Overview: Siemens Logistics' software gives ground handlers an interactive map of all airport movements.

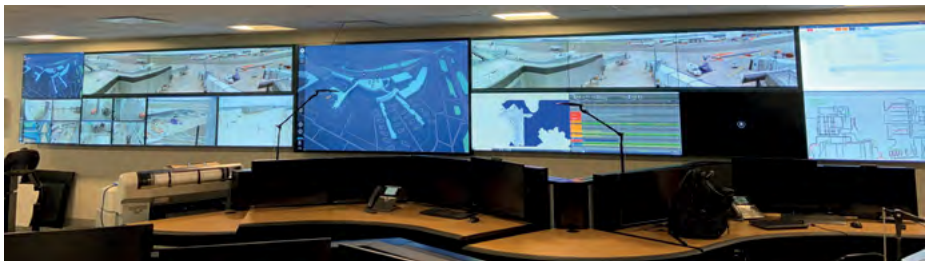
Sensor sensibility

As virtual models that visually replicate the operational status and behaviour of real-life assets, digital twins can enable airport decision-makers to glean actionable insights across the airfield, apron area and throughout the terminals. Paul Sillers examines the broadening spectrum of areas where digital twins add value to the airport environment.

Powered by a cocktail of Internet of Things (IoT) sensors, cloud-based data storage, artificial intelligence (AI), and high-speed wireless networks, digital twins can track and display a real-time virtual representation of every element within the airport environment to the relevant decision-makers.

Whether for a regional, secondary or primary hub, flight arrivals, apron movements, the whereabouts and availability of ground support equipment, the operational health of check-in kiosks, congestion build-ups at elevators, passenger throughput at terminal checkpoints and much more

Near future: SITA's digital twin is able to estimate flight arrivals in the next 120 minutes.



Doubling up: the digital twin display in the control room of New York's LaGuardia Airport.

> **Opportunities to utilise digital twins not only revolve around better situational awareness across the airport but also around being able to go back in time and 'replay' what happened and learn from those experiences.**
>
> Gustavo Pina, Director, SITA Lab

can all be replicated on a digital twin. Hitherto, obtaining a holistic perspective of the airport's activities meant sifting through heaps of raw data trapped deep within disconnected silos.

Now armed with digital twins, airports of all sizes and their stakeholders can proactively address looming issues and avert disruption to the smooth flow of aircraft, passengers and baggage.

"There are many more sources of data today and that's continuing to grow as the digitalisation of the airport matures, where everything in the airport has sensors emitting data," says Gustavo Pina, Director of SITA Lab.

"Opportunities to utilise digital twins not only revolve around better situational awareness across the airport but also around being able to go back in time and 'replay' what happened and learn from those experiences."

SITA has collaborated with New York's LaGuardia Airport to leverage digital twins for visualising flight arrivals in the next 120 minutes, anticipate how and where passengers are likely to cluster, and pre-emptively deploy staff to address congestion.

"With digital twins we can tap into many data sources," adds Pina, "so if there's a power outage you can get in

Checked luggage

With transfers currently posing the greatest risk of a bag going astray – some 37% of mishandled bags occurred during transfers in 2020, according to SITA's latest Baggage IT Insights – digital twin technology could provide a remedy.

Siemens Logistics' cloud-based Baggage 360 software provides airports, airlines and ground handlers with an interactive map of all airport movements and a resource-planning and simulation tool, enabling allocation and optimisation of fixed, mobile and human assets using machine learning to predict baggage volumes for the next 24 hours and pinpoint potential bottlenecks.

Siemens demonstrated the digital twin system's potential during a pilot last year, when Baggage 360 improved end-to-end journey times by nine minutes thanks to smarter allocation of laterals – the points at which ground handlers feed the baggage handling system with transfer bags.

"The virtual representation of real-time operations helps airports to monitor and manage processes remotely and intuitively," says Michael Reichle of Siemens Logistics. "Our pilot customers were impressed by how additional functionalities increased their operational efficiency."

On a single day, Baggage 360 contributed to 22% fewer left-behind bags, resulting in repatriation cost savings amounting to thousands of euros – not to mention improved customer experience.

Tomorrow's airports

Noida International Airport

Digital twins are already playing a key role in the formation of new airports. At Dehli's Noida International (NIA), a greenfield airport being constructed near Jewar – and touted as India's first net zero-emission and fully digital airport – ViitorCloud Technologies is implementing an interactive holographic digital twin which simulates the entire master plan of the airport, capable of depicting and integrating core features and concepts.

The digital twin allows stakeholders to evaluate internal and external design options and interact with a virtual 3D holographic model of the airport throughout the design and development phases.

"ViitorCloud's solution will enable decision-makers to see exactly how the airport would look during various phases of construction," says Nicholas Schenk, NIA's Chief Development Officer. "Using 3D glasses on the surface of the holographic table, the solution can simulate the entire master plan of the airport, interactively walk through the airport infrastructure from a first-person camera, bird's eye view and much more."

one view what kiosks, check-in counters and gates are operational, what elevators are working, where your staff are – and that helps the airport recover much faster."

LIVE WIRE

Being able to invigilate, in real time, both the macro and micro perspective using a digital twin is invaluable as airports strive to push efficiencies as aviation emerges from the pandemic.

"Live integration is important because [we can respond to] everything we display on the digital twin," says Ligiu Uiorean, Founding Director at AirportLabs, a Romania-based SME.

RealTime Airport, AirportLabs' scaleable cloud-based digital twin situational awareness solution, is focused on live operations in command and control centres – putting pertinent

The big picture: AirportLabs' RealTime Airport is focused on live operations in command and control centres, putting pertinent information in front of staff to help inform decision-making.

information in front of airlines, ground handlers, retail outlets and security staff to inform decision-making.

Uiorean says: "Resources are allocated to particular stands and if an aircraft fails to depart on time you have to reallocate the stand based on various criteria, such as aircraft compatibility.

"You can see from any stand to any stand how many people are transferring. This is displayed on the digital twin using lines of different colours and thickness to denote how short the transfer time is and how many people need to transfer."

Using RealTime Airport, which is implemented at Dubai Airport (and many other airports) when queue time alerts are activated, the average queuing time can be reduced from seven to four minutes.

"Which has a huge impact, both in terms of passenger experience, but also in terms of airport capacity," says Uiorean.

The system also acquires data from temperature sensors throughout the terminal, opening up opportunities for sustainability efficiencies.

At Dubai, with around 6,000 flight information screens consuming roughly 100 watts at maximum brightness, using RealTime Airport screen brightness can be adjusted dynamically, based on the number of people detected in the area, the number of flights that are in the area and also the displayed content. For example, general information messages have a reduced brightness compared to critical alerts.

"This saves megawatts of power over the year because the difference between 100% luminosity and 50% luminosity is around 75% of power," says Uiorean.

Lowering screen luminosity via the digital twin also reduces heat in the terminal and means that less energy needs to be expended on air conditioning.

REMOTE CONTROL

Another opportunity presented by digital twins is that, with the trend towards working from home and hybrid working, command and control functions no longer have to be physically located

within the airport but can be distributed. "During the COVID disruption, this was an advantage because you have all this information at your fingertips on your computer with an internet connection – that's all you need," says Uiorean. "Potentially, in the future, a lot of expensive terminal space devoted to command and control could be used instead for processing passengers, for extra airport retail and F&B."

Ground control: Moonware's HALO digital twin offers a real-time visualisation of the status of airfield equipment.

DESTINATION AUTONOMY

While airports have been modernising the terminal user experience with everything from mobile boarding passes to biometrics, when it comes to airside, particularly on the airfield, operations are still mostly paper- and radio-based and airfield assets are often untracked and underutilised.

San Francisco-based start-up Moonware has developed a digital twin solution, HALO, that provides real-time airside visualisation of the status of airfield equipment, indicating whether they are in the process of servicing an aircraft, performing maintenance or standing idle.

Saunon Malekshahi, Moonware co-founder and CTO, says: "With respect to digital twins specifically, HALO is designed to be the real-time ground support equipment (GSE) fleet management software in airports, which automates the scheduling and dispatching of vehicles, whether human-operated or autonomous, to service aircraft.

"You can think of HALO as 'ground control' for GSE – a digital and automated surface management system that complements advanced airspace management services, which will become prevalent with eVTOL and newer forms of air transport."

Moonware's system pulls in data from airline flight schedules and feeds that into the back end of the HALO software. This is coupled with the instrumentation of GSE with GPS sensors. "We then pick up position data, run it through a stack, and output the dispatching, the routing and the visualisation on to a mobile platform showing where everything is on the airfield," says Malekshahi.

Anticipating the next era of urban aerial mobility, which will be largely based on automation, Moonware has also developed ATLAS – an autonomous and electric pushback vehicle designed for eVTOLs and Part 23 aircraft.

"It's the first vehicle that will form part of the automated fleet that performs airside tasks autonomously, whether that be in airports or vertiports," says Malekshahi. ■

Food for thought

Singapore-based SATS and Dassault Systèmes teamed up to implement the world's first 3D digital twin experience of an airline central kitchen using Dassault Systèmes' cloud-based 3DEXPERIENCE.

"Digital twin technology helps SATS simulate different production scenarios and cooking processes to optimise resources within our kitchens," says SATS' Chief Digital Officer, Albert Pozo Hernandez. The digital twin pairs virtual and physical catering operations to capture operational know-how in order to model different food production scenarios, improve capacity planning and forecast ingredients usage in its large-batch food production facilities.

SATS' virtual kitchen captures and integrates data into a 3D virtual environment to ensure consistency, enabling the facility's operation managers to react efficiently to changing situations.

World first: a digital twin of an airline's central kitchen has been created.