The GIS That St. Johns Built

Perfect storm of factors requires public works department to quickly change the way it did business.

By Rene Rodriguez

Rocky Agbunag, with St. Johns County, Florida's Public Works Department, watched with the rest of the state as hurricane after hurricane—Charley, Frances, Ivan, and then Jeanne—pummeled Florida in 2004.

"One hurricane after another—you just feel for those who were hit," said Agbunag, the asset management coordinator for St. Johns County.

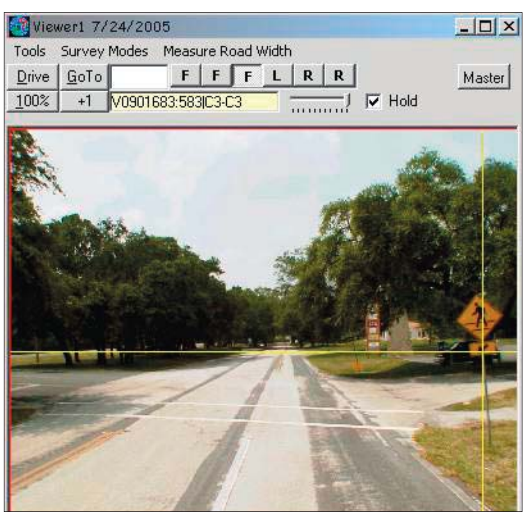
In addition to the lives that were affected, the damage to public and private property was catastrophic—a nightmare for those who are in public works.

St. Johns County in recent years has been spared Mother Nature's wrath. But its location on Florida's northeastern coast makes it as vulnerable as any part of Florida to the ravages of the sea.

A storm of another kind has been brewing in recent years: an unfunded government mandate, Governmental Accounting Standards Board (GASB) Statement 34, which requires 87,000 state and local governments across the United States to move their accounting practices to a business accounting model. For public works departments, this meant for the first time that infrastructure assets—bridges, roads, storm and sanitary sewers, and the like—needed to be valued and reported on. At a minimum, this mandate would require a systematic inventory of such assets. Since 2003, all governments have been expected to comply.

Meanwhile, population growth and development are booming in St. Johns County. Now the ninth-fastest growing county in the United States, the current population of 160,000 is expected to double in the next 20 years.

Threat of hurricanes, a government mandate, and an influx of people—combined, these factors created a perfect storm that required the St. Johns County Public Works Department to quickly change the way it did business.



Cameras mounted on a moving video van capture signage data to be imported into the GIS.

"We needed first and foremost to know our universe of assets and what condition they were in, and then we needed to develop a way to better track and maintain these assets," Agbunag said. "We needed a better way to analyze and visualize and prepare for change."

A Complex Project

The department determined that it needed more than a stand-alone GIS or computerized maintenance management system (CMMS), it needed both, and it needed them to serve as the foundation for a future enterprise asset management system (EAMS).

"We had a multidisciplinary and complex project in front of us, so thoroughly understanding the needs and business processes of the department was crucial for successful planning and implementation," Agbunag said.

The county did its homework, which consisted of a study of Best Management Practices (BMPs) for the department's three divisions:

- Roads and Bridges/Mowing, which maintains and improves the county's roadways and drainage systems
- Engineering/Traffic Engineering/Pavement Management, which designs and constructs the county's roadways and traffic and drainage systems
- Fleet Maintenance, which manages, maintains, and fuels the county's mobile equipment

In addition to studying resources needs, the BMP study assessed where bottlenecks occurred in the workflow and which processes had become archaic.

For example, Roads and Bridges/Mowing is where most of the hard physical work gets done. The department today employs 83 full-time workers who maintain 730 miles of paved road and 30 miles of dirt road. In the past, rural pastures dominated the landscape, which required ditch and dirt road maintenance and bush-hogging. Now, new-home developments, golf courses, and commercial facilities abound, with more planned to be built, all requiring curbs, gutters, pipes, pavement, small mowers for mowing smaller spaces, and landscaping. The BMP study found that the division's ratio of reactive versus proactive maintenance was 75 percent to 25 percent respectively, and that needed to be reversed in order to meet changing demands.

Eye on the Future

A CMMS would help St. Johns County transition from a reactive to a proactive maintenance process; as a result, having a CMMS was a key recommendation of the BMP study.

St. Johns County already had a CMMS, but it was an older legacy system, and it would not interface well with a new GIS. Moreover, it was not "GIS-centric."

GIS-centric means a database or software product that is centered on a GIS as opposed to interfaced with (connected to) a GIS. Thus, a GIS-centric database or software product provides for an open, shared, and standardized environment for users throughout an enterprise or organization. Multiple, duplicitous systems are eliminated in favor of one standard system.

Because the county had its sights set on the future, its CMMS had to be GIS-centric. Software with GIS-centric capabilities ultimately would enable a single, manageable, and editable data source for all of St. Johns County's departments, not just public works. As a result, future duplication of data and efforts would be avoided.

The county selected Woolpert, Inc. (www.woolpert.com), a civil engineering and enterprise technologies consulting firm, to develop the GIS-EAMS.

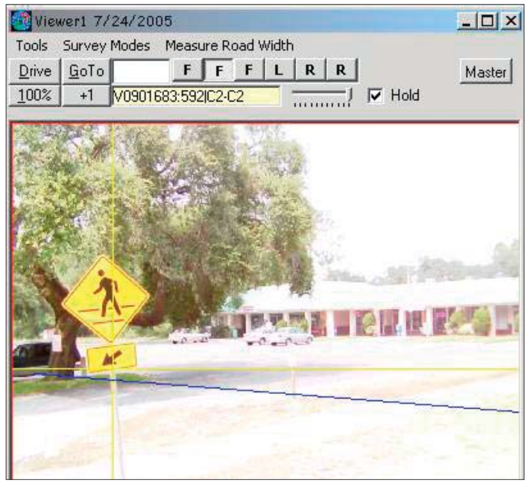
Woolpert recommended that the county jettison the existing CMMS and start anew.

The consultant's next step was to evaluate CMMS packages on the market and determine "best fit" for St. Johns County. Nine CMMS packages were evaluated for the following core capabilities:

- Work request/work order processing
- Preventive maintenance scheduling
- Work management, tracking, and reporting
- Materials and parts inventory control
- Tracking of contract services

The CMMS packages were evaluated to see if they met requirements for pavement management, budgeting/financial reporting, right-of-way permitting, and for a customer service/call center.

Each package was also compared for its system architecture, GIS integration abilities, web and mobile capabilities, ability to support interfaces with the county's existing systems, compatibility with the county's network environment, adaptability, and support services.



A photo of the same sign captured at another angle from another camera on the moving van.

Ultimately, Azteca's (www.azteca.com) Cityworks CMMS product was chosen, especially because of its GIS-centricity.

Building the GIS-EAMS

The subsequent GIS-EAMS building process at St. Johns County was a lot like building a custom home as opposed to one on spec.

Woolpert's first step was to "blueprint" the project in phases: 1) concept, 2) pilot—proof of concept, and 3) system-wide implementation

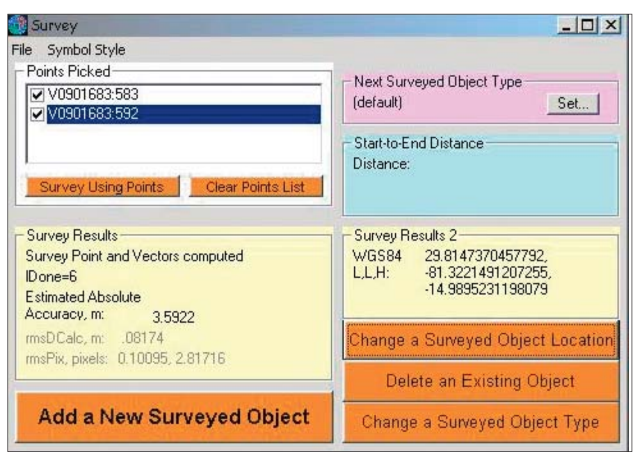
As part of the concept phase, the consultant reviewed the BMP study and conducted additional focus-group conversations with St. Johns personnel to further refine the GIS-EAMS needs.

The consultant used the BMP study and focus group conversations—as well as GASB Statement 34 requirements, American Society for Testing and Materials (ASTM) Pavement Condition Index (PCI) surveys, and Federal Highway Administration (FHWA) bridge inspection standards—to make recommendations for what assets needed to be inventoried; the technologies/techniques to be used for data collection; and the amount of information, level of detail, and condition assessment required for each asset type.

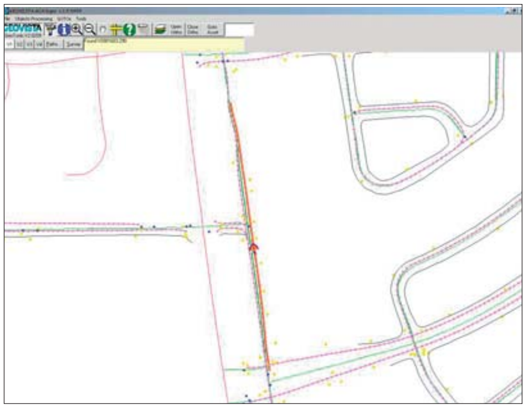
Woolpert began with fieldwork data preparation by reviewing existing county mapping and electronic data, including:

- Aerial orthophotography
- County-owned road GIS datasets and databases
- Pavement maintenance management system databases, maps, and digital graphic layers
- County GIS datasets
- County address electronic files

Simultaneously, the consultant began building the GIS with the intent of populating most features and attributes from the field. A pre-field inventory stage identified data that needed to be incorporated into a data model to be verified in the field during the inventory and condition assessment. A post-field inventory



A screenshot of the data collected on the sign.



A map in the GIS indicating where the van was at the time it captured this particular signage data.

stage identified data that would be added or generated once the field data was quality-controlled and delivered.

Beginning with the pilot and then moving to full implementation, the following assets were inventoried and condition-assessed:

- Drainage structures (ditches, ponds, closed stormwater structures, driveway culverts)
- Transportation assets (traffic signs and signals, guardrails, sidewalks, and street lighting)
- Road pavement and bridges

Different data collection techniques were used depending on the asset:

For drainage structures, global positioning system (GPS) satellite surveying was used in conjunction with SmartSurveyor, Woolpert's mobile mapping system software, which enabled crews to map infrastructure and attributes on the fly. The two-man field crews used Real-Time Differential (RTD) mapping-grade GPS receivers connected to pen-based field computers running SmartSurveyor. The RTD techniques located features within +/- 3 ft horizontal accuracy at a 90 percent confidence level. This process provided a complete inventory of required assets while reducing data collection costs.

FOR TRANSPORTATION ASSETS, GEOSPAN's (www.geospan.com) GeoVista non-coplanar desktop surveying system was used. GeoVista combines rapid, close-range surveys with video captured from six high-resolution cameras mounted on a moving van and panning 360 degrees to obtain high levels of detail in real time. Ultimately, the digital video data was imported into the GIS, bringing maximum imagery to the desktop to meet the county's asset inventory objectives.

All told, an estimated 40,000 signs—along with support structures such as poles, bridge mounts, signal mounts, and guardrail mounts—were inventoried and assessed using the GeoVista technology.

The software allows access to asset inventory information by:

- Pointing at a location on the map (brings up the captured video of the location)
- Selecting an asset location symbol from the map (brings up asset data form)
- Selecting an asset location symbol in the video (brings up asset data form)
- Entering two street names (brings up image in intersection)

The software enables GPS point extraction for any location viewable in the GeoVista imagery by simply selecting the same pixel representing the desired location in at least two different images. GPS point locations are then displayed in every GeoVista video frame within a specified distance from the viewer.

The software provides visual confirmation of what has been inventoried and allows retrieval of the database records by simply clicking on the object in the GeoVista imagery. This capability also shows assets that have been removed from the physical landscape, but still exist in the database.

FOR ROAD PAVEMENT AND BRIDGES, field recording instruments were configured before going into the field to facilitate collection of information and populating of the data within the GIS. Custom digital forms were developed so distress observations could be captured in the field with consistency and applied to the appropriate section represented within the roadway network. This process created a seamless daily transfer of data.

To gather the data, Woolpert used visual "windshield" surveys and ride quality tests that conformed to ASTM standards. Ride-quality distress indicators included bumps, corrugation, shoving, swells, and railroad crossings at low, medium, and high speed levels. Ultimately, Woolpert inspectors would identify alligator "fatigue" cracking, block cracking, bumps and sags, edge cracking, lane/shoulder drop off/longitudinal/transverse cracking, patching and utility cut patching, and weathering and raveling. Pavement condition index surveys identified stress type and severity.

The GEOSPAN video footage also was used to verify collected pavement and bridge data.

Since almost all of the data was populated into the GIS in real-time and "scrubbed" that day or evening, the GIS was created with accurate information from the very start. Simultaneously, the GIS-centric CMMS was configured using Cityworks. As a result, St. Johns County has a highly accurate GIS-CMMS, which is serving as the foundation for a countywide EAMS. This database is an asset in and of itself, and, therefore, will be maintained much like any physical asset must be maintained.

Benefits

Since launching the GIS-EAMS, the following benefits have been realized:

- MOWING—Mowing areas were quantified and delineated in the GIS, which has enabled the county to quantify mowing activities by area and thereby track performance based on established goals.
- DITCH CLEANING—Ditches were identified and mapped. Using the new GIS maps, maintenance crews can see the size and shape of a ditch before going out into the field. They can determine equipment and other resources needed before even leaving for the job site.
- REPAVING—Pavement segments were created within the GIS, with a pavement management system integrated with the CMMS and GIS. As a result, the county now has better tools to analyze and plan for work within the street network. The coun-

ty also now can visually identify activity overlap between the pavement management division and other divisions within the public works department.

- STRIPING—Striping identified within the GIS has enhanced the ability to determine which roads have adequate striping and which roads do not. Aerial images and video logs are used in addition to querying the GIS database for a particular type of striping in a given area.

- TRAFFIC SIGN MAINTENANCE—Crews equipped with integrated GPS equipment and digital cameras can continually update the GIS database while performing work in the field. Crews can position a sign in the GIS map and attach a picture and GPS coordinates.

- STORMWATER STRUCTURES MAINTENANCE—Crews can effectively anticipate problems due to collapsed or nonfunctional storm structures. The county can quantify structures and locate manholes in support of NPDES and GASB 34 requirements.

- MEETING GASB STATEMENT 34 REQUIREMENTS—Since implementing the GIS-EAMS, the county expects to improve its annual work plan budgeting process. Having a clear understanding of assets' condition, the county will be better prepared to assess the value of those assets, thereby meeting GASB 34 reporting requirements. The county is currently beta-testing a Cityworks budgeting tool with the goal of easily and accurately calculating the value of assets in minutes as opposed to weeks or months.

Solid Foundation

Designing and ultimately pouring the foundation for the GIS-EAMS, as well as constructing the GIS-CMMS framework, took time, forethought, and planning. "The process was worth it," Agbunag said. "As we begin to 'frame in' this custom GIS-EAMS by bringing other parts of our enterprise into the fold, we'll know we're making solid, workable, coordinated improvements, not just add-ons."

By taking the time to build it right—right from the start—no "storm" can knock over the GIS that St. Johns built. GE

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