisation (RECAT) techniques. Separation can be reduced because the Chinese are using a lot of margin in addition to what ICAO specifies. The European team explained RECAT and its potential benefits to Chinese stakeholders in one of the workshops. “Before they implement RECAT they first have to reduce separation,” Outters says.

At Pudong where aircraft experience long taxi times, the project focuses on how to handle runway crossings, which currently only occur on one taxiway.

The new CONOPS examines different operating rules and improved use of an advanced surface movement guidance & control system (A-SMGCS). The team has also shared experiences gained at Paris Charles de Gaulle where multiple runway crossing points are in use along with a Runway Status Lights (RWSL) system.

Runway safety is a top priority for everyone involved in the Shanghai project.

The project team also informed stakeholders about a new onboard function that uses ADS-B In technology to provide an alert if an aircraft is occupying the runway. The alert would prompt the pilot to stop a takeoff or suspend an approach and go around. This capability which has not yet been certified is supplied by Thales Avionics and Honeywell on Airbus aircraft.

The plans to improve airports, airspace and procedures at Shanghai are aimed at keeping its position as one of the leading air transport hubs in the Asia Pacific region. There is even talk in Shanghai of adding a third airport by which time the metroplex would match New York City with its three major airports. With the torrid pace of growth in air traffic in China, a third airport may be needed sooner rather than later. www.airtrafficmanagement.net

