Transportation GIS Trends

ESRI • Spring 2010

GIS for Transportation

Server GIS Buses in Change for Danish Public Transit Agency

By Matt Freeman, ESRI Writer

Movia is Denmark's largest public transit agency, providing 214 million passenger trips per year in the Greater Copenhagen area and parts of eastern Denmark. With 570 bus lines and 9 local train lines in its coverage area, Movia strives to meet the daily transit needs of 2.4 million inhabitants with an employment base of 1.2 million jobs.

For the public transit agency, planning and maintaining bus routes are vital parts of its business, but until recently, the workflows and processes of transit planners were not as efficient and streamlined as Movia would have preferred. Movia has many dedicated employees, but the transit agency's computer systems and internal processes needed a technological boost to streamline its business processes.

When planners needed vital transit planning data, such as demographic characteristics

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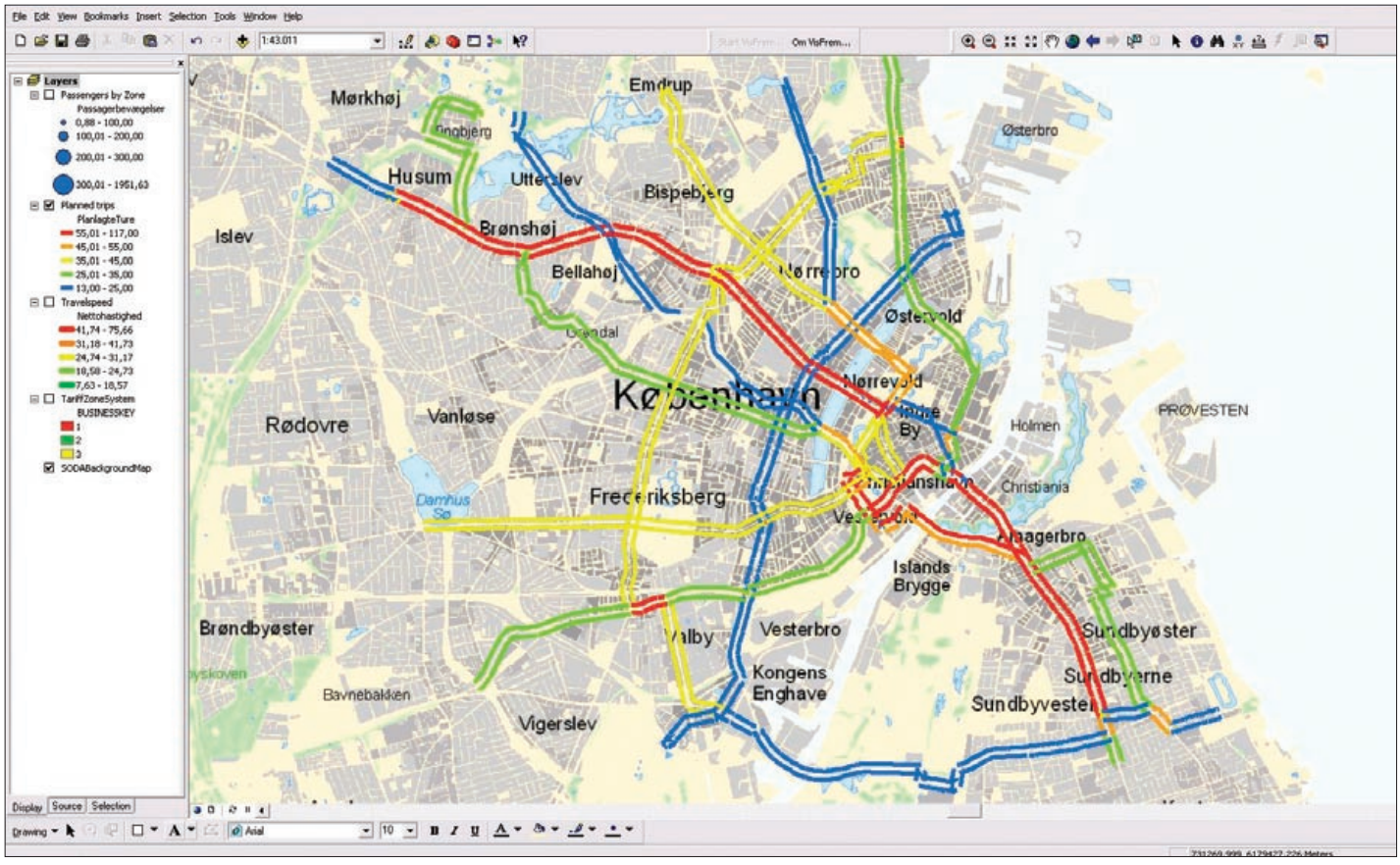
In This Issue



Movia's GIS provides an accurate picture of the number of buses and their routes during rush hour.

ESRI on the Road

ESRI International User Conference
July 12–16, 2010
San Diego, California USA

International Traffic Records Forum
July 25–28, 2010
New Orleans, Louisiana USA

American Railway Engineering and Maintenance-of-Way Association (AREMA) 2010
August 29–September 1, 2010
Orlando, Florida USA

American Association of Port Authorities (AAPA) 2010
September 19–23, 2010
Port of Halifax, Nova Scotia, Canada

InnoTrans
September 21–24, 2010
Berlin, Germany

Airports Council International (ACI) North America
September 26–29, 2010
Pittsburgh, Pennsylvania USA

Post Expo 2010
October 6–8, 2010
Copenhagen, Denmark

American Trucking Association (ATA) National Conference
October 16–19, 2010
Phoenix, Arizona USA

ITS World Congress
October 25–29, 2010
Busan, South Korea

ACI World 2010
November 1–3, 2010
Bermuda

TransComp 2010
November 12–17, 2010
Ft. Lauderdale, Florida USA

Talking Transportation

Terry Bills
ESRI Industry Manager
Transportation and Logistics

Welcome to the spring 2010 issue of *Transportation GIS Trends*. In this issue, you will find articles covering the wide diversity of topics in transportation GIS, such as a common operating picture at a port, an enterprise GIS at an airport, and a right-of-way management system for highway and rail agencies. I'm especially proud of the Movia and Phoenix Sky Harbor International Airport articles in this issue. Both of these stories represent great success in transportation GIS.

The Movia article points out how the desire to more effectively use internal information sources led the Danish public transit agency to create a comprehensive spatial information system. The new system allowed Movia to provide better service to its customers and improve bus routing, in turn reducing carbon emissions.

In the last few years, we have witnessed a tremendous interest among public transit agencies in how GIS can help them improve not only service but also their operations and customer satisfaction. Movia is certainly at the head of that trend, and it is no surprise that Copenhagen is one of the world's leaders in terms of public transit and the use of nonmotorized (bicycle) transportation.

Phoenix Sky Harbor International Airport represents another strong trend for GIS and airports. Because airports are generally revenue-producing entities for their cities, there is a strong emphasis on operational efficiency and return on investment for all IT procurements. It is to Sky Harbor's credit that it came to recognize that an enterprise approach would help the airport better manage many of its operations and provide a centralized store of information. The same spatial information can support a large number of applications, including facilities, lease, and maintenance and security management.

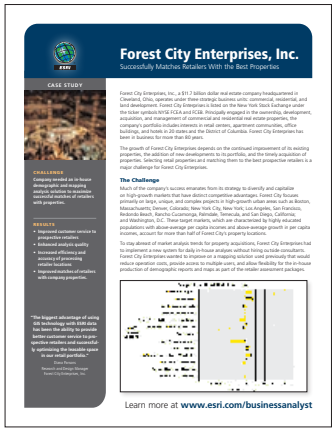
We believe that you will find new ideas from these industry-leading examples and that *Transportation GIS Trends* will continue to be a forum where transportation professionals can share their experiences and successes.

Along those lines, ESRI will soon be releasing a number of new resources for the transportation community. Look for the unveiling of a new transportation resources Web site at http://resources.esri.com/gateway/index.cfm. These new resource pages will give you a single place where you can go to get white papers, templates, best practices, data models, and data modeling help and communicate with other users attempting similar types of projects. In addition, there will be an active blog, and we will be soliciting guest postings from our user community in the near future.

Enjoy!

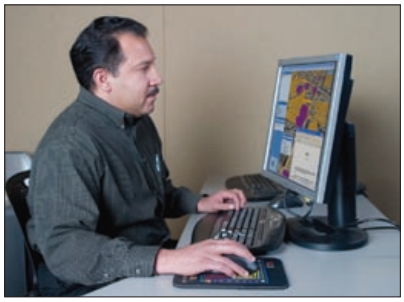
Terry Bills

Case Studies Wanted



Share the benefits of your GIS work with colleagues by submitting case studies for future issues of this newsletter. Topics include all transportation modes such as highway management, public transport, paratransit, postal address data management, port facility management, airport noise analysis, linear referencing methods, and railroad studies. Case study articles can be full page or half page and up to 800 words. We also like to include high-resolution screen shots or photography with the articles. To submit a case study article, contact Marshall Cammack at mcammack@esri.com or Terry Bills at tbills@esri.com**.**

Career Opportunities at ESRI



Are you looking for a career where you can apply your industry expertise in a challenging new way? Join ESRI and make an impact on the utilization of GIS in the transportation sector.

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ESRI to Develop Highway Maintenance and Linear Referencing Solution

Due to be released by ESRI at the end of 2010 is a comprehensive highway data maintenance and linear referencing solution. Aimed at highway departments, state departments of transportation, and national roadway administrations, it will provide an integrated set of tools and functionality that allows agencies to easily maintain highway geometry, their associated multiple linear referencing systems, and complex roadway features.

The highway data maintenance and linear referencing solution will use the newly updated ESRI transportation data model (www.esri.com/industries/transport/community/data_model.html). Designed to support the full agency workflow with desktop, server, and mobile versions, it will accommodate the myriad of ways in which highway agencies typically collect, edit, and maintain various roadway information. For U.S.-based state departments of transportation, a highway performance monitoring system (HPMS) reporting module will be included. A straight-line diagram tool will be available worldwide to all highway users and supported in the mobile environment for field data collection and editing. Additional features include the ability to define and configure specific workflows along with robust data validation tools.

> "We feel strongly that the finished product will allow many of our customers to more easily integrate information and take GIS to an enterprise level in their organizations."

"ESRI has assembled an excellent team to address a problem that has been a significant hurdle for many highway agencies for some time," says ESRI transportation industry manager Terry Bills. "We feel strongly that the finished product will allow many of our customers to more easily integrate information and take GIS to an enterprise level in their organizations."

The project, the result of highway agencies needing to support multiple spatial geometries with multiple linear referencing and route systems, facilitates the integration of roadway characteristic data. Since roadway data is often stored in a number of stand-alone applications, the ESRI solution is designed to simplify data integration while allowing various levels of customization to conform to preexisting workflows and business systems.

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Server GIS Buses in Change for Danish Public Transit Agency

and locations of educational facilities for route planning, it became evident that Movia's systems made workflows and processes too time-consuming and complicated. The agency concluded that to meet the increasingly higher demands of its customers, it had to make some technical updates to provide the best possible customer service and communications.

Movia set some goals that it believed would make the company a global leader in the transit industry. The agency's main goals were to design a more efficient workflow, increase customer service by providing real-time transit information, and create an integrated planning system where all the vital parts of transit planning and operations are integrated into one solution. Movia also wanted to have access to relevant data to perform analyses and forecasting to enhance its transit planning.

"The core idea was to improve transit planners' workflows by ensuring that they all had the relevant information readily available to them on their screen," says Movia IT manager Carsten Bo Jacobsen.

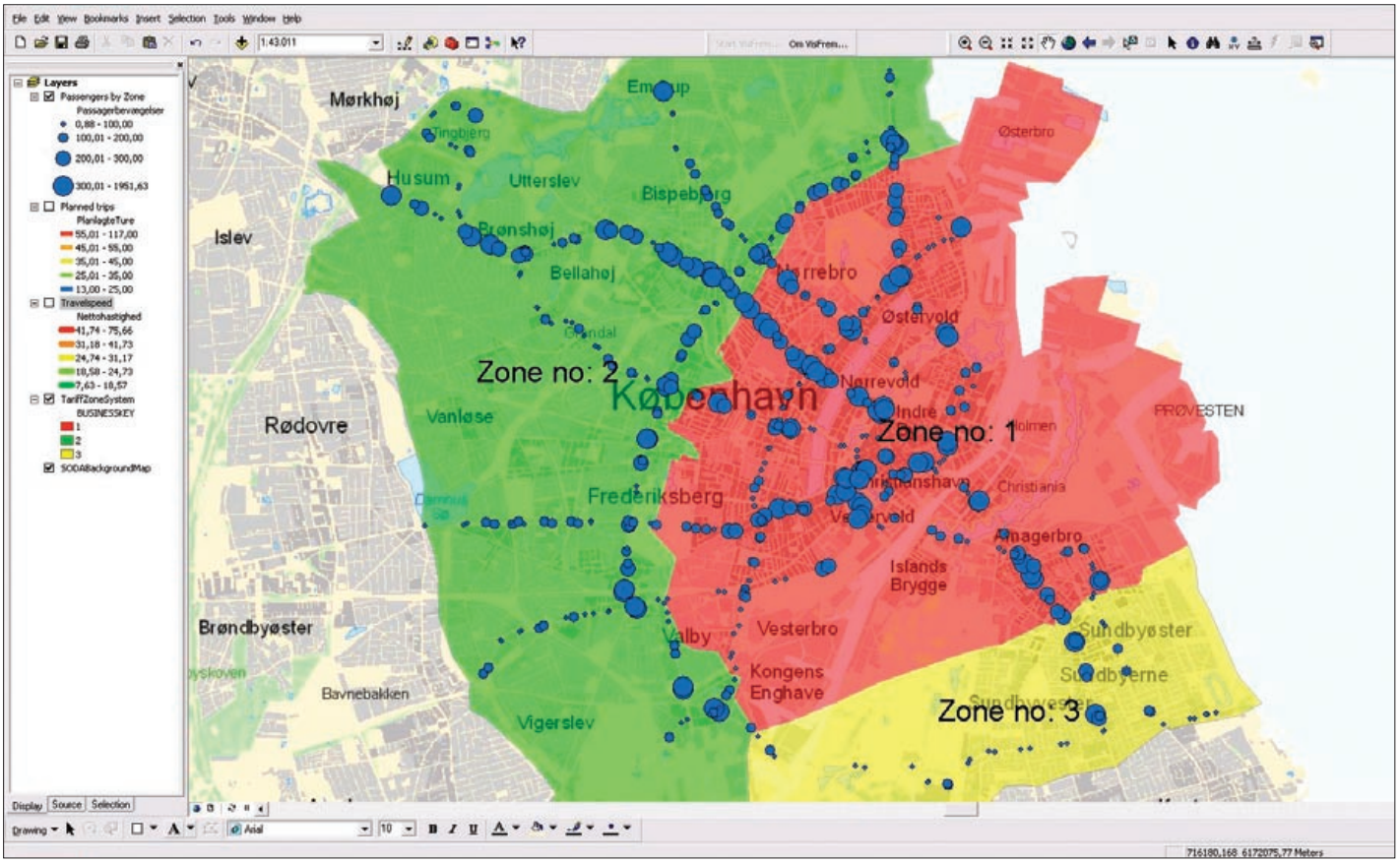
The integrated system that Movia was seeking did not exist in an off-the-shelf software solution. Therefore, the company sought a strategic cooperative relationship that could assist in developing and maintaining the desired solution. Movia found that Informi GIS A/S, the Danish distributor of ESRI geographic information system (GIS) software, offered the best solution and support to accomplish its goals.

"We chose a GIS platform, key in the IT architecture, as we believed that in travel planning and customer information, the map is the key element," says Jacobsen. "We chose Informi GIS and ArcGIS Server because we believed that at a strategic level, the pairing had the most to offer in relation to GIS collaboration and product development."

Building on ArcGIS Server, Informi GIS and Movia developed GeoTransit, a whole new range of transit applications that seamlessly integrated the information from Movia's existing systems with spatial data maintenance tools. GeoTransit supports Movia's enterprise-wide business processes by providing the tools to maintain the spatial locations of stops, routes, patterns, and fare zones along with the ability to integrate current schedule information, passenger counts, predictive travel time information, and real-time road closure information.

Integrated Systems Make the Buses Run on Time

Before GeoTransit was developed, it could take three days for a driving plan to be assigned to a bus route through a specific area, because the required information was located in many different systems. Now that all the systems have been integrated, it takes only a day to complete the same task. The process has become much easier to manage because the system provides direct access to all relevant information, and



Passenger Counts by Transit Service Areas

having more efficient workflows has reduced the time needed to train new transit planners.

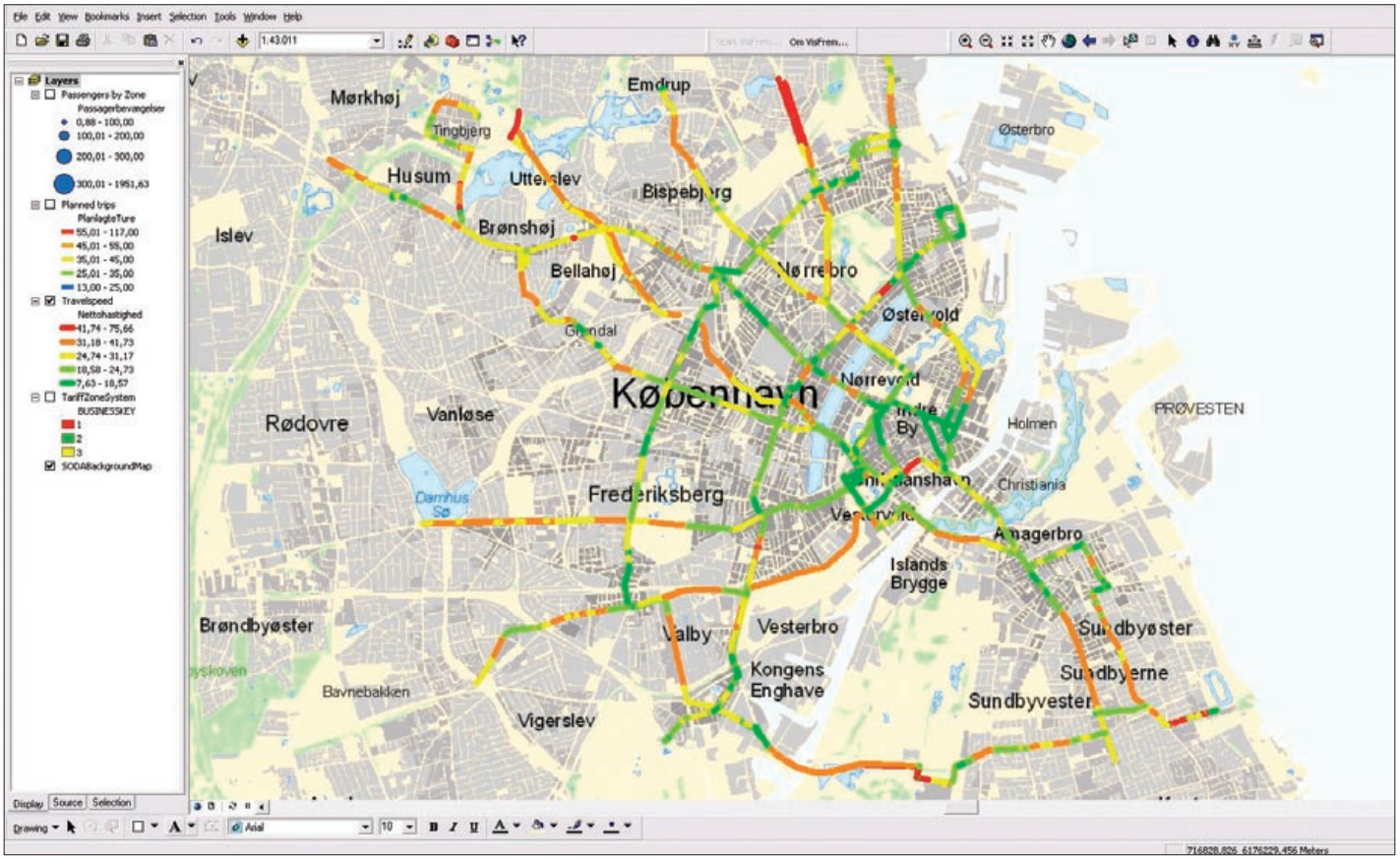
With GIS as a central part of the IT architecture, data that originally did not have a spatial reference is now linked in the GIS. This gives Movia the ability to better analyze stops by identifying passengers within a specific service area. Movia has also found it useful to identify the busiest bus stops in a service area and show how many buses are running daily at one stretch to ensure efficient route planning. To provide passengers with bus arrival information at select stops, Movia is able to calculate travel speed on selected lines and transmit this information to kiosks. Using the GeoTransit solution, Movia is also able to divide the number of passengers and road map hours into geographic areas to better serve outlying communities.

The GeoTransit integrated solution also opens up new possibilities. "We are on track to reach a level where GeoTransit not only is a transit planning solution but also provides vital transit decision support," explains Mogens Buch-Larsen, vice president, IT, Finance and Human Resources. "In the future, we will move in a direction where we can ask the system to make recommendations as to how an optimal network appears, based on employment, education, commuting, and demographic data patterns. The system has improved efficiency and allows analysis of a much wider range of parameters."

Movia's GeoTransit solution meets the needs and requirements of a modern transit agency driven to compete with other, more individual modes of travel, such as automobiles. It has allowed more efficient and accurate route planning, ultimately improving the company's overall bottom line. Additionally, GeoTransit has improved opportunities for providing customer information, which in turn has helped increase customer satisfaction and will ensure that more passengers see Movia as a viable transit alternative.

With more than 15,000 bus stops, 112 local train stations, and 338 kilometers of train tracks loaded into the GIS system, it is now possible for Movia to gather and analyze valuable data for planning, managing, and monitoring daily transit traffic into one integrated system.

For more information, contact Mogens Buch-Larsen at mbl@moviatrafik.dk or Carsten Bo Jacobsen at cbj@moviatrafik.dk.



A calculation of bus travel speeds on selected lines helps determine routing.

Enterprise GIS Takes Off at Phoenix Sky Harbor

By Matt Freeman, ESRI Writer

Already one of the 10 busiest airports in the world, with approximately 1,500 flights, 100,000 passengers, and 700 tons of cargo daily, Phoenix Sky Harbor International Airport generates an economic impact of more than $90 million a day for Arizona's largest metropolitan area.

With a growing pool of travelers and cargo relying on the airport for safe passage to a final destination, the City of Phoenix recognized that its Aviation Department needed an enterprise-wide GIS that would combine data locked in existing information systems into a single user interface and serve more than 200 airport personnel simultaneously. Such a system would not only improve customer service and safety but also allow users to effectively manage their work activities by providing accurate and current information.

In 2007, the city and the Aviation Department made the decision to move forward with GIS technology and selected Woolpert, Inc., a design, engineering, and geospatial firm with experience in the airport industry, to assist with the implementation. "We recognized the need for an enterprise-class information system to support changes from planned development," says City of Phoenix assistant aviation director Carl Newman. "We were confident that with these increased efficiencies, GIS would pay for itself over time."

All the data for the GIS is stored in Oracle Spatial and accessed through ESRI technology. Aviation Department personnel use the resultant system via a Web portal built on ESRI's ArcGIS Server platform. The data-rich enterprise GIS also includes business tools for managing the airport's operations and growing number of assets.

"Before 2007, data on interior and exterior assets was maintained in several systems, which weren't always compatible," explains Michael Youngs, Phoenix Aviation Department GIS program manager. "If someone asked a basic question—like, How many fire extinguishers do we service?—there was no easy way to answer."

Information on the Fly

The airport's enterprise GIS features an abundance of data, sophisticated technology, and reengineered business processes. The enterprise system gives airport employees visual access to data such as

- Aerial photography and digital orthophotos of areas surrounding the airport operations area
- Aboveground features and underground utility data
- A geodatabase design with 300 feature classes, from smoke detectors and passenger-assistance monitors to noise contours and 3D roof prints
- Interior floor plan data and attribution for buildings in and around the airport, collected via floor plan surveys and CAD drawing conversions

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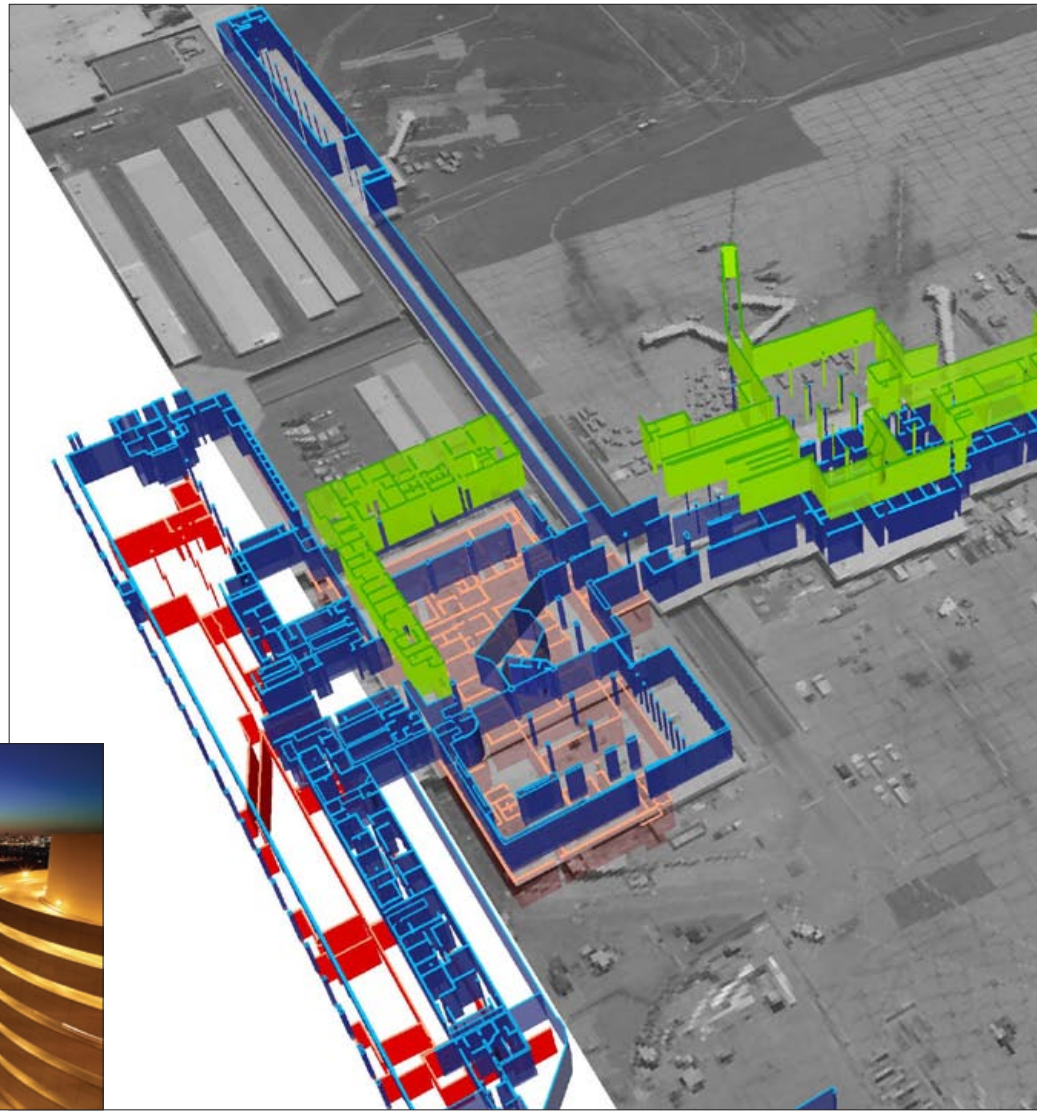
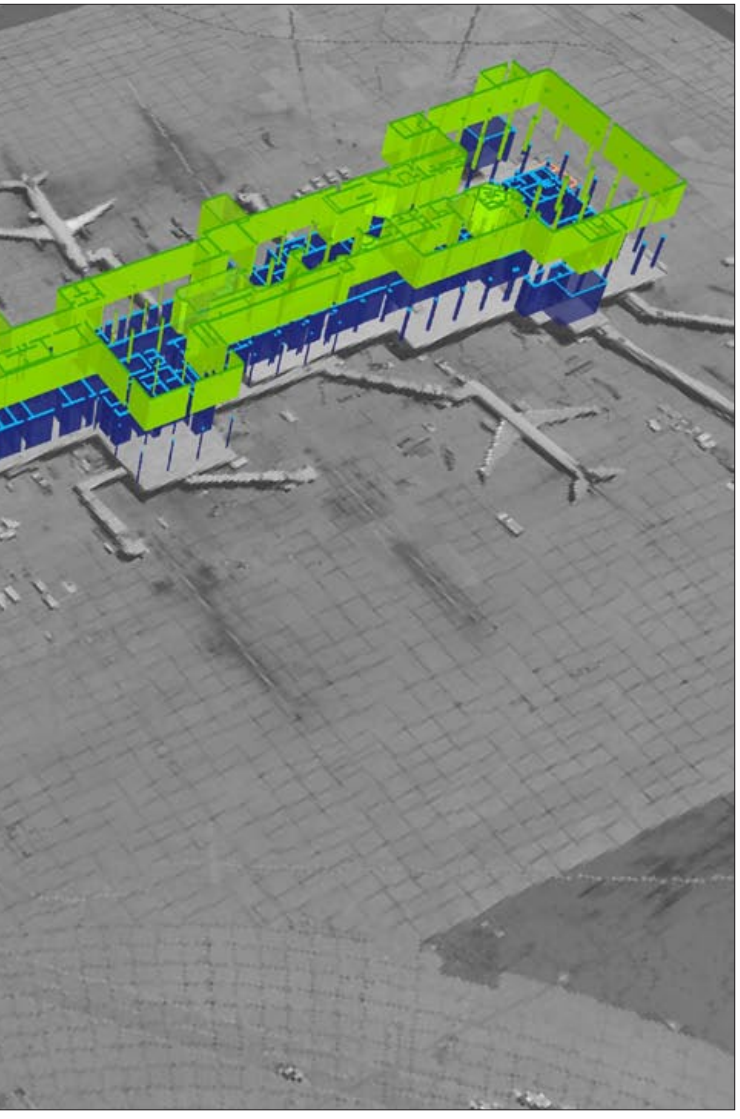
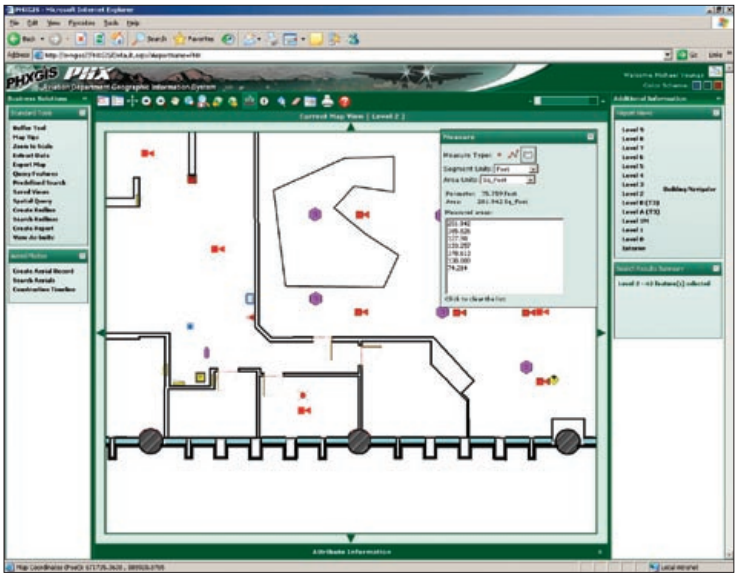


GIS portal users can access this overview map of Phoenix Sky Harbor.

Orthophoto and detailed runway/taxiway data is accessible through the GIS portal.



The airport's stacked floor plans are available in the GIS.



Users can review interior floor plans and calculate area and perimeter with this measurement tool, available through the GIS portal.

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Enterprise GIS Takes Off at Phoenix Sky Harbor

- An intranet viewing portal based on ESRI's ArcGIS Server technology
- Integration with many existing information systems
- Ten servers in multiple clustered environments, which provide performance, reliability, and availability, including a redundant failover system at a remote location in case of system outages

About 85 unique users from the Aviation Department's 10 divisions, who are neither GIS specialists nor technicians, go through the portal weekly to review or plan maintenance work orders, check interior space measurements and calculate rates for airport tenants, create area maps with aerial images showing existing conditions and planned improvements, insert maps into slide presentations for management, and output maps and data for internal and external reporting.

What users cannot get in self-serve mode from the portal, they get by submitting requests for custom maps and reports from the GIS group. User requests, numbering about 16 per month, typically involve oversized, data-rich maps or complex queries. "We're getting repeat requests now because users understand what we can do for them," says Jamie Ritchie, the department's GIS coordinator.

For example, to assist the Operations Department, the GIS group created new emergency evacuation maps, which had previously been difficult to update and reproduce. These maps, complete with exits, assembly areas, and varying "you are here" orientations, were saved as PDF files on DVDs so tenants could print and post maps and share them with employees. Explains Youngs, "We could produce these because we have very accurate interior building data," which is atypical for airport GIS programs.

To assist the Fiscal Management Department, the GIS group completed a space accounting and reconciliation project. "In one day, we generated maps and reports identifying discrepancies in actual versus leased square footage," Youngs says. "Without the GIS, this would have been labor intensive, with a wheel and tape measure, and taken a month or longer."

Phoenix Sky Harbor International Airport is currently developing the PHX Sky Train, which by 2013 will begin transporting passengers to and from the airport, reducing the number of vehicles, easing traffic and curb congestion, and providing a seamless connection with the regional light rail system.

"We saved on startup costs for the train project because we provided engineers with digital terrain models, contour data, and orthophoto imagery from the GIS," Youngs explains. "So they didn't have to collect that data again."

Custom Tools Streamline Daily Business

A critical application for portal users is the GIS interface with Phoenix Aviation Department's work order management system. When a maintenance worker must replace air conditioning equipment, for example, the worker accesses the portal to find the exact location as well as other equipment nearby due for maintenance. This exercise maximizes productivity, as it combines activities.

"Uniting the GIS with the work order management system allows us to plan efficiently, and it's just one way the GIS is saving money," says Youngs.

Another custom application helps users manage airfield signage. Employees can access signage locations and images through the portal, plan and track maintenance, and generate reports to show compliance with Federal Aviation Administration (FAA) standards.

The GIS interface with the computer-aided dispatch system allows dispatchers to access geographic data when addressing calls. "We're now considered the

From the GIS portal, users can view orthophoto data and terminal and apron markings.

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Enterprise GIS Takes Off at Phoenix Sky Harbor

official source of data for airport police and fire dispatch," says Newman.

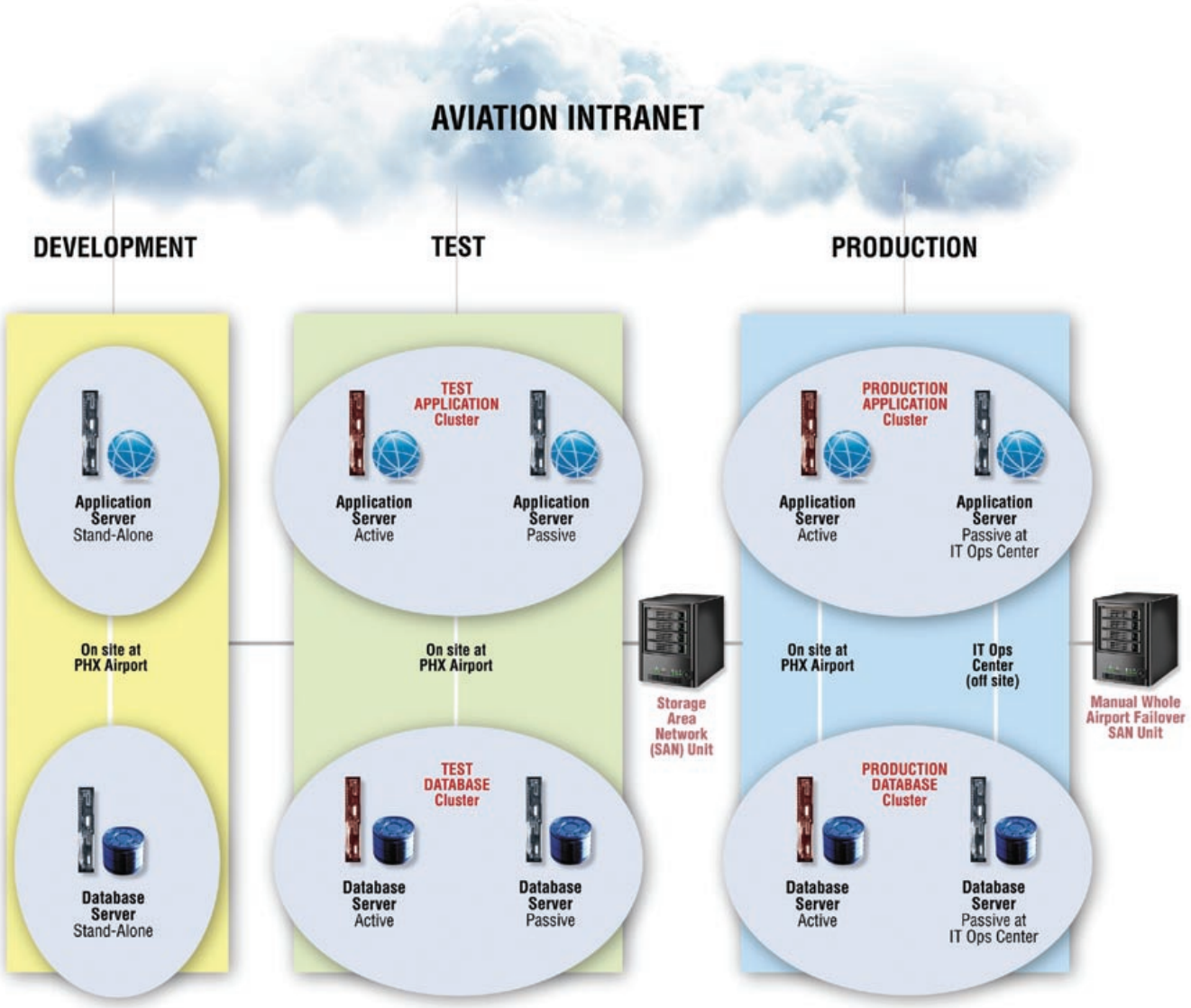
One of the newest features in the airport's GIS is a project planning tool that allows users to add a proposed project location to the GIS, query the system, and run reports to detect potential conflicts such as affected utilities and other projects planned in that area. More business tools are planned. According to aviation director Danny Murphy, "Our goal is to produce a tool for every business function at the airport that relies on location information."

Phoenix Sky Harbor's enterprise GIS was not an overnight success. Many operating practices had to be changed before GIS was implemented. For example, Aviation Department workflows were revamped so that changes in the field, such as new construction, retrofits, maintenance, and tenant improvements, could be intercepted, captured, and recorded in the system by the airport's GIS technicians. Described as the heart and soul of the data maintenance operation, the system is constantly updated by the GIS technicians, with most changes being completed within days.

The same group conducts random field checks using GPS and surveying equipment and audits interior spaces to verify data on converted CAD drawings. Employees who observe an update, such as an airfield light not captured in the GIS, can use the system's redline tool to identify the change so it can be validated in the field and included in the GIS.

Youngs and Ritchie train employees on portal navigation and procedures for requesting custom maps and reports. Youngs routinely gives project updates to management at all levels. "We continue to show everyone what the capabilities are and keep our customers engaged and excited," says Youngs.

For more information, contact Michael Youngs, GIS program manager, City of Phoenix Aviation Department (mike.youngs@phoenix.gov).

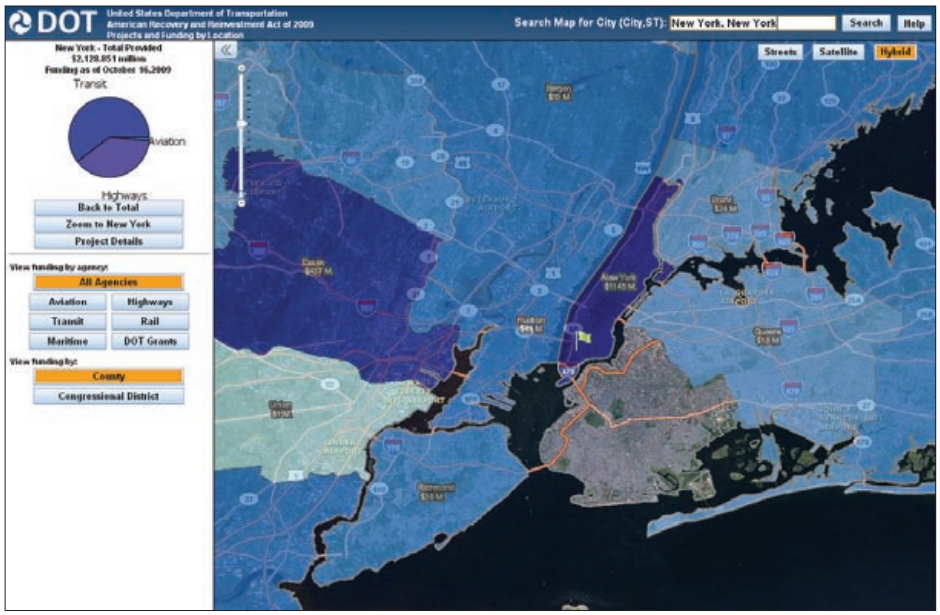


The GIS architecture features two development, four test, and four production servers.

U.S. DOT Uses GIS to Show ARRA Spending

Web Mapping Application Gives Details of Projects and Funding

The United States Department of Transportation (U.S. DOT) is using ESRI's GIS technology to report American Recovery and Reinvestment Act (ARRA) spending at arra-gis.dot.gov. The online map provides information about dollars obligated and projects pending in states and territories at the county and congressional district levels.



The U.S. DOT map shows ARRA projects and funding by county, congressional district, and agency.

Once a geographic region is selected, visitors can easily access project details including federal funding amount and descriptions. The application also allows searches according to U.S. DOT agencies such as aviation, transit, maritime, highways, and rail.

U.S. DOT has long used ESRI technology to visualize and analyze mission-critical information and support decision making. With this new Web mapping application, the department continues to leverage its investment in GIS and use its comprehensive authoritative data.

"U.S. DOT is sharing important information with citizens in a way that is easily accessible and understood," says ESRI president Jack Dangermond. "It is a great example of how government can use GIS and Gov 2.0 technology to improve government services and deliver transparency and accountability."

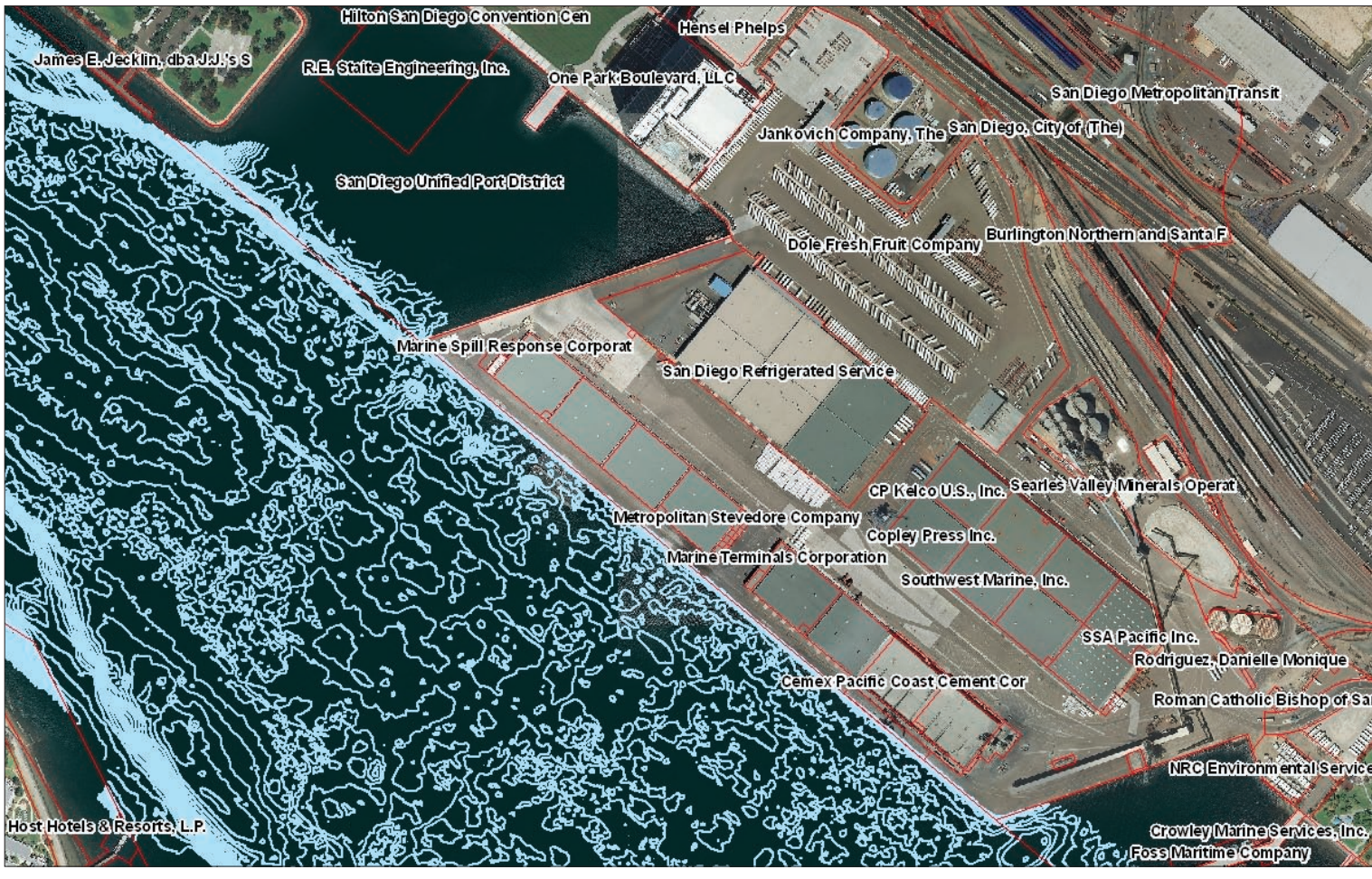
GIS Gives Port a Common Operating Picture

New users and data reuse optimize port activities

By Karen Richardson, ESRI Writer

The Port of San Diego, California, maintains a diverse facility spread across 6,000 acres. With the exception of the San Diego Convention Center, the San Diego Port Authority is responsible for the entire port, including park and concessionaires, the walkway, large public art installations, two marine terminals, and a cruise ship terminal surrounding San Diego Bay. Operating these assets generated revenues of $133.7 million in 2007. The port, which uses information technology (IT) enterprise systems such as SAP and a document system to manage business information, realized that applying the same concept to space management would be advantageous. The system the port envisioned would be accessed by every department and used by everyone from summer interns to the CEO.

The port had been using GIS since the 1990s in the engineering and real estate departments. Although both departments were essentially creating and using the same data, this data was not shared, and efforts were being duplicated. However, there was no easy way to share data.



"Our vision of creating a common operating picture with a geographic perspective gives everyone the information they require along with the basic GIS functionality necessary to do their jobs in the best way they can," explains Malcolm Meikle, geographic information systems coordinator for the San Diego Unified Port District.

Making GIS Part of the Daily Workflow

Three years ago, the port's information technology department added ArcGIS Server, a complete and integrated server-based GIS, to its ArcGIS Desktop software. This change made facilities data accessible to the departments that needed it. The goal was to streamline workflows by identifying tasks, questions, and requests that were best answered using a geographic approach. This approach paid off. "Using GIS, the time it takes to access critical information went from seven or eight hours to mere minutes, because the data is now in one location and it is up-to-date," says Meikle. "Just this change has sped up our workflow and is driving faster, more informed decision making."

The port worked with various departments to customize interfaces using ArcGIS Desktop and generic Web browsers to give access to port data that now resides in a single location: a geodatabase. The geodatabase is the common data storage and management framework for ArcGIS Server. Source data is also managed in the geodatabase, which minimizes redundant copies and eliminates the possibility of varying versions of data.

Adopting new technology to improve business processes can be a daunting task. The port found that it needed to keep daily tasks as unchanged as possible while incorporating tools for bringing real benefits to the users. CAD has continued as the technology used in the data production environment for creating drawing files for structures around the port. Designers use the ArcGIS for AutoCAD extension, a free tool from ESRI, to bring GIS data into the CAD environment. Using this extension, engineers can continue working with familiar software while gaining access to GIS data. It can be GIS data created in-house or GIS data from ArcGIS Online, an ESRI-hosted repository of GIS maps, layers, and tools.

ArcGIS for AutoCAD has proved to be a valuable tool that allows operators to see the GIS basemap in their native CAD environment and find answers to questions because all the information is accessible through the basemap. "AutoCAD users are drawn to this tool because it gives them a window into GIS information while still allowing them to work in their familiar AutoCAD environment," says Ari Isaak, a GIS analyst for the Unified Port of San Diego.

Creating an enterprise GIS has driven the implementation of data and file structure standards in the engineering department so CAD data can be seamlessly displayed and analyzed through the wide variety of ArcGIS Server clients. Web-based clients, accessible to all port employees, provide new tools for understanding the infrastructure the port manages and maintains. Users in engineering management and general services and asset managers in the real estate department also use these tools.

Moving data from CAD to GIS, CAD operators must follow naming conventions for drawings, layers, objects, and attribute blocks. The port adopted the United States National CAD Standard—used by organizations throughout the United States for exchanging building design and construction data—as a guideline for its own CAD data standards. The Department of Homeland Security Geospatial Data Model is used as a data model guide.

All scanned paper plat and record drawings are accessed by an intermediate table that contains relevant information about the documents that are stored in the geodatabase. Standardizing layer naming conventions for new drawings, as well as the creation of a master CAD drawing, means that engineering staff update those files instead of storing these drawings on local drives. This ensures that

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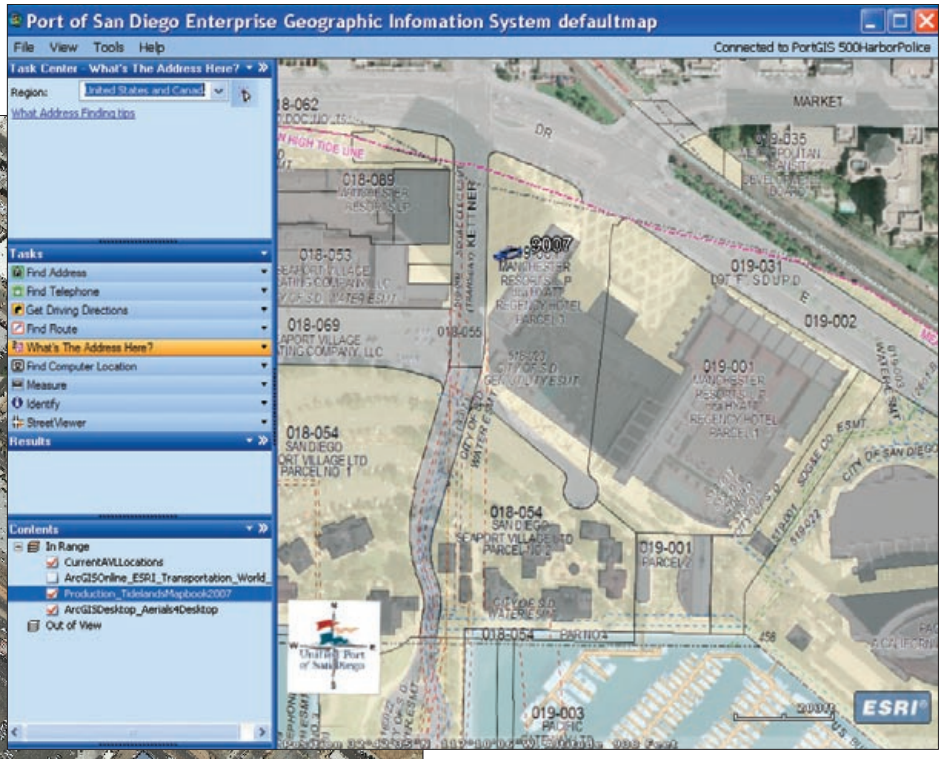
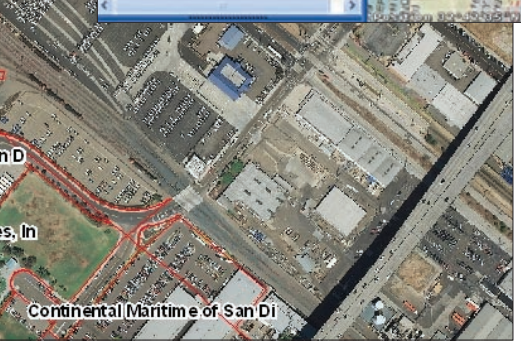


PortGIS Explorer is the most widely used GIS Web application. It gives staff access to high-resolution aerial photos and TideLands Mapbook.



With GIS, the Port of San Diego can efficiently manage assets located on 6,000 acres surrounding San Diego Bay.

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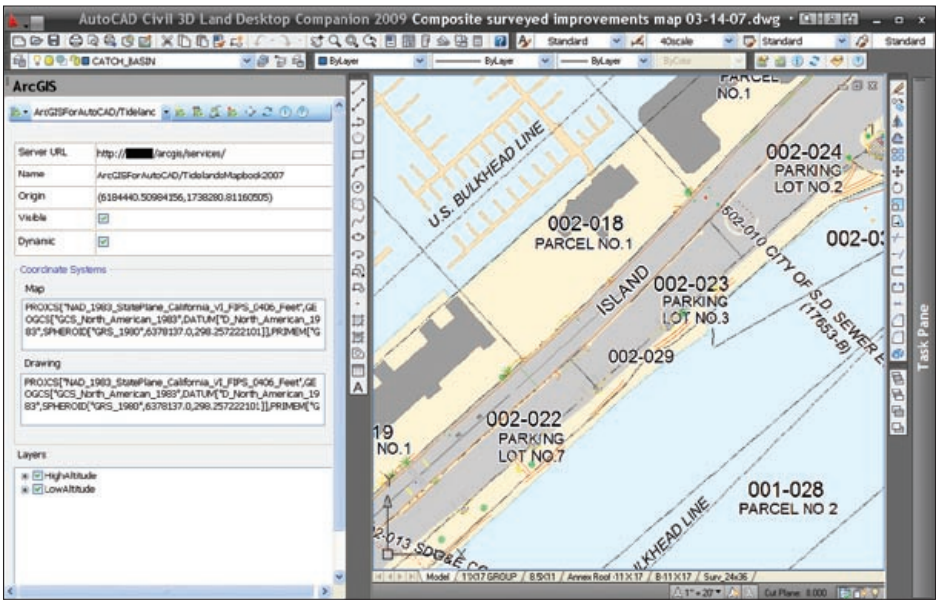
GIS Gives Port a Common Operating Picture

every department can understand and use GIS data. This has made attribution much easier, and CAD operators no longer need to guess how to describe features in the drawings.

Just Add Imagery

Another advantage of this system is the ability to view and use imagery in the CAD stations using the ArcGIS for AutoCAD tool. In the past, when engineers added TIFF images to AutoCAD—one at a time—the draw time was lengthy. If a drawing spanned more than one image, each image had to be loaded separately. This process was time-consuming and frustrating for operators. "CAD designers love ArcGIS for AutoCAD if for no other reason than they finally have access to very high-resolution aerial [photos] quickly," says Isaak.



Using the ArcGIS for AutoCAD extension, engineers can bring GIS data into a familiar CAD environment.

The port has two sources for imagery: .3-meter resolution aerial photographs from ArcGIS Online and 4-inch pixel resolution aerial photos taken in April 2009 by the port. The 4-inch resolution photos are used for quality control and as a source for creating new data. To use the aerial images for these purposes, engineers must follow strict standards and use the same coordinate system employed by the GIS operators.

This simple change has been advantageous. Now, drawings can be viewed in the correct geographic space even if an image is not used as a backdrop. Drawings can also be located by performing a spatial search rather than by the name of a drawing. Now, drawings can be used for more than one project. Previously, they had to be copied and pasted into work projects. These changes have cut down on the errors inherent in copying data and the amount of file space needed to store the drawings. Because the source data is managed in the GIS database, it can be used more than once. Now, everyone in the port is using the most accurate data.

Web-Based Enterprise GIS throughout the Port

"By using geographic data and systems, the port is able to use geography as the common factor to bring together data that otherwise is difficult to integrate," says Meikle. In 2007, when ArcGIS was adopted, the GIS group moved from the real estate to the IT department. This allowed IT to manage and disseminate GIS data throughout the port. Access to the GIS data and system has empowered the port's employees to integrate their own independently developed workflows for managing spatial data and accomplishing their work using the information they need.

Departments that traditionally hadn't thought about using the port's facility information, such as the harbor police, are now users. Today, the harbor police employ two applications for tracking vehicles around port property—a desktop application built with ArcGIS Explorer and an in-car application that displays map data in Web browsers that was created with OpenLayers, an open source JavaScript library.

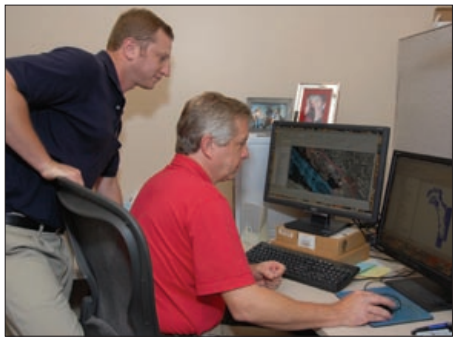
Staff throughout the port can access the GIS through the PortGIS Resource Center. This central gateway to GIS information is accessed by clicking an icon on the port's internal Web home page. Here, staff can choose one of three Web applications—PortGIS Explorer, PortGIS Utilities, or PortGIS Projects—designed for various tasks and departments.

The most used GIS Web application is PortGIS Explorer. Staff can access high-resolution aerial photos and the port's TideLands Mapbook, which represents the port's overall geographic interests at the Port of San Diego. Users can navigate around the map to see exactly the information they need, turn layers on and off, and create maps to include in reports and e-mails. Data can be queried, and measurements between two or more points can be obtained.

The PortGIS Utilities application focuses on current conditions. End users can view utility line work and access PDFs of official engineering drawings by location. This application furnishes all the functionality of PortGIS Explorer as well as georeferenced maps from important documents. PortGIS Utilities brings together the port's development effort affecting all the managed land and creates a common operating picture for departments as they move forward in their planning efforts. The PortGIS Projects application deals with future developments, the regulatory process, and obligations to which the port is committed.

Standards Make Workers More Efficient

PortGIS Utilities is the central clearinghouse for the port's utilities data, including electrical, fire, natural gas, fuel, sanitary sewer, storm drain, telephone, water, chemical, fiber optics, and communication lines. The data



GIS analysts review updates to the port's online GIS portal.

is converted to ESRI feature classes using a batch file, which runs nightly. Instead of the engineers working with a traditional file system to structure the data, the data is spatially indexed so it can be more easily located. This also allows engineers to share data with the rest of the port. Simply having the data created using standards that are managed and shared from one location makes it much easier for staff to find answers.

The entire system was built using the Microsoft .NET framework, a file geodatabase, and Windows Server 2008 on a 64-bit machine. Clients were created using the .NET Web Application Development Framework (ADF) that comes with ArcGIS Server, which was customized using Visual Studio and incorporated many ideas from the .NET ADF Code gallery at the ESRI Web site. The IT department also created a streamlined method that assists users by installing software remotely. If staff members have questions, they can send e-mails to the IT department or check out %scratchworkspace% (posdgis.wordpress.com/), a blog maintained by the port's GIS professionals.

Today, port staff can not only ask questions like, How much square footage is available? but also reach further into the data by gaining access to official record drawings and viewing the relationship between a developer's plans and the geographic interests of the port. GIS is used in every department. It helps the harbor police track police cars. The general services department uses it for engineering data accumulation and maintenance. The finance department uses GIS to track money coming into the port by tracking corporate leases, maintaining parking meters, and other activities. Today, the more than 600 employees at the port can use GIS data and Web-based applications.

For more information, contact Malcolm Meikle, geographic information systems coordinator, San Diego Unified Port District (e-mail: mmeikle@portofsandiego.org).

Visit the CAD Integration Resource Center (resources.esri.com/caddata). For more information on ArcGIS for AutoCAD and to download the free extension, visit www.esri.com/arcgisforautocad.

GIS Keeps Development of Alpine Rail Link on Track

By Jim Baumann, ESRI Writer

The Brenner Pass has served as a vital alpine link between Austria and Italy since early Roman times by supporting trade and transportation from northern to southern Europe. Because the pass lies at a lower elevation than other alpine routes, it was the designated location for the first modern highway through the Alps, which was built in 1772, as well as the first transalpine railway, opened in 1867.

Over the years, traffic through the pass has steadily increased, resulting today in a virtually continuous stream of cars and trucks that slowly traverse the well-known route, subsequently polluting the nearby alpine villages and meadows. Annual commercial traffic on the superhighway going through the Brenner Pass has increased from about one million heavy transport vehicles in the early 1990s to more than two million trucks today. Automobile traffic exceeds 10 million cars yearly.

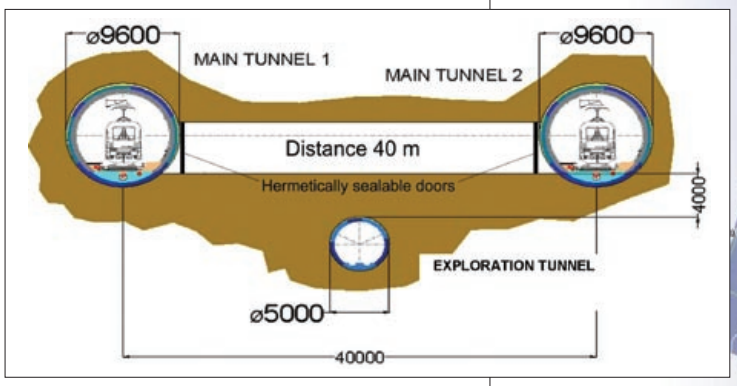
Recognizing the critical need to improve its transportation networks, the European Union (EU) initiated a series of studies and proposals that resulted in the Trans-European Transportation Networks (TEN-T) project, which was adopted by the EU in 1996. Briefly, TEN-T is a series of coordinated improvements to roadways, airports, railways, and water transportation networks designed to stimulate economic growth, competitiveness, and employment throughout Europe.

The TEN-T studies revealed that road freight was expected to increase dramatically throughout Europe by 2020. It was concluded that while Europe was dependent on overland transportation, a more energy-efficient freight system was vital to improve the quality of the environment and stimulate the economy.

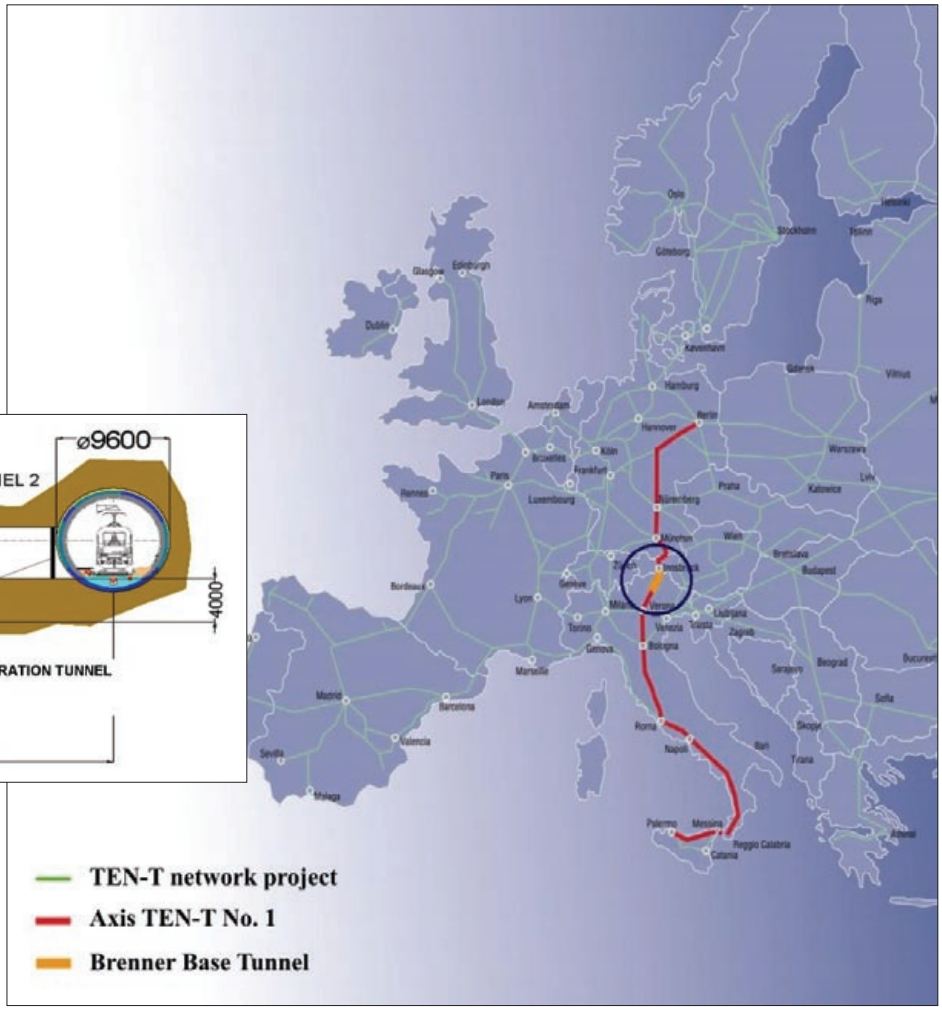
> "GIS offers a general overview of the entire project area by organizing all available data—basic mapping, results of analyses, etc.—in a well-structured, georeferenced database."

The first part (TEN 1) of the TEN-T project is a revitalization of the rail network from Berlin, Germany, to Palermo, Italy. It is divided into eight distinct projects, and the projected completion date for the entire railway corridor is 2040. The Brenner Base Tunnel section of TEN 1 is 56 kilometers in length and will be completed by 2020. It will stretch from Innsbruck, Austria, to Fortezza, Italy. The tunnel is expected to take much of the existing truck and automobile traffic out of the Brenner Pass, transporting its cargo—primarily freight (80 percent) but also passengers (20 percent)—through the region by railway.

The Galleria di Base del Brennero, or Brenner Basistunnel (BBT SE), is the European public limited company entrusted with the design and construction of the Brenner Base



Cross-section of the Brenner Base Tunnel Design Depicting the Main and Exploration Tunnels



Map of Axis No. 1, the Berlin to Palermo Rail Link of the TEN-T Project

Geological and hydrogeological data is displayed in the geology mode.

Tunnel, considered to be the core of the European railway axis from Berlin to Palermo. The project is composed of two main tunnels connected every 336 meters by transverse tunnels for safety and maintenance purposes as well as a third tunnel used for exploration purposes.

Because of the breadth of the technical requirements necessary to complete the project, including design, geology, environment, and topographical analyses, and the vast area in which the project is being carried out, a considerable amount of data was collected during the analysis and design phases. The data acquired during the subsequent construction and operating phases will be added to this substantial database.

To manage this comprehensive geographic database, BBT SE decided to adopt a modular and scalable GIS based on the latest Web technologies, which will enable everyone involved in the implementation of the project to access relevant geospatial information quickly and efficiently.

BBT SE utilized Territorium Online's WebGIS Framework tools (mapAccel), which are designed to work in conjunction with ESRI's ArcGIS Server technology. Territorium Online is a business partner of ESRI Italia, ESRI's distributor in Italy. The scalable architecture provides different levels of use based on the interest, expertise, and access privileges of the user.

The GIS applications developed are divided into two primary tiers. The internal GIS application is used by BBT SE engineers for project planning and development. The external application is for use by the general public so that they can easily follow the progress of the project. The multilanguage applications are structured in one public and five internal views. All are derived from a single master view.

The system is thus composed of six thematic modules and constitutes the core of the BBT SE GIS architecture. The modules include geology, planning, water monitoring, topography, land parcels and owners, and the public module. Data access is provided according to authorization and restriction as well as the need for specific functionality. Data access control and access rights must be enforced because the project uses some data that is considered sensitive, and it is necessary to implement some restrictions regarding viewing and editing capabilities, not only for security reasons but also to minimize the chance of introducing errors into the database.

The general public is encouraged to access the BBT SE site through a dedicated Web portal (www.bbt-se.com) or by using one of the multimedia touch screen kiosks located in public places in Innsbruck and Fortezza and in the main railway stations in the project area.

A Typical Multimedia Touch Screen Kiosk

Commenting on the development of the GIS applications, Rosalia Di Bella, doctor of engineering and BBT SE's GIS administrator, says, "In order to define in detail the architecture of the GIS applications and ensure that they meet the real needs of those who will use them, a series of interviews was conducted with all BBT designers and coworkers. These interviews highlighted not only the expectations of each sector with regard to the corporate application but also the kind and quality of data available for immediate inclusion into the GIS database and which data would be acquired from future studies and investigations. Because of the server-oriented architecture, our data is collected and verified just once. This centralized management of the data eliminates redundancy and allows us to provide different hierarchically organized views of the data according to specific parameters."

Continues Di Bella, "The creation of our system for the cross-border territory of the Brenner Base Tunnel project was very demanding not only because of the need to harmonize the different cartographic reference systems used by Italy and Austria but also from a technical perspective, because both countries organize some of their administrative data—for example, their cadastral data—in different manners. Also, heterogeneous data formats could not be immediately incorporated into the GIS. The need to develop a multilingual user interface and data storage capability for German, Italian, and English speakers also expanded the scope and complexity of the project."

Di Bella believes that the GIS applications developed by BBT SE could become a standard of reference for other parts of the TEN 1 corridor. In addition, with the recent formal adoption by the European Parliament and Council of the Infrastructure for Spatial Information in Europe (INSPIRE) directive, which

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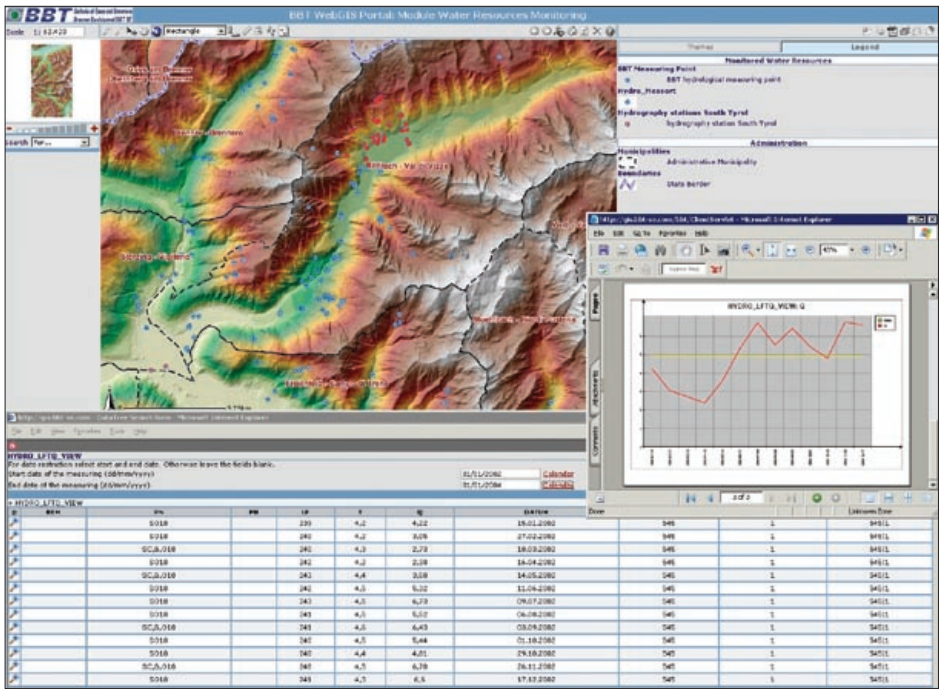
GIS Keeps Development of Alpine Rail Link on Track

mandates the implementation of standards for exchanging, sharing, accessing, and using spatial data among EU member states, it is likely that the GIS development work performed by BBT SE will have long-ranging effects on other TEN-T projects.

Summarizing the GIS implementation for the BBT SE project, Di Bella says, "GIS offers a general overview of the entire project area by organizing all available data—basic mapping, results of analyses, etc.—in a well-structured, georeferenced database. If you consider the size and complexity of the project area and the large amount of data produced by the technical sectors of BBT SE, the use of a GIS system seems to be the only possible solution to guarantee efficient management without redundancies in the data.

"In addition, the modular architecture used for developing BBT SE's GIS allows a horizontal integration by creating new thematic modules, as well as a vertical integration by implementing new functionalities on the base module, which can be transferred to the thematic modules. Thanks to this mechanism, the system is highly flexible, and it is possible to easily adapt it to the changes that will arise during the entire life cycle of the project. Therefore, the GIS is not only an instrument for archiving and analysis during the design stage but also a valid support system for data control and management during construction. Once the tunnel has been built, it may be used as a decision support system for monitoring, operations, and maintenance activities."



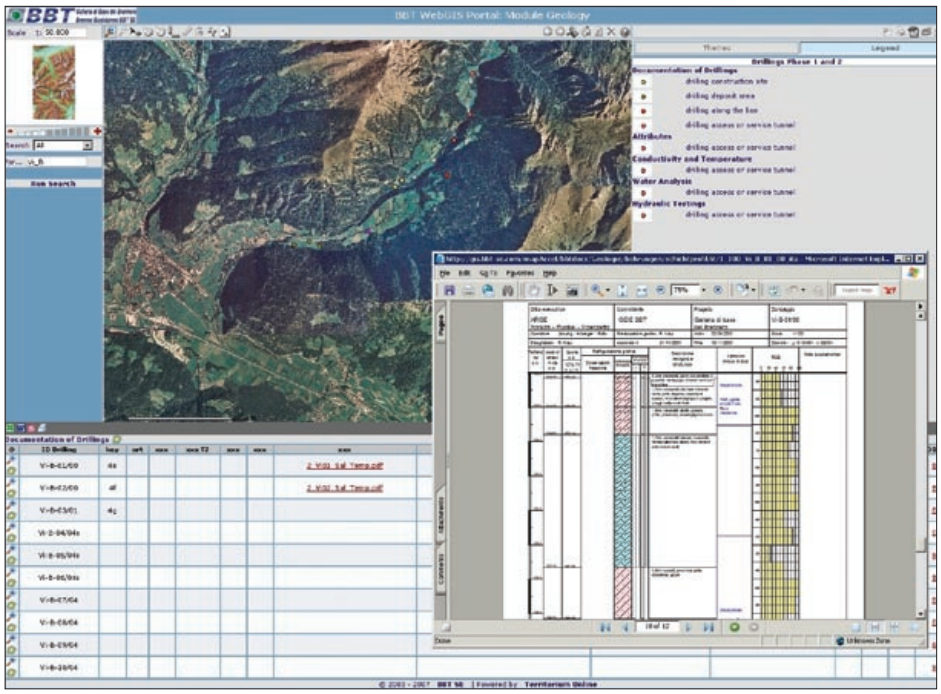
Water Resources Monitoring Module with a Statistical Chart That Can Be Calculated on the Fly Using Data Selected by the User

An Example of the Interface of the Multiple Touch Screen Kiosks

BBT SE was awarded both the regional and national Ebiz und Egovernment awards in 2006, which are sponsored by the Austrian publishing house Report Verlag and promoted by the Austrian Federal Chancellery. The purpose of the awards is to emphasize the opportunities e-business offers organizations for reorganizing business and management processes because of the ever-increasing amount of digital documents. The award recognizes excellence in implementing innovative programs to stimulate the use of electronic media in business.

Observes Di Bella, "These awards provide recognition of the efforts we have made in the use of GIS technology to not only support the construction of the Brenner Base Tunnel but also publish some of the related information electronically to keep the public informed of our progress."

The Egovernment awards jury noted that BBT SE's project was innovative and forward thinking in its approach to providing the public with an interesting and easy-to-use application to follow the progress of the Brenner Base Tunnel project. In addition, it was praised



Geology Module Shown with a Linked Document That the User Can Easily Access

for promoting cooperation between Italy and Austria, two EU member states, in the development of the project.

Di Bella concludes, "Because of its capabilities as a powerful system for the spatial and temporal analysis of different kinds of data on both large and medium scales, a GIS is much more able than other systems to support a complex engineering project of this nature during all its construction stages. Therefore, GIS will continue to play a key role during the future project stages of the Brenner Base Tunnel, representing, at the same time, a model of innovative approach for similar projects in terms of the use of this instrument for big infrastructure projects with a long-term project timetable."

For more information, contact Rosalia Di Bella, doctor of engineering, BBT SE, at Rosalia.DiBella@bbt-se.com.

Capitalizing on New Technologies
Transportation Projects Simplified with GIS Integration

By Susan Marlow, President/CEO, Smart Data Strategies

With the growing demands imposed on our transportation infrastructure, state and local transportation agencies require capable, efficient solutions to enable them to resolve problems and make informed decisions with confidence. To meet these needs, transportation administrators increasingly depend on the unmatched potential of GIS and its ability to organize, display, and facilitate complete analyses of vast amounts of information. Having digital parcel maps available with detailed property information just a mouse click away opens the door to a whole new way of managing right-of-way projects.

Observing this trend and seeking to take advantage of the opportunities in GIS integration, the Transportation Research Board (TRB) began examining its potential in the right-of-way process by involving a panel of experts to monitor the research of current and future possibilities. As a division of the National Research Council, the board's mission is to promote innovation and progress in transportation through research. The independent advisory group focuses on all modes of transportation and provides an objective and interdisciplinary setting where it initiates and manages research projects in order to share information on transportation policy and programs. With support at both the federal and state levels, the board widely disseminates the research results, offering expert advice while promoting technical excellence.

However, several difficulties may stand between a transportation agency and its successful use of GIS technology. Road blocks such as insufficient funding, complex multidepartmental organizations, disconnected or "stovepipe" systems, lack of data integrity and standardization, or lack of trained GIS resources are the most common obstacles. With this in mind, ESRI business partner Smart Data Strategies, Inc. (SDS), developed the DREAMaps for Transportation Right of Way Management System. Built on the ArcGIS Server platform, SDS' product has been implemented within several transportation agencies and is a comprehensive solution for GIS integration that incorporates data and system standardization, uncomplicated multiuser functionality, and practical capability without excessive software and hardware changes.

The Illinois Department of Transportation and the Nevada Department of Transportation are two organizations that SDS has helped overcome their technology challenges.

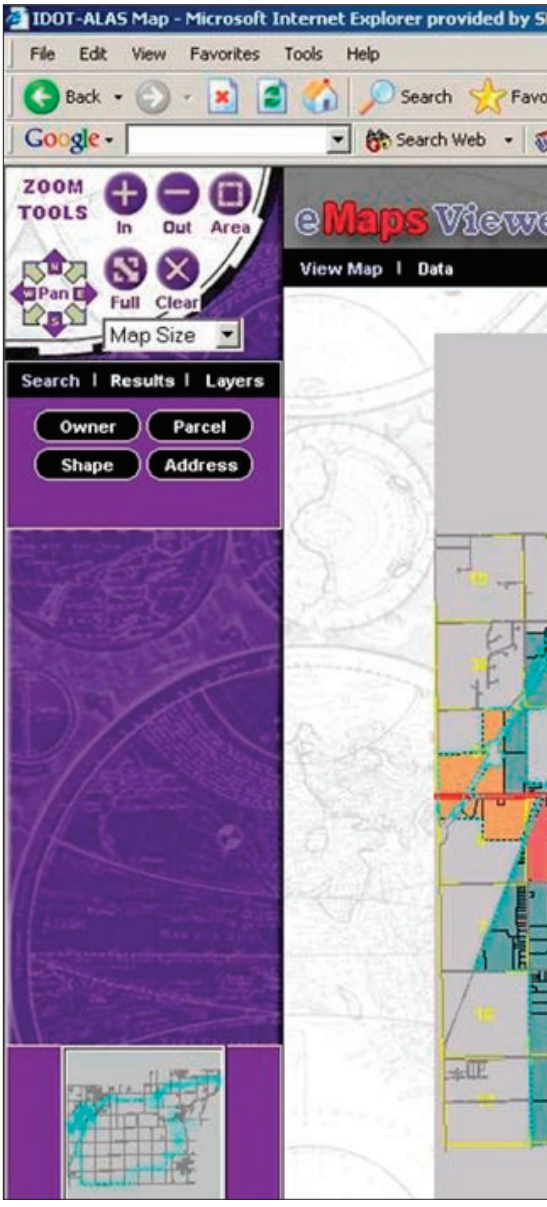
IDOT: GIS Functionality in Large-Scale Land Acquisition for Public Use

In 2002, a site in Will County, Illinois, was approved by the Federal Aviation Administration (FAA) to become the future home of the South Suburban Airport (SSA). Since SSA was to be a state-run airport, the Illinois Department of Transportation (IDOT) would have the authority to purchase and acquire real property for the purpose of establishing and constructing the airport to benefit the public.

The airport design involved a site on 24,000 acres of land that consisted of roughly 1,200 residences, 100 farms, and 20 businesses. The airport and its facilities would eventually displace all these properties. In order to acquire the necessary land and provide relocation assistance to those residing in the affected area, a team of vendors was selected by IDOT to begin the land acquisition process.

Much of the project involved managing the land acquisition and land-use tasks associated with the creation of the new airport. Since the project involved real property transfers, additional tools became necessary. The project required a software system that could easily update, maintain, and organize property ownership maps, legal documents, and communications. Within the capabilities of the software, there was an additional need for status reporting that would make information available to not only the engaged parties but also the public at large.

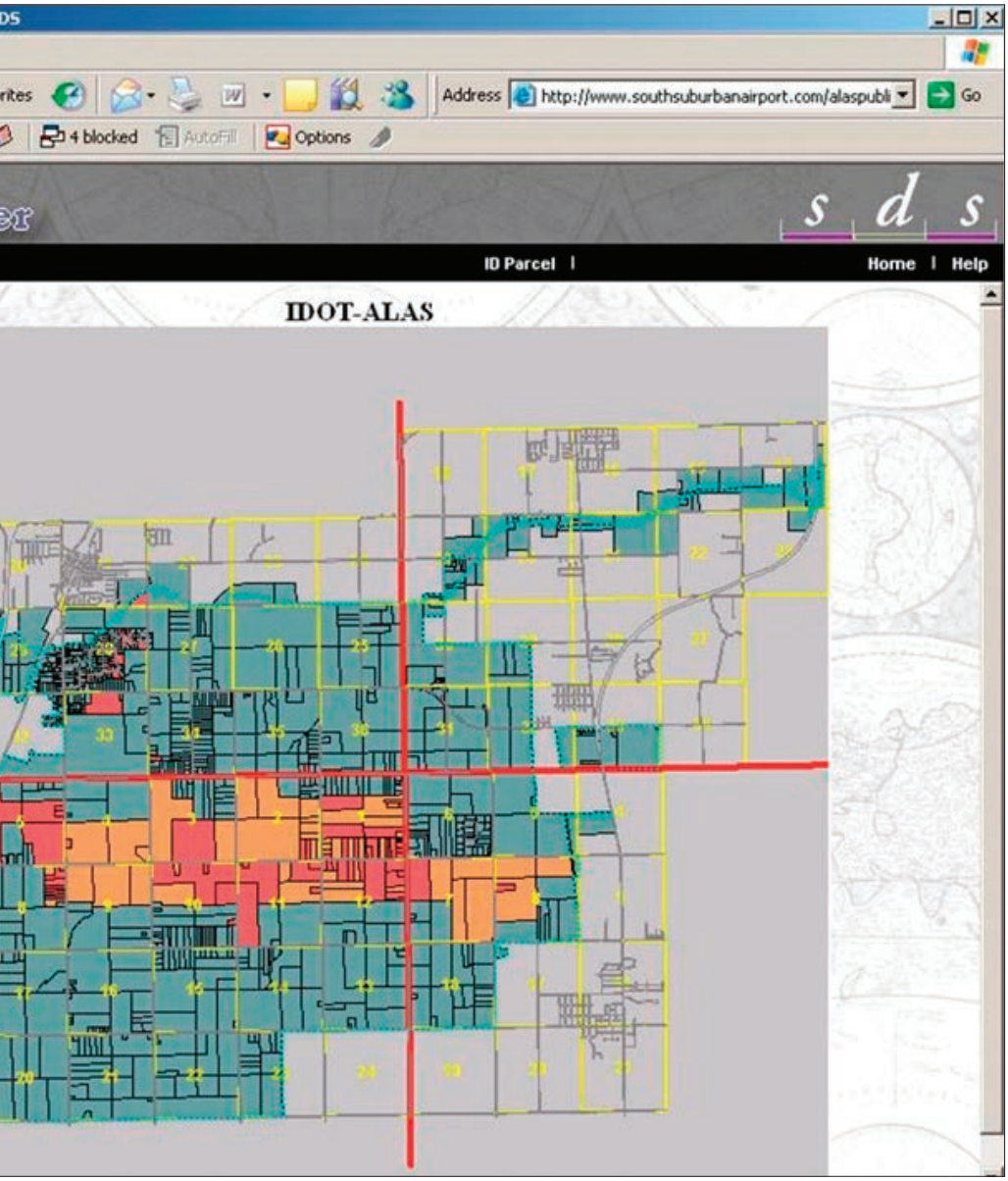
The Aeronautical Land Acquisition System (ALAS), built on DREAMaps, was developed to aid in the decision-making process by integrating the tools needed to analyze the property data of areas being considered for the airport and related facilities. The system additionally provided real information that would assist IDOT in its goal of continuously driving revenue through the land that had already been acquired. One example of this was the income produced from farmland that was still being cultivated during the acquisition process.



With the simultaneous occurrence of land selection, ownership transfer, acquisition, and reporting, IDOT needed complete accessibility along with project management and status monitoring capabilities. Where the use of standard project management software failed to accommodate the specific processes and format of land records effectively, the ALAS system succeeded. By incorporating document management, spatial analysis, and real-time database viewing and editing, the progress of the entire project could be monitored effectively. With a clear, user-friendly interface, the software allowed users to easily identify and gather information about properties, as each parcel was color-coded to signify its acquisition or pending acquisition status, visually indicating the total project status.

"Without ALAS, I would not be able to keep track of all of the paperwork, status reports, and financial and parcel information regarding this project," notes Terry Tappenbeck, chief of land acquisition, IDOT Division of Aeronautics. "With direct Internet access to the system, I am able to answer inquiries quickly with up-to-date information without having to contact any contractors."

As a project of this magnitude includes diverse parties across a large area, a Web site was created to provide selected information to project contractors, managers, and the public. To aid in the expedient delivery of status updates and required notifications, the software incorporated an automatic e-mail notification system. By attaining high levels of mass public communication, the project won a Master Communicator Award.



IDOT uses customized tools to analyze property data for airport-related projects.

NDOT: GIS Functionality in Permitting and Permit Tracking

Following a significant audit of its right-of-way operations, the Nevada Department of Transportation (NDOT) identified the need for advancement in the management of its right-of-way information. To improve business processes for its engineering, utilities, and permitting divisions, NDOT established specific objectives for the creation of its Integrated Right-of-Way Information Network (IRWIN) Permitting and Permit Tracking System. IRWIN was composed of several elements—an electronic document management system (EDMS), property inventory, property management, and permit management including utilities and outdoor advertising.

The first objective of this multiyear, multiphase project was the creation of an easy-access computing environment to provide property inventory information, utility agreements, and encroachment permits to both the internal staff and the general public. The second objective focused on the property inventory, outlining the need for a management system that would support inventory, access, retrieval, and management reporting of all right-of-way

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Capitalizing on New Technologies

property. To improve service to customers, the third objective was the development of a Web-based system that would give NDOT users customized tools to analyze property data for airport research, application requests, status tracking, and fee payments.

NDOT recognized the need for a streamlined workflow and common interface solutions. The GIS-centric application that was selected works to simplify data integration and the transformation between databases and file systems of legacy systems using the latest collaboration and Web technologies. The system is designed to take advantage of work done by the GIS section and create a historical road network showing most of the system changes over time. This will allow users to perform queries and receive results for a specific place or time. Various documents and contract plans in the EDMS will then be linked with GIS to facilitate work processes. The EDMS portion alone is expected to save hundreds of person-hours each year in right-of-way and other divisions that need access to contract plans. The system will also integrate with NDOT's GIS/land records system (LRS), Public Lands Survey System data, video logging system, and integrated financial system.

The system covers all facets of the right-of-way process, ranging from acquisition to property management permitting. With multiuser capabilities, the entire permit process can be tracked with standard reporting, customized reporting, and ad hoc inquiry capabilities. A thorough and up-to-date status assessment can be provided with detailed date tracking from the initial funding estimate through the final certification, offering management the ability to track the entire process from the overall project status to the specific parcel level. In addition, repository capabilities allow the storage of transaction metadata to keep an audit trail of transactions that have been triggered and completed.

While the IRWIN system will allow NDOT to reach its internal goals, the largest achievement of this system will be seen ultimately in the benefits provided to NDOT customers. With the ability to monitor permits, applications, and fee payment status, customers will have easier access to timely information. Enhanced research capabilities and a strengthened communication platform will allow questions, problems, and resolutions to be expedited.

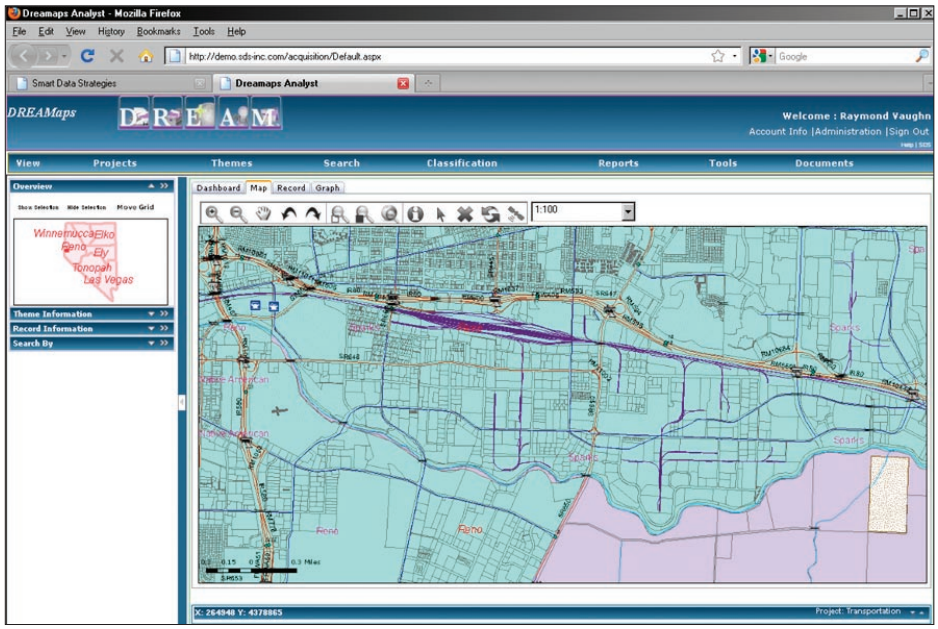
The Next Generation

As the application of GIS integration continues to expand, the transportation industry can expect to experience unlimited advancements and radical changes in efficiency and capability. With the needs of the industry identified, the evolution has begun with the collection of normalized, accurate data and the consolidation of that data into a standard, aggregate system.

GIS applications are now more accessible thanks to the increasing availability of commercial off-the-shelf (COTS) products, such as those used by NDOT and IDOT. The use of COTS products reduces overall cost and accelerates the implementation time while increasing scalability and technical support. The convenience and widespread use afforded by Web-based applications further simplify the system updating process while simultaneously achieving large-scale standardization and mass communication capabilities.

Previously, the parcel layer of data, which had always been particularly critical to the right-of-way process, was the most difficult data to obtain. Today, private companies are investing in the creation and collection of parcel data across the nation. The presence and increased accessibility of this data will have a profound impact on the transportation industry.

With the information collectively located and efficiently organized, the possibilities for extraction and analysis are boundless. The utilization of GIS integration will help streamline projects from the initial planning stages through the development phases. Agencies can make use of estimation tools, allowing thorough cost analysis based on authentic, updated data. Timely reporting on a variety of factors and stipulations can be made quickly and accurately. The escalating role of GIS integration signals tremendous growth and remarkable possibilities for the future of the transportation industry.



With DREAMaps Analyst on ArcGIS Server, users can view project data, mileposts, parcels, and project status.

For more information, contact Susan Marlow, president/CEO, Smart Data Strategies, Inc., at sales@sds-inc.com.

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