

Airports Turn to GIS to Manage

Enterprise GIS at Airports Resembles Those of Cities

Over the past five years, airports have begun resembling municipalities in the scope and complexity of their GIS applications. Because many major airports now function as large cities – comprised of multiple departments each with its own use for geospatial data and functionality – the evolution of GIS in aviation has recently focused on integrating data into a single database and serving it out to several user groups via the web. As a result, airports routinely use GIS technology to perform daily operations and to manage capital programs. Three airports in Europe – Copenhagen Airport in Denmark, Lyon-Saint Exupery in France, and the Airport of Frankfurt/Main, Germany – are among the leaders in developing and applying the latest geospatial technology.

By Kevin P. Corbley

Airports Resemble Cities

In many ways airports operate in similar fashion to small cities: they cover large land areas and have numerous departments responsible for the maintenance of specific infrastructure segments. Pavement, buildings, power networks, water/wastewater systems and traffic are all elements whose proper management and safe operation are relied upon by airports and cities alike. It is, therefore, no surprise that air-



Lyon-Saint Exupery Airport

ports should follow municipalities in their quest for enterprise GIS implementation. Since the late 1990s, the trend among municipal GIS users has clearly progressed toward sharing data among offices and extending geospatial analysis functionality to the entire workforce through simple-to-use applications available over an intranet, the Internet or wireless means. Airports have caught on to this trend and are rapidly becoming savvy users of web-based GIS technology. Many are now planning to take the next step in GIS implementation by putting wireless location-based services applications into the hands of their field crews. Representatives from three European airports reported on their progress in achieving these goals at the GeoSpatial

World Conference sponsored in May 2003 in New Orleans, Louisiana, by Intergraph Mapping and Geospatial Solutions of Huntsville, Alabama, USA.

Airport Frankfurt

The Airport of Frankfurt/Main is one of the busiest in the world, each year serving approximately 49 million passengers and conveying 1.62 million tons of cargo. More than 120 air carriers flying to 290 destinations in 108 countries account for about 460,000 aircraft movements annually. The 19-square-kilometer airport is poised for expansion of both land area and flight operations, and GIS will play a pivotal

Expansions and Daily Operations

role. As manager of the airport and its 62,500 employees, Fraport AG of Frankfurt is spearheading a GIS enhancement project that will soon benefit the planned airport expansion program and rainwater runoff activities. The airport was an early adopter of digital spatial technology, first utilizing CAD in 1989 for documentation of architectural information. In 1992, the airport migrated its CAD to Intergraph's MGE GIS platform with an Oracle database to handle increasing demands for spatial data applications.

The primary GIS database contains a dozen feature layers, such as topography, land register, buildings, power equipment and key utility networks. These networks include 200 kilometers (km) of pipes for rain water runoff, 110 km of waste water

conduits and 115 km of fresh water supply. "New business requirements and increased cooperation between the different business units of Fraport created the need for new technology," said Joachim Becker-Sahl, Fraport's Manager of CAD and GIS Software. Fraport selected Intergraph's GeoMedia line of GIS products to interface with the existing database and serve data to various airport offices via the web. The upgrade to GeoMedia was made because this software could handle existing data in its native DGN format without the need for a costly conversion or migration to a new database. In addition it can import data in other GIS formats from parties outside the airport.

This latter capability had become a necessity as Fraport prepares for the complicated real estate transactions that will occur to

accommodate the airport expansion in all directions. Land ownership and related spatial data is being supplied by adjoining land owners as the plan moves forward.

Fraport is relying on GeoMedia to integrate these diverse data sets into a single cohesive data set that will be used as a reference during the transaction and after the land becomes part of the airport. In terms of anticipation, however, airport personnel are looking forward to a pilot program involving GeoMedia

PublicWorks Manager, a software designed to manage water and wastewater projects. At the Frankfurt airport, designers and engineers must constantly be aware of the percentage of impervious surfaces that contribute to rain water runoff. The network of wastewater pipes must be sufficient to handle the drainage, now and in the future when the airport is larger.

In 2004, Fraport will kick off a pilot project using the Advanced Feature Model in

GeoMedia PublicWorks Manager to analyze and establish suitable relationships between features, such as pavement and wastewater pipelines. If successful, the project will be expanded to assist in devising water drainage plans for the existing land area as well as the new runways.

Improving Safety in Copenhagen

Copenhagen Airport in Denmark is another major European aviation hub, serving nearly 20 million passengers per year. More than 90 percent of Copenhagen travelers arrive from or depart to international destinations. The airport also counts itself among the growing number worldwide that have dedicated significant space to retail shopping. Airport grounds total 11.8 square km. In 2001, the airport contracted NIRAS Consulting Engineers and Planners Inc. of Denmark to direct a major GIS implementation. With a background in spatial technology limited to CAD-based data and applications, Copenhagen Airport has a new goal of providing sophisticated GIS functionality to all relevant airport personnel regardless of their location. This means NIRAS is implementing GIS for the desktop, via the intranet, and soon on wireless personal data assistants (PDAs).

"The GIS strategy evaluated the status of the airport, in particular its current GIS data and needs for future functionality, as well as the need for an enterprise-wide GIS capable of smooth adoption to different applications and easy integration with other IT systems," said Ole Johansen, Manager of the GIS Competence Center within NIRAS. Based on these criteria, the airport has selected Intergraph's GeoMedia and GeoMedia WebMap packages as the main platform upon which the entire GIS system will be built. In addition, NIRAS has recommended using IntelliWhere OnDemand from Intergraph's IntelliWhere Division to serve GIS data and applications to handheld PDAs.

The primary data layers for the new GIS include MicroStation CAD files of the entire airport infrastructure including buildings, pavement, runways, and pipelines, as well as building floor plans and airport engineering



Noise monitoring of Fraport AG with generalized base Map of Rhein-Main Area as background.



Classification of areas at the Frankfurt Airport (bitumen, concrete, green area, gravel, crushed stones, lawn lattice stones, group plaster)



Map of the central area of Roskilde Airport, a general aviation facility under the administration of Copenhagen Airport.

designs. All GIS data sets are being migrated from CAD to a single spatial database for access by GeoMedia. The GIS is already being used to create basemap layers including orthophotographs. Elevation data from a recent radar survey has also been collected for inclusion in the database.

Three GIS pilot applications are now underway at the airport. Although rather simple, the first was very important. Its objective was to produce a Restricted Vehicle Route Map of Roskilde Airport, a general aviation facility administered by Copenhagen Airport. The airport's Document Centre extracted street polygons from the basemap data and overlaid them with restricted route vectors, which indicate where surface vehicles are permitted to travel on the airport grounds to avoid accidents with aircraft. This small map was printed and is handed to the driver of every delivery truck entering the security gate to ensure they know where to go.

Another pilot just beginning is an analysis of bird strikes, a potentially disastrous incident at an airport. The Bird Strike Office within the Traffic Operations Department is using GIS to map the locations of bird sightings and any collisions with aircraft that do occur. Personnel are examining how this information might be used for risk analysis so that preventive measures can be taken to minimize the risk of a strike. It is planned to have airport field crews equipped with PDAs to digitally pinpoint bird sightings around the airport and transmit this data back to the Bird Strike Office.



Copenhagen Airport

With Copenhagen Airport undergoing construction for the addition of new terminals, Traffic Operations has embarked on a unique and potentially valuable pilot program involving height limitations. The objective is to use the GIS to create a 3D airport grid which engineering personnel can use to isolate any spot on the airport grounds to determine if a construction crane of a given height can be safely placed there without interfering with aircraft traffic.

Traffic Operations routinely calculates height limitations allowing safe clearance around runways for landing or departing aircraft. The department is using GeoMedia to integrate this data with new digital terrain and surface models extracted from the radar survey to measure actual height allowances for construction equipment across the airport. These height restrictions will be represented as a GIS grid covering the entire airport, making it simple for anyone to click on a ground point and see what the height clearance is there. Copenhagen has additional plans to develop other desktop and mobile GIS applications to meet the needs of airport departments such as environmental protection and airport security.

Going Mobile in Lyon

The Lyon Chamber of Commerce and Industry manages the Lyon-Saint Exupery Airport with a keen eye toward generating revenue to the local economy. One way the Chamber has accomplished this is by aggressively maintaining the airport infrastructure and facilities. Since 1990, the airport has implemented a variety of GIS, CAD and automated applications. Falling under the responsibility of Information Systems (IS) are software systems relating to computer-assisted maintenance management, property rental, and communications network.

"For property to be well managed, it must be known well," said Pascal Deborde of the Lyon Chamber. "This knowledge must be shared by all those concerned in the organization as well as other applications of Information Systems." With this objective in mind, the Chamber has implemented GeoMedia Professional and GeoMedia WebMap to manage and serve the reference work data sets to the various IS applications. The reference work data

refers to building drawings, as-built infrastructure and utility network diagrams, and equipment locator documents – the source information required as inputs for the primary IS applications.

Previously, each application had its own database of reference information that could not be easily accessed and shared with other departments. With the implementation of GeoMedia running on top of a single Oracle Spatial database where the data is now stored, any airport department can retrieve reference work data digitally. Both data and GIS functions are served over the airport intranet using GeoMedia WebMap. Now under development is a

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pilot program to make the reference data sets available to mobile crews using HP iPAQ PDAs running IntelliWhere OnDemand. This will allow crews to search for and locate equipment in the field and review documentation relating to it simply by querying the PDA with a wireless intranet connection. The Chamber expects to dramatically enhance the efficiency of its mobile personnel thanks to this take-anywhere GIS application.

The Sky is the Limit

Representatives from each airport expressed optimism that GIS use, especially mobile applications, will grow substantially in coming years as long-time users find different ways to implement the technology. And with the data now freely distributed to personnel in nearly every airport department, unique new applications will be found as first-time users learn to apply geospatial technology.

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