BEHIND THE SCENES SMARI SMARI ARPORT CHANG

In March 2019, Singapore's Changi Airport was crowned the World's Best Airport for the 7th consecutive time by Skytrax. Two weeks later, Changi Airport announced the opening of the Jewel, and once again enjoyed the global limelight. Behind the sparkle and dazzle, lies a serious commitment to cement Singapore as an aviation hub. *Aerospace Singapore* looks beyond the hype and uncovers the innovative spirit of Changi as it prepares to be a Smart Airport of the future.

Jewel at Changi Airport: Evening View of the Shisedo Forest Valley & HSBC Rain Vortex. The latter is the world's tallest indoor waterfall, surrounded by over 120 species of plants in a climate controlled dome designed by architect Moshe Safdie.

FEATURE



The new icon of Changi.

fter years of anticipation, Jewel Changi Airport opened its doors to visitors on 17 April 2019, to global media coverage. Among a myriad of attractions, the Jewel houses about 300 unique retail outlets and eateries, a hotel, and a 14,000 square meters indoor air-conditioned garden known as the Canopy Park. At its heart is the world's largest indoor waterfall, which is fast becoming an "Instaworthy" icon.

The S\$1.7 billion project started out as a means of capacity expansion for Changi's Terminal 1. Built over an old open-air carpark, the Jewel has become a gleaming symbol of commitment to innovate and strengthen Changi Airport's offerings, in order to boost its appeal to travellers. This was iterated by CAG's Chief Executive Officer, Mr Lee Seow Hiang, at the project's groundbreaking in 2013, "An important hallmark of Changi Airport's growth over the past thirty-odd years has been continual change and innovation. In charting the airport's future, this spirit continues to underpin our strategy. Faced with intensifying competition, we

challenged ourselves to rethink what an airport can be – not just as a gateway for flights, but as a tourism destination on its own."

FOR A BIGGER SLICE OF A BIGGER PIE

Indeed, air hubs all over the globe are enhancing their destination appeal to have a bigger slice of the air travel pie. The International Air Transport Association (IATA) expects 7.2 billion passengers to travel in 2035, a near doubling of the 3.8 billion air travellers in 2016. Asia Pacific is projected to lead air travel demand with the fastest growth of new air passengers. By 2035, there will be 1.8 billion new annual passengers in Asia Pacific and an overall market size of 3.1 billion.

In a bid to capture market share and tourism dollars, several mega airport projects have been announced in Asia, and will come into service in the next decade. These include Hong Kong International Airport's Three-Runway System, to be completed by 2024, and the Beijing Daxing International Airport, set to be the biggest in the world when it opens in September this year.

In Singapore, preparation is well under way for Changi East – a 1,080 hectares expansion project covering a new Terminal 5 (T5), a three-runway system, new cargo complexes and other supporting infrastructure. When completed, T5 will have a capacity of 50 million passengers per annum (mppa), bringing Changi Airport's total handling capacity to 135 mppa by the end of the next decade.

INNOVATIONS AT WORK @ CHANGI AIRPORT

T5 is gearing up to be not only one



Bolstering increased capacity with efficient aircraft and ground handling, as well as seamless customer experience, is another step in Changi's strategy to remain a top choice for airlines and passengers.



Self-service FAST machines for passengers at Changi Airport.

of the largest, but more importantly, the most advanced airport terminal in the world. Bolstering the increased capacity with efficient aircraft and ground handling, as well as seamless customer experience, is another step in Changi's strategy to remain a top choice for airlines and passengers.

The use of technology is a necessity in the context of Singapore, to overcome manpower and resource constraints. To improve the air sector's competitiveness and Changi's service standards, the Singapore government launched the Air Transport Industry Transformation Map (ITM) in 2017. The ITM aims to increase productivity in the sector by 40 per cent by 2025, through encouraging and supporting the use of innovative technologies by airport stakeholders.

Creating a Seamless Passenger Experience

Changi's Terminal 4 (T4), which opened in October 2017, is a test bed for technologies planned to be incorporated into T5. A range of innovations is being trialled, utilising robotics, automation and digital technologies to increase operational efficiency.

T4 is the first terminal in Changi Airport to introduce a fully automated departure process, through its Fast and Seamless Travel (FAST) system, which leverages facial recognition and biometric technology. In essence, every passenger's face becomes the token that gets them through checkpoints.

The FAST system starts with selfservice kiosks, where passengers' identities are first captured. After printing their own boarding passes and bag tags, they can then drop their bags at an automated bag drop machine. The FAST process also allows for immigration verification to be fully automated via fingerprint and facial data, without the need for manual verification by the officers. At the boarding gate, passengers who have used the automated immigration gate can simply scan their boarding pass at the boarding gate and authenticate their identity with the facial recognition system.

Passengers also need only go through pre-boarding security once at T4, through Changi's first Central Security Checkpoint. New Computed Tomography (CT) security screening machines produce 3D images of the bags, leading to more effective checks for screening staff and eliminating the need for passengers to remove laptops and other electronic items from their bags. Once the security checks are done, passengers will be free to shop and dine in the transit area until boarding time.

Enhancing Air Traffic Management

Air traffic around Changi is in one of the busiest and most complex blocks of airspace in the world. This was noted by Singapore's Minister for Transport Khaw Boon Wan at the recent China Civil Aviation Development Forum in May. He added, "With significant air traffic growth, air navigation service providers bear the heavy responsibility of providing air traffic services safely and efficiently. To manage increasingly crowded and complex airspaces, heavy investment in state-of-the-art technologies and systems, as well as investments in continuous training and upskilling, are critical."

In 2017, the Civil Aviation Authority of Singapore (CAAS) awarded Air Traffic Management



The immersive wall entertains passengers at T4's Centralised Security Screening Area.

FEATURE

service provider NATS a contract, valued at S\$7 million, to develop a smart digital tower prototype. The smart tower would allow air traffic controllers to use technology, including artificial intelligence, to guide planes to land and take off without physically seeing them from a control tower.

The contract includes the installation of more than 100 cameras to capture Changi's two runways. Images from these cameras will be "stitched" to provide a completely digitised realtime view of the aerodrome. The Smart Tower will also enable the tagging and labelling of aircraft call signs and flight information for easy flight identification and greater situation awareness. The cameras will be able to track, pan, tilt, and zoom, to enable a closer look at objects or areas of interest.

The digital tower offers several advantages, such as the possibility of increasing visibility in hazy or dark conditions, by adjusting the images from the infra-red cameras. It also enables integration of two or more control tower operations into a single integrated facility. This will enhance the coordination between multiple control towers, reduce the complexity of operations and improve safety.

The trial at Changi is reported to be taking place for a period of 22 months, from the end of this year. NATS Chief Executive Officer, Mr Martin Rolfe said, "We're





A new digital tower control room for London City Airport is due to enter full operations service in 2019.

absolutely delighted to have been chosen to work .. on what will be a transformational project for Changi Airport and the wider aviation industry. I believe the work we do together over the next two years will help shape how smart digital tower and smart airport technologies are applied to hub airports all over the world."

Leveraging Technologies for Ground Operations

As the main ground-handling and in-flight catering service provider at Changi Airport, SATS, is also leading innovations in airside and ground operations. In 2017, it unveiled its Technology Innovation Centre, TechnIC@SATS, which adopts a peopleled approach to deploying technology. SATS President and Chief Executive Officer, Mr Alex Hungate, underscored the need for constant innovation and productivity gains to compete in today's marketplace. "By harnessing the power of information and technology, we can provide more dynamic, agile services that make travel more seamless for passengers and enhances connectivity, ... as well as improve quality and cost of our food."

In Terminal 3, SATS has partnered Singapore Airlines to introduce a "Smart Wheelchair System", a convoy of wheelchairs using vision-based technology that allows one staff to handle 3 wheelchairs at the same time. It has also trialled Dolly, an automated guided vehicle (AGV) that uses FollowMe technology to enable one staff to transport more than one food trolley per trip.

On the airside, SATS is testing AGVs that can pull baggage trucks that hold passengers' luggage from a plane to the baggage handling area in as little as 10 minutes. The technology can potentially be used to load and unload cargo, as well as tow aircraft. Another SATS trial uses an autonomous electric vehicle to ferry documents for air cargo.

SATS has also integrated Internet of Things (IoT) technology into daily ramp operations in the form of Smart Watches and Bluetooth bone conductor headsets. These technologies allow ramp staff to receive real-time operational information, enabling them to make better decisions and respond faster to operational changes. The deployment of these technologies has cut down the time needed to service flights by 10 per cent.

"Investments in technology also give us better operating leverage as we scale our business. As the volume of business increases, we can increase productivity with the current workforce to meet growing demand," said Hungate. Back in its in-flight catering facility, SATS has expanded overall food production by 14 per cent, with a S\$25 million facility driven by automation and data-driven analytics. For example, its new central automated rice line can cook 4,000 portions per hour with a three-man team compared with eight workers in the past.

Bringing it All Together

Operations at Changi Airport, like most other airports, is fast-paced and complex, involving different agencies working together. With growing traffic, there is a stronger need to optimise the airport's infrastructure and operational efficiency. This is achieved through the Airport Central Decision Making (A-CDM), which was fully adopted by Changi in early 2017 after results from operational trials showed that aircraft taxiing time reduced by 90 seconds per flight during peak hours.

The A-CDM concept involves two key components – Target Off-Block Time (TOBT) and Target Start-up Approval Time (TSAT). TOBT refers to the predicted time that all the groundhandling activities will be completed, while TSAT refers to the time an aircraft can expect to push back. These operational information is shared amongst airport partners through the Airport Operations Centre System (AOCS) which is a custom-designed software to facilitate the collaboration across all key airport partners. The end goal is to improve gate management, flight punctuality, reduce apron taxiway and holding point congestion. This

is achieved via improved real time information sharing between airport operator, airlines, ground handlers and air traffic control (ATC).

With A-CDM, Changi's ATC can sequence the departure queue in advance based on expected readiness of flights instead of a

first-come-first served sequence. This improved sequencing helps to reduce the waiting time between subsequent departures and waiting time at the runway. A-CDM also helps the airport utilise infrastructure and resources efficiently. For example, if an airline informs of a delay in arrival of its aircraft, resources already lined up for that flight, such as the baggage and aircraft interior cleaning teams, can be deployed to another flight which is arriving earlier.

AN ICON OF PROGRESS

Right from the very beginning, Changi Airport established its reputation for innovative offerings. It was the first to introduce the concept of airport gardens when it opened in 1981, and the first to allow passengers to make free local telephone calls in transit.

While Changi continues to pursue innovation and utilise disruptive technologies to its advantage, safety and security must remain a top priority. Recent drone intrusions that resulted in costly flight delays, for example, must be addressed swiftly to prevent future incursions that endanger public safety. Changi will also need to remain nimble to respond to future disruptions such as new aircraft technologies that enable ultralonghaul flights, which allow airlines



SATS staff with augmented reality smart glasses for ramp handling operations.

"

Operations at Changi Airport is fast-paced and complex, involving different agencies working together. With growing traffic, there is a stronger need to optimise the airport's infrastructure and operational efficiency.

"

the option of bypassing traditional hubs.

The coordinated governmentled approach is demonstrating Singapore's commitment to push boundaries, reap maximum benefits, and hold off challengers clamouring for a piece of the pie.