RISING PERFORMANCE

AIRPORT OPERATORS MUST COMPLY WITH RIGOROUS INTERNATIONAL SPECIFICATIONS FOR FACILITIES AND SAFETY. ERIK DAHLBERG REPORTS ON A ROMANIAN COMPANY THAT USED A BLEND OF GEOSPATIAL TECHNOLOGIES TO DELIVER COMPREHENSIVE, TIMELY INFORMATION

Civil aviation is an outlier. It's among the few industries where tight government regulations are widely accepted – and with good reason. The aviation industry's exceptional record of safety and efficiency comes as a direct result of tightly defined and consistent regulations for equipment, infrastructure and procedures in the air and on the ground.

But it's not easy. To maintain certification, airports and facilities must be able to document that they comply with national and international requirements. As a result, the civil aviation industry has become one of the most demanding consumers of geospatial data.

The basic need is not new. In a situation experienced by geospatial professionals around the world, aviation clients want information that is accurate and up to date. The difference lies in the details: how, where and by whom the data will be used helps determine the best approach to collecting, managing and analysing field information.

For airports, the work to gather and maintain the needed information can be a daunting task. In western Romania, SC Gauss LLC, a surveying consultancy in the city of Timisoara, uses a blend of geospatial technologies to provide precise information on airport facilities and airspace obstructions. According to Cristian Iosub, head of GPS and mobile mapping at Gauss, the new solutions have opened a significant business opportunity.

Gauss initiated work in 2014 to gather geospatial data for the Timisoara Traian Vuia International Airport (TVIA). The airport serves Timisoara, Romania's third-largest city and the economic hub of western Romania. According to the most recent available data, in 2015 TVIA handled more than 924,000 passengers and 12,000 aircraft take-offs and landings. Iosub said the project presented Gauss with an opportunity to establish a long-term relationship with an important client by enabling TVIA to document compliance with ICAO regulations. At the same time, the work could demonstrate Gauss's capability to handle large, complex projects.

Airports are notoriously busy and complex places. Their operations are subject to exacting specifications for construction and maintenance of infrastructure including runways, taxiways, parking areas, terminal buildings and myriad utilities, fuel systems and supporting facilities.

In much of the world, the regulations are set by the International Civil Aviation Organization (ICAO), a specialised agency of the United Nations that maintains policies and standards for safe, efficient and sustainable operation of global civil aviation. The Romanian Civil Aviation Authority (AACR) sets aviation standards for Romania; AACR rules closely follow the ICAO regulations.

Rules and regulations

The ICAO specifications for airports are exacting. There are details about everything from runway dimensions and materials down to aircraft parking spaces and placement of lights and signs in the airfield. It's essential for airports to comply with the ICAO and national regulations. Loss of certification could cause civil aviation to drop off,

which would result in serious economic losses to the region served by the airport.

The onus for compliance falls to the individual airports. They must be able to document and demonstrate conformance with applicable regulations. To do so, airport operators must know the location of every component of airport infrastructure – an ideal application for geospatial technology.

But the ICAO requirements extend well beyond the airport fences. To ensure safety for aircraft servicing the airport, the regulations require airspaces surrounding an airport to be free of obstacles. The airspaces are described using obstacle limitation surfaces, which delineate the extents of airspace around the airport that are covered by restrictions on structures that protrude into the airspace.

The surfaces are defined by the distance from the airfield and relationship to routine and emergency flight paths followed by aircraft approaching or departing the airport. Airport operators need to identify objects that might protrude into the airspace and capture data on the location and height of the object. Because the height of the limitation surface above the ground varies as the terrain changes around the airport, accurate elevation data is essential.

Iosub explains that there are big differences between the information needed for airfield assets versus the obstacle limitation surfaces. "Certification and compliance for airport design needs detail on thousands of assets with centimetre precision," he says. "It covers several square kilometres to include all on-airport facilities. In contrast, obstacle limitation needs less detail, but covers a much larger area surrounding the airport. The required precision goes down as the distance from the airport increases."

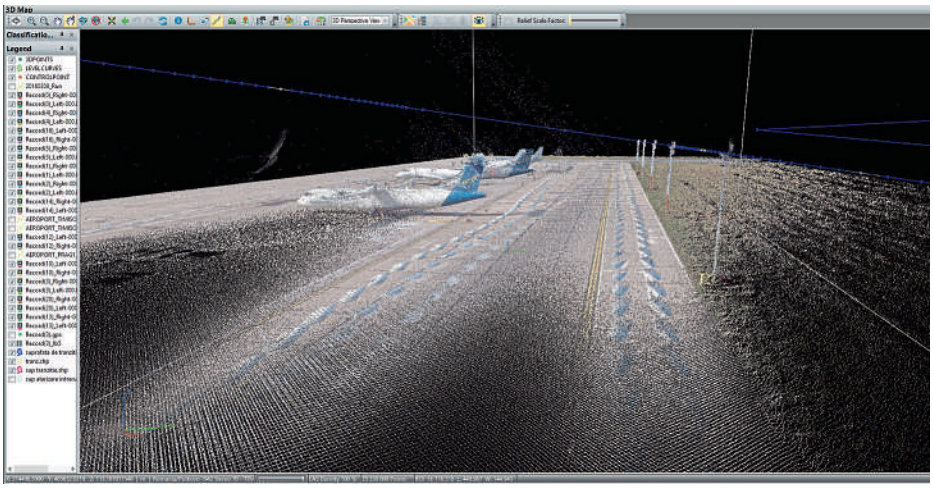
To meet the different requirements, Gauss called on its array of positioning tools and expertise. The technologies included mobile mapping using a vehicle-mounted scanner, camera and positioning system as well as survey-grade GNSS receivers and total stations.

Gauss also needed to acquire new expertise for working to ICAO specifications. Iosub travelled to Bucharest to complete special training courses and examinations on ICAO and AACR requirements to become certified for the airport work. Other members of the Gauss teams received training on airport safety and security procedures and passed background checks to be credentialed for access to the airport's secure areas.

Scanning data from the mobile mapping system at the TVIA terminal area. The system used LiDAR and imagery to produce detailed database of airport assets

A high-level view of the 3D point cloud for the Timisoara airport. Surveyors needed roughly four hours to capture the information for the airfield and terminal areas

Gauss used a Trimble MX2 mobile mapping system to capture georeferenced scans and images at the Timisoara airport. They also use the system to survey highways and utility corridors



Mobile mapping data for the airport provided locations for all airfield assets. Users can extract precise measurements to document compliance with national and international regulations

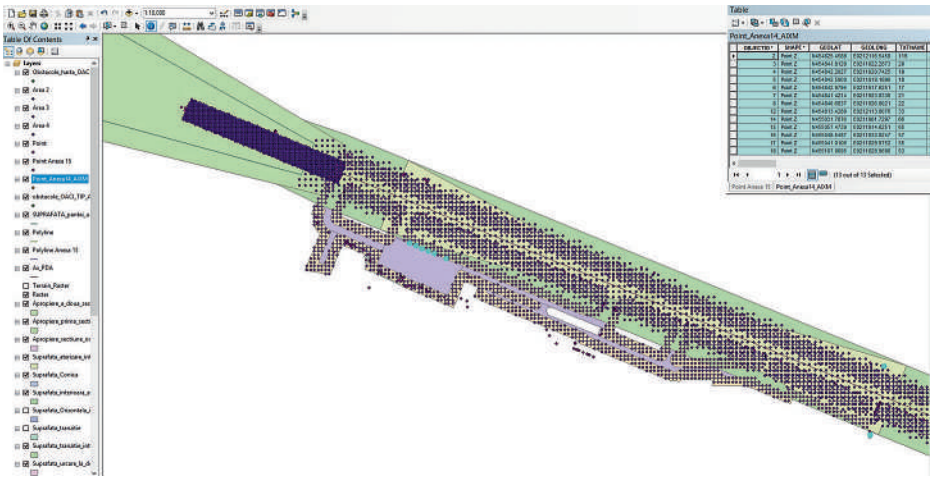
One airfield, four hours

To gather information on assets and obstructions, airports typically rely on classical survey data collection. The process provides the required detail and precision, but can be very time-consuming. Additionally, because the presence of survey teams can affect aircraft operations, much of the work must take place at night or during other 'slow' periods, further adding to the time and expense of acquiring data.

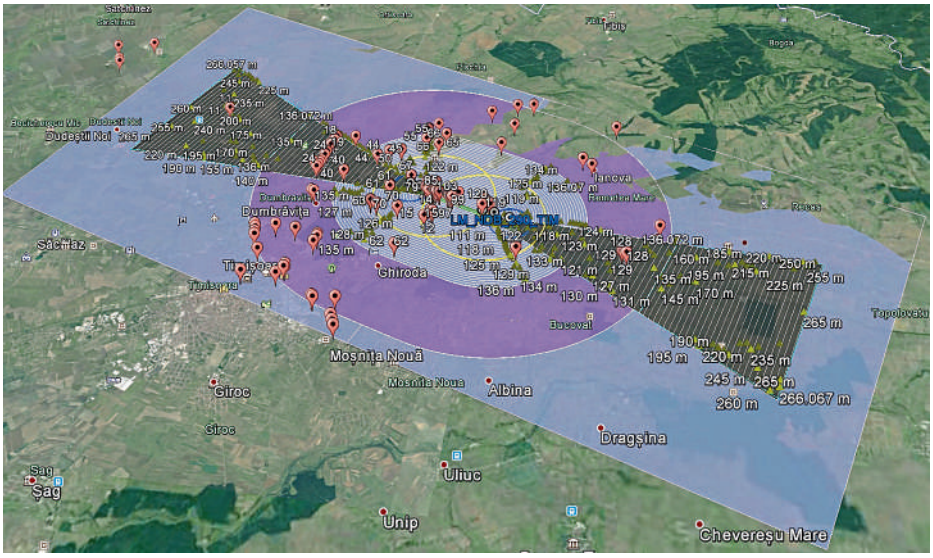
Gauss decided to bypass many of the challenges by using mobile mapping technologies for much of the work. The company had purchased a Trimble MX2 vehicle-mounted spatial imaging system the previous year for use in highway corridor surveys. Iosub knew that when used in conjunction with precise GNSS, the MX2 could provide the precision, accuracy and speed needed for the airport project.

The mobile mapping work commenced in April last year. As part of the initial project planning, Gauss personnel identified a series of WGS84 geodetic control points at TVIA. They conducted static GNSS measurements to confirm the points' locations and stability. One point would serve as a reference station for the GNSS measurements during the mobile mapping. A Trimble NetR9 GNSS reference receiver with a Trimble Zephyr geodetic antenna installed over the designated station collected data for GNSS post processing. The other stations could be used as check points for quality control.

To meet ICAO requirements, Gauss needed to map an area at the airport measuring roughly 5.5km by 0.8km. While the MX2 LiDAR sensors have a range of 250m, Iosub decided that working at a shorter range would provide higher data



A portion of the GIS database that Gauss developed from the mapping surveys. The database extended to include obstacle locations several kilometres from the airfield



Obstacle analyses around the Timisoara airport. Gauss combined computed surfaces with existing maps and elevation data to identify potential obstacles

density. The team divided the project into strips 120m wide. With the MX2 installed on a small car, they could drive along the centre of each strip at a speed of 20kph.

With the control and route planning in place, the Gauss team started driving. Each run collected roughly nine million 3D points, along with georeferenced imagery. They completed the survey of the airport in less than four hours and collected about 330 million points. Because of the short time required for data collection, the team could easily work around the airport's busy periods for aircraft operations.

For the initial post processing, Iosub used Applanix POSPac Mobile Mapping software. The software combined data from the GNSS and inertial instruments in the MX2 to produce a precise trajectory of the LiDAR and camera mapping sensors. Next, the team used Trimble Trident software to process the LiDAR data into a point cloud and merge the imagery with the 3D data. They also used Trident to extract specific features and measurements from the LiDAR data.

The Gauss team followed a comprehensive quality assurance process for the survey and data extraction. Using RTK GNSS tied to the Romanian national grid (Rompos), they verified key points and features and provided an independent check on the accuracy and consistency of the LiDAR results. The team also used a Trimble R10 GNSS receiver and Trimble S7 total station to locate certain additional features not captured by the MX2. The conventional data was loaded to Trimble Business Center software (TBC) for processing and analysis of the survey information.

Mapping safe airspaces

The next part of the work took the Gauss staff outside of the airfield fences, where they needed to identify and measure objects that could potentially penetrate TVIA's obstacle limitation surfaces. ICAO specifications define two areas for locating obstacles based on distance from the airport. Objects in the second area can be located with precisions of tens of metres. But in Area One, closer to the airfield, Gauss needed locations with precision of 3-5m.

Iosub and the team defined the two areas and created a software model of obstruction surfaces. They combined the model with national maps to identify potential obstructions, pulling information from government databases to obtain rough elevation and locations of potential obstacles. In the field, they used a total station or GNSS to capture location and elevation of the base of the obstacles. Using defined forms for data collection, they captured accurate locations, with total station or LiDAR measurements providing the height of the object.

A new opportunity takes off

The airport survey produced a large, detailed database of the entire airfield and surrounding facilities. Gauss can use the points and imagery to extract information including runway dimensions and profiles, lighting and markings on runways and taxiways. The company provided free Trident Viewer software to TVIA, which enabled airport officials to visualise the site and request specific information. Gauss also transferred the airfield data into an Esri ArcMap database.

Iosub remains in frequent contact with airport officials, who often request additional information or detailed measurements. In nearly all cases, he can provide data quickly: it's simply a matter of extracting the new information from the Trident or ArcMap databases. TVIA has prepared photos and movies using the Trident Viewer, which they use to provide measurements and visual proof of compliance. The data enables the airport to pass inspections without the need for extra visits to the field.

The work required a significant investment by Gauss in training and certification, but Iosub feels it was a good business decision. "It's not over yet," he says. "The client needed the data quickly and we were able to satisfy their needs. They trust us and continue to ask for additional information." Iosub expects to do another survey soon and will use the data to update and maintain the point cloud and master database.

The work at Timisoara is opening new doors for Gauss. "The European Union has a lot of requirements for airport regulations," Iosub explains. "We have demonstrated that we can gather data quickly and work with the regulations. Other airports are already asking about it. Investing in new tools and expertise makes it easier to do complex projects and attract new business."

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