The CAPS application showing interactive 4D airspace – flight plan conflict analysis

TOWARDS A SMART DIGITAL REALITY

Digital transformation can bring innovation and efficiency to global aviation

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The Covid-19 pandemic's impact on the aviation industry has been unprecedented. While air traffic reached a record-high level of 39 million flights in 2019, it came to a sudden halt in March 2020, with travel restricted worldwide to reduce the spread of the virus. The International Air Transport Association (IATA) estimated that the airline industry could lose up to US$250 billion in revenue, a 55% decline compared to 2019. Such a massive disruption, of course, has an immediate and profound impact on the industry and its bottom line.

However, it also provides an opportunity to re-evaluate the status quo and implement changes in the sector that could result in more efficient and effective operations and better outcomes.

In terms of technology, the pandemic provides an opportunity to take digital transformation to the next level. There is a major evolution in terms of Big Data in aviation, with annual data generation expected to reach 98 million terabytes by 2026, according to Forbes. Technology that leverages this data is essential to optimise operations in aviation and to provide answers to many of the top concerns in the industry, including fuel and cost efficiency, delay reduction, airport safety, weather hazards and noise and air pollution.

Sink or SWIM

Despite the downturn caused by Covid-19, air traffic will resume and continue to grow, which requires the industry to make the most of limited runways and airspace capacity. A central piece in aviation modernization programs worldwide – such as NextGen in the USA and SESAR in Europe – is System Wide Information Management (SWIM), an integral part of the ICAO Global Air Navigation Plan (GANP). SWIM provides open standards, infrastructure, and governance to enable globally interoperable systems and data for the air traffic management (ATM) network. While SWIM is a key enabler to pave the way for future aviation traffic growth, it also helps reduce costs by decreasing the number and types of interfaces, systems, and facilities.

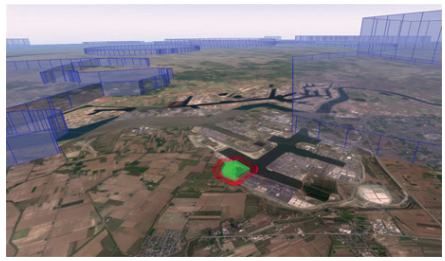
As an example, together with Airbus Defence and Space, Hexagon developed the Collaborative Airspace Provision Service (CAPS) application to find and reserve free portions of airspace while minimizing conflicts. A key part of the CAPS application is the use of open interfaces from Open Geospatial Consortium (OGC) and SWIM-adopted standards: AIXM for aeronautical information, WXXM for

weather data exchange, and FIXM for flight plan data exchange.

These digital formats enable a very accurate, high-quality representation of the current and predicted airspace situation. By relying on complex situation analysis using predicated flight positions (4D trajectories), airspace reservation times, and high-speed calculations (interactive visual analytics), users can immediately see the impact of an airspace reservation, leading to more efficient decision making by ATM operators and airspace users.

Moreover, the use of a standardized, interoperable airspace reservation representation using AIXM 5.1 enabled Airbus Defence and Space to easily integrate it with their other SWIM-enabled operational systems. By relying on Hexagon's COTS components to work with myriad data sources and categories, the engineering team could entirely focus on the business logic rather than on the technology to achieve it, making it possible to develop the solution within a period of four months or approximately 500 working hours. Comparing these numbers to previous development projects of the same size by the company shows clear savings in development costs since other applications of the same maturity level took approximately 3 times as many working hours.

Another example comes from Lufthansa Systems, which also relies on Hexagon's Luciad SDKs and server application for its Lido/Flight WINDS flight dispatch system. The software optimizes flight plans for



Left: Unifly's innovative platform allows users to see reserved airspaces and no-fly zones to safely plan their UAV routes
Below: A display of alternative Lufthansa flight paths to avoid a cyclone and other airline flight paths

commercial aircraft. This system initially focused on the pre-flight phase, but with the help of Hexagon's technology to support real-time 4D visualization, Lufthansa Systems extended this to support airliners in flight. This helps pilots steer clear of costly delays and obstacles while in flight. The weather along the US East Coast is generally unpredictable; storms can develop within hours. Airlines that could avoid diversions because of storm fronts would save tens of thousands of dollars each time. With the Lido/Flight WINDS, dispatchers can react to storm predictions to alert pilots who would otherwise be taken by surprise.

The system directly exploits the power of the underlying Hexagon technology, including the ability to combine any number of data layers, GPU-accelerated visual analytics in 4D, and the power of handling dynamic data such as video feeds and weather data. The technology and its intuitive interface also align with Eurocontrol's plans to shorten cycles in opening and closing airspaces, which is expected to reduce reaction times from half an hour to just 5 minutes.

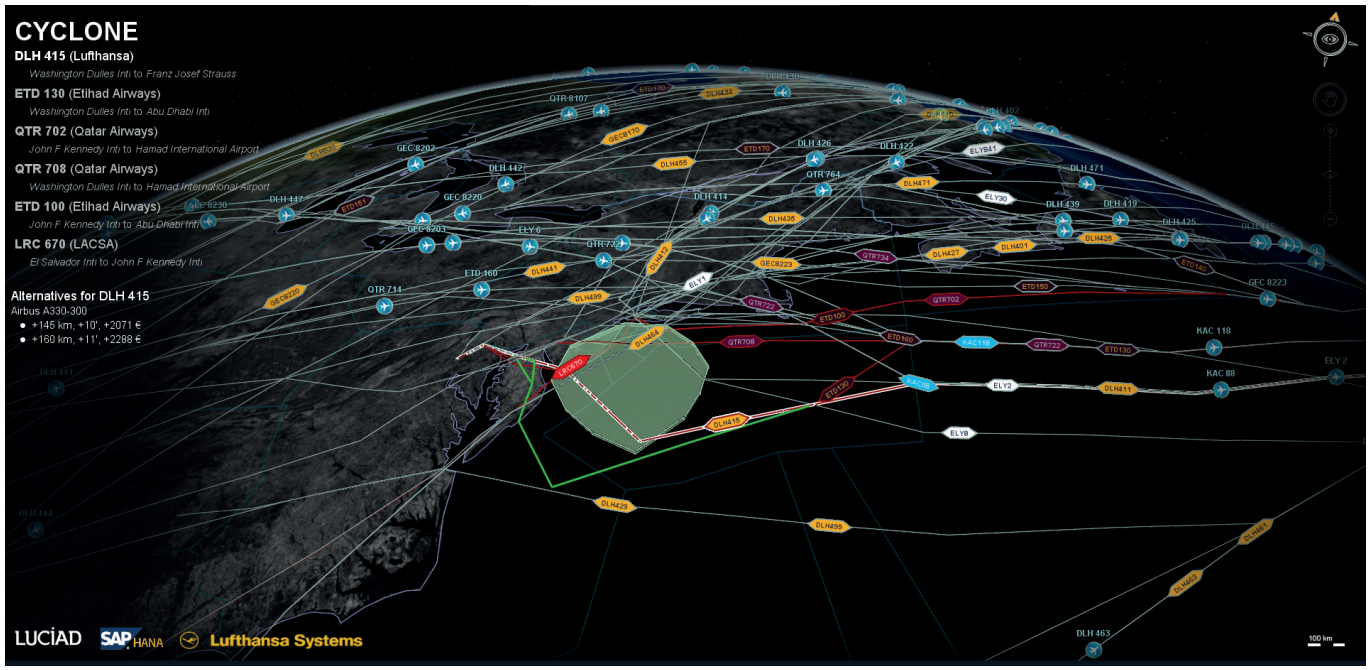
Embracing unmanned air traffic

Drones are a growing business across the world, delivering services in all environments, including urban areas. Mapping, infrastructure inspections, and precision agriculture are a few of the common commercial services that utilize drones. Another is deliveries.

During the Covid-19 lockdown, many people turned to e-commerce to buy goods. However, in terms of social distancing, this created health risks for the delivery person and the customer. As a result, there has been a renewed interest in the use of autonomous drone deliveries.

Companies such as Wing, a subsidiary of Alphabet, and Amazon's Prime Air Unit are working to provide delivery services using drones. Both teams have been working on trials and pilot programs in cooperation with aviation authorities like FAA and SESAR Joint Undertaking to safely integrate drone traffic into the aviation system, since strict drone regulations in many countries prevent rollouts at such scale. In the UK and the US, for example, current regulation makes it illegal to fly drones out of a pilot's line of sight.

While aviation authorities and regulations play a key role in the rollout of drone

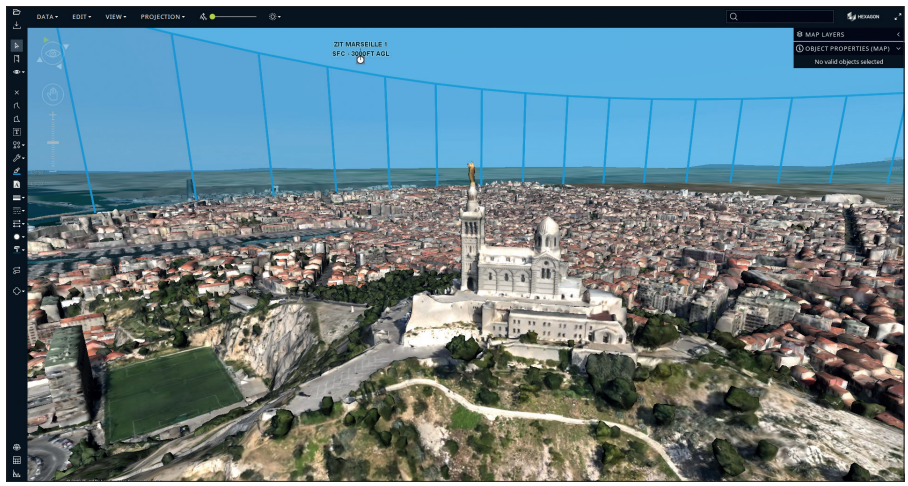


deliveries, the underlying technology is ready to safely integrate drones into the manned aviation system. Unifly, a leader in unmanned air traffic management software, introduced a cloud-based software platform to safely plan and fly unmanned vehicles in commercial airspace and to share the real-time position of drones into the aviation system. The platform is created on top of Hexagon's geospatial software components and is defined as a services-oriented architecture, entirely based on open and proven SWIM standards and interfaces that maximize interoperability and reusability. Any system supporting SWIM can directly connect and use the information.

Immersive experiences

Despite the impact of the COVID-19 pandemic, technological breakthroughs and innovations are continuing to take place. One disruptive technological trend that will define the next decade is the move towards creating immersive digital experiences encompassing digitally extended realities and digital copies of the real world. Earlier this year, Hexagon introduced HxDR, a new cloud-based digital reality visualization platform.

HxDR creates accurate digital representations of the real world through the seamless fusion of reality capture data from a suite of airborne, ground, and mobile sensors. Users can then leverage the complete, accurate, and precise real-world replicas to visualize and share their 3D design projects and models within a real-world context. The technology combines advanced visualization technologies, AI, and machine learning along with professional airborne reality captures.

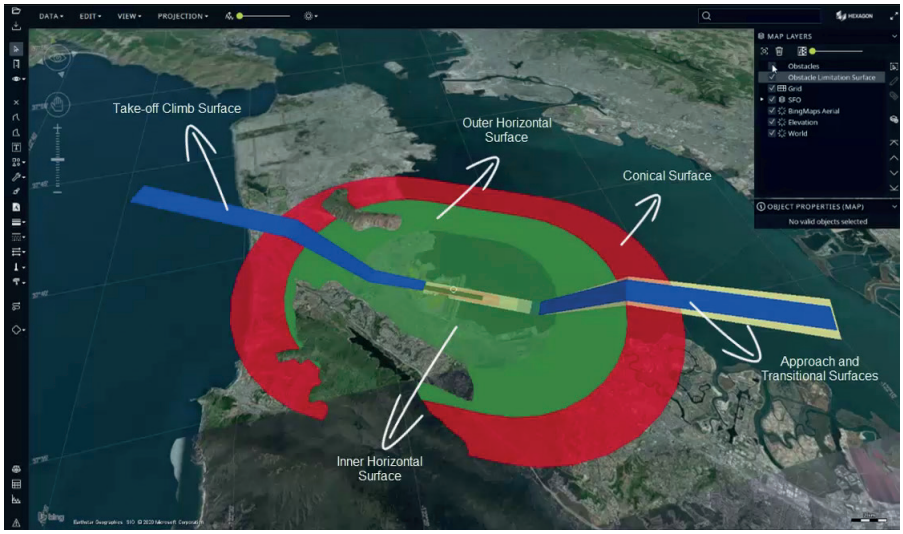


Above: Display of a 3D reality mesh of Marseille in combination with a temporary no-fly zone around the city centre
Below: Dynamic OLS visualization around San Francisco International Airport

Letting users create their own digital realities addresses the growing need for simple-to-create yet highly sophisticated and accurate visualizations of reality capture data that boost project efficiencies and cost savings. One potential use case in aviation is airport clearance analysis, to investigate the impact of obstacles, such as buildings and cranes, around the airport.

While clear skies and forecasts play a major role in safe aviation operations, situational awareness closer to the ground is also critical. That's where obstacle limitation surfaces (OLS) come in. This key concept, defined by ICAO for Airport Clearance Management, aims to ensure the safety of aircraft operations. With an OLS, ground control managers can visualize and analyse plane take-off and landing clearances in 3D to ensure safe operations. In addition, air navigation service providers (ANSPs), airports, and local authorities can use an OLS to check whether a construction project is safely outside the necessary parameters to avoid the possibility of collisions.

To improve the user experience and show the predicted reality, this can be combined with a reality capture from the airport and its environment. Hexagon's technology supports loading 3D reality captures through open interfaces from the OGC, along with electronic terrain and obstacle data through a variety of digital terrain and aviation data formats such as AIXM 5.1. The OLS itself is defined as a 3D entity according to ICAO Annex 14 standards and accounts for the elevation surface. The user can drag and drop any 3D obstacle, such as a CAD model. The eTOD tool checks dynamically for collisions between the obstacle and the OLS and updates the styling accordingly as the user moves the obstacle.



A time for change

The use cases and technology insights in this article illustrate the vital role of embracing digital innovations in light of challenges like the Covid-19 pandemic. Next to addressing many of the top concerns in aviation such as airspace, and flight planning optimization, integration of drones in commercial airspace and airport safety management, the use of state-of-the-art SWIM standards and services also helps to significantly reduce development and integration costs. By embracing this digital transformation and the sensor, software, and autonomous solutions that serve as the foundation and catalyst for change, the aviation industry can achieve new levels of efficiency in the delivery of their mission- and business-critical operations. ❖