SPECIAL ISSUE
GOVERNMENT

THE ESSENTIAL VOICE OF THE INDUSTRY

GEOWORLD

NOVEMBER 2012

FOLLOW 5 KEY TIPS FOR BUILDING COLLABORATIVE GIS

GeoWORLD

Vol. 25, No. 11

1030 W. Higgins Road, Suite 230
Park Ridge, IL 60068
www.geoplace.com

Integrated Content

EDITOR IN CHIEF, GEOWORLD, GEOPLACE.COM AND GEOREPORT
Todd Danielson, tdanielson@geoplace.com
CHIEF NEWS CORRESPONDENT L. Scott Tillett
EDITORIAL AND SOCIAL MEDIA ASSISTANT Kelly Thomas

GeoTec Event

CONFERENCE SHOW MANAGER Katie Smith, ksmith@m2media360.com
CONFERENCE PROGRAM MANAGER Todd Danielson, tdanielson@geoplace.com

Contributing Editors

Peter Batty, Joseph K. Berry, Ron Bisio, Mark Dolezel, Ron Lake, Janet Jackson, Mark Reichardt, Erik Shepard, Daniel Sui, Nigel Waters, Patrick Wong

Editorial Advisory Board

Dan Adams **TOMTOM**
Peter Batty **UBISENSE**
Tim Case **AUTODESK INC.**
Jack Dangermond **ESRI**
Charles H. Drinnan **EWAM ASSOCIATES**
Jim Farley **ORACLE CORP.**
Connie Gurchiek **TRANSCEND SPATIAL SOLUTIONS**
William Holland **REDGIANT ANALYTICS INC.**
Anup Jindal **RMSI**
Roy Kolstad **NAVTEQ**
Ron Lake **GALDOS SYSTEMS**
David Linden **SAIC**
Xavier Lopez **ORACLE CORP.**
Dale Lutz **SAFE SOFTWARE**
Carey Mann **BENTLEY SYSTEMS INC.**
Carl Reed **OPEN GEOSPATIAL CONSORTIUM INC.**
Walter S. Scott **DIGITALGLOBE**
David Sonnen **IDC**
Mladen Stojic **ERDAS INC.**
Steve Woolven **APPLANIX CORP.**

Production

PRODUCTION DIRECTOR Mary Jo Tomei, mtomei@m2media360.com
ART DIRECTOR Kathleen Sage, ksage@m2media360.com

Advertising

WORLDWIDE ADVERTISING ACCOUNTS MANAGER
Craig Miller, cmiller@m2media360.com, 213-596-7228

List Rental, Reprint Marketing Services

Cheryl Naughton, cnaughton@m2media360.com

M2MEDIA360

CEO/PRESIDENT Marion Minor
VICE PRESIDENT, FINANCE AND OPERATIONS Gerald Winkel
VICE PRESIDENT, CIRCULATION AND COLLATERAL SERVICES Joanne Juda-Prainito
PRODUCTION AND OPERATIONS DIRECTOR Mary Jo Tomei

GeoWorld is published monthly by M2MEDIA360, a Bev-Al Communications Company. Authorization to photocopy items for educational, internal or personal use, or specific clients, is granted by M2MEDIA360, provided appropriate fees are paid prior to photocopying items, please contact Cheryl Naughton, cnaughton@m2media360.com

M2MEDIA360
1030 W. Higgins Road, Suite 230
Park Ridge, IL 60068
Phone: (847) 720-5600
Fax: (847) 720-5601
e-mail: tdanielson@geoplace.com
Web: www.geoplace.com

CIRCULATION: For subscription inquiries and customer service questions please call 845-856-2229.

 ISSN# 0897-5507
Canadian GST# 82917 9944 RT 0001 Canadian CPM #1528653
Single Copy Price U.S $8.00,
Single Copy Price Canada/Mexico/Foreign $12.00

FROM THE ARCHIVES

GeoWorld magazine has built a reputation as a trusted source of information with consistently forward-looking and authoritative content. We were the first publication to address the needs of the GIS user community, and we have enjoyed much success as the industry "found its footing" and expanded into a wide range of disciplines. We feel lucky to have served a dedicated readership for more than two decades.

The content of each *GeoWorld* issue has been posted online at *www.geoplace.com* since 1996. This rich resource provides perspective on technology development and clear relevance to the challenges faced today. To highlight some of the informational resources available, each issue will feature archived stories relating to that issue's cover story.

Simply click on "Articles & Archives" at the top of the menu bar on *GeoPlace.com*, and type in a few of the key words from the following list to find the full article on our site.

November 2011
Just Let Go: Dublin, Ohio, Unlearns to Learn Web Mapping
By Brandon B. Brown

August 2011
Buffalo Overlook: A Citywide GIS Tracks Public Works
By Eric Brady

November 2010
Government GIS Can Overcome a Changing Economic Climate
By Shawn McLeod

GeoWorld Services

GeoWorld Online Visit GeoWorld at GeoPlace.com for online reviews, features, news, classified ads and event listings.

GeoMarketplace The GeoMarketplace resource directory provides an easy means to connect with product and services vendors. Indexed listings of imagery, data, data conversion, hardware, mapping/surveying, mobile mapping, software development and Web services will appear monthly. Contact Cheryl Naughton at cnaughton@m2media360.com for more information.

Reprints Order custom reprints of GeoWorld columns and features on glossy magazine stock in black and white or full color, individualized with company logos, photos or advertising insertions. For reprints, please contact: Contact Cheryl Naughton by phone, 678-292-6054, fax 360-294-6054, or e-mail cnaughton@m2media360.com.

Advertising To advertise in GeoWorld, contact Craig Miller, worldwide advertising accounts manager [213-596-7228, cmiller@m2media360.com].

Subscriptions To order a GeoWorld subscription, visit the magazine's Web site (www.geoplace.com). To report an address change or correct circulation problems, contact Customer Service [845-856-2229].

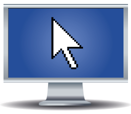
List Rental Order custom mailing lists from GeoWorld if you are looking for professionals in the geospatial industry working with GIS applications in government, utilities, education and the private sector. Contact Cheryl Naughton by phone, 678-292-6054, fax 360-294-6054, or e-mail cnaughton@m2media360.com. All names are proven direct-mail responsive, and they are all selectable by title and business. One phone call will guide you toward the best list choices for your needs.

M2MEDIA 360 american business media

GeoWorld

NOVEMBER 2012

Time-sensitive *GeoWorld* departments such as NetLink, PeopleLink, Product News and Business News now are maintained solely at the GeoPlace.com Web site. Check there often for the latest updates as they happen.



The digital version of this issue contains additional coverage of this section. Visit GeoPlace.com for more information.

GeoWorld (ISSN 0897-5507, USPS 023-416) is published monthly by M2MEDIA360, a Bev-Al Communications, Inc. company. 1030 W. Higgins Road, Suite 230, Park Ridge, IL 60068 USA
GeoWorld is distributed free to qualified subscribers in the geospatial industry.
POSTMASTER Please send change of address to:
***GeoWorld*, PO Box 4290, Port Jervis, NY 12771**
Subscription rates - one year: US $72, two years: US $128; one year Canada: $90, two years Canada: $163. All other countries, one year: $108 (includes airmail postage). Payable in U.S. funds only. Customer Service and subscription requests, please call Phone (845) 856-2229; Fax (845) 856-5822 or subscribe online at www.geoplace.com/subscribe.
Periodical postage paid at Park Ridge, IL and additional mailing offices.

Government Special Issue

FEATURES

Elections Have Consequences (for Geotechnology)

POSITION

BY TODD DANIELSON

Shortly before Barack Obama was elected for the first time in 2008, I attended the major GEOINT conference on geospatial intelligence. A few of the high-ranking military speakers were concerned that if Obama won, defense spending would be cut, and those cuts would be suffered by the entire GEOINT industry.

Four years later, little to none of the expected budget cuts have happened. Every time defense spending is proposed or "floated," it seems to "dodge the bullet" (pun intended). Even when the threat seems real, as was the case in spring 2012 when it was announced that the U.S. government would drastically cut back or cancel its EnhancedView contract, which provides a large portion of the revenue for commercial satellite imaging companies, the cuts didn't happen.

It was widely speculated that these cuts would decimate the commercial imaging industry, to the point where competing companies GeoEye and DigitalGlobe began a war of sorts to try and take over the other company. The harsh words eventually settled down, but the two companies have since announced an actual merger, and I believe a major motivation was expected cuts in their government contracts … at some point.

But these cuts aren't happening soon. Shortly after the initial announcement about the proposed cuts, both GeoEye and DigitalGlobe announced deals worth hundreds of millions of dollars through at least 2013 for government work. And in DigitalGlobe's latest financial results, it reported $81.1 million in Defense and Intelligence contracts (about 76 percent of total revenue) for third-quarter 2012, up 24 percent from this time a year ago.

FEMA Saved?

One of the possible turning points of the presidential election may have been Hurricane/Superstorm Sandy. Some analysts say it made Obama seem "presidential" when he needed it, but it also pointed out a difference in philosophy.

Mitt Romney and some other Republicans were on the record saying they believed the Federal Emergency Management Agency (FEMA) funding should be cut back, and more responsibility should be put on the states to take care of disasters. Unfortunately, most states don't have the budgets for major disasters, and they certainly aren't prepared for anything as massive as Sandy.

Theories sometimes run into reality, and people who lost their homes likely were glad to see the strong emergency-management response that the federal government can provide. And one of the major elements of a strong emergency response is mapping, so any boon to FEMA and local response centers has to be a boon to the geotechnology industry.

Free Market vs. Government

Another interesting battle was pitched between those favoring "free market" principles under (almost) any circumstances and those who believe government has a larger role in making decisions. A major lobbyist in our industry, the Management Association for Private Photogrammetric Surveyors (MAPPS), has long backed free-market politicians. It suggested members seek voting guidance from the U.S. Chamber of Commerce, which largely supports conservative and Republican candidates, and it advocated for the Freedom from Government Competition Act.

It's my guess that MAPPS was disappointed in the recent election and believes that more government (or the same government) isn't what's best for its members. However, I also believe that those who make a living working for GIS departments in federal or municipal government organizations think the opposite and will feel more secure in their jobs.

I'll leave it up to history to decide who was right or wrong, but I do know that elections have consequences. GW

Todd Danielson is editor of *GeoWorld* magazine, PO Box 773498, Steamboat Springs, CO 80477; e-mail: *tdanielson@geoplace.com*.

3-D Maps Emerging from Post-Hurricane Data Project

Scientists from the U.S. Geological Survey (USGS) applied a new technology to map urban flooding in the wake of Hurricane Isaac, which made landfall as a Category 1 hurricane near New Orleans in August 2012. Terrestrial LIDAR (T-LIDAR) allowed USGS scientists to collect highly detailed information in areas of Louisiana, Mississippi and Alabama, where the hurricane's impact was most severe.

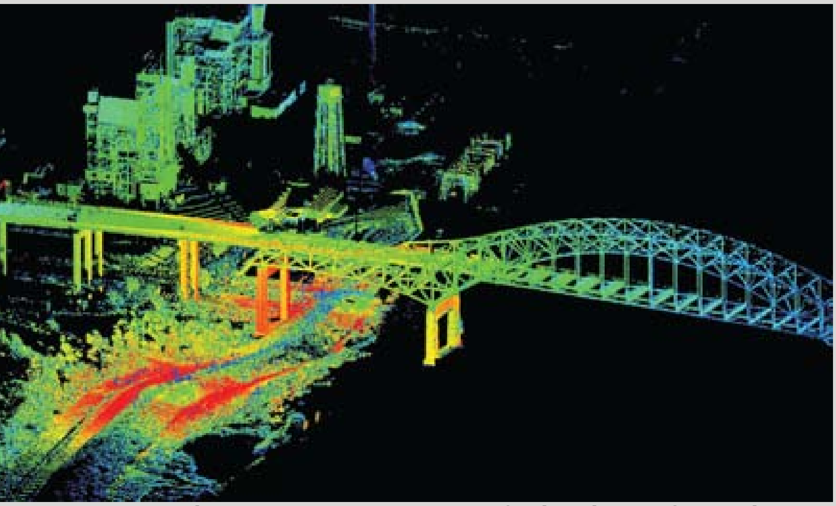
Using a portable T-LIDAR instrument, scientists were able to generate 3-D maps of buildings, dams, levees and other structures while also showing areas of storm damage. The instrument can quickly collect millions of topographic data points in a full 360-degree view, producing accurate topographic information and map areas at a range of up to two-thirds of a mile.

USGS is using information from the post-Isaac project to develop 3-D models of streets and structures as well as floodwater levels reached during the storm and current water levels—ultimately building an interactive 3-D flood-inundation map to help identify areas where flooding potential would be greatest during future storms. The map also should help determine the extent of wind and flood damage from Hurricane Isaac.

"If a picture paints a thousand words, a T-LIDAR scan paints several million words to capture the fleeting aftermath of a hurricane's impact," said Marcia McNutt, USGS director. "The ability to rapidly preserve for posterity a quantifiable, three-dimensional representation of storm damage is going to open the doors for new flood-hazard science."

T-LIDAR works by effectively looking sideways from ground level to capture vertical details such as water levels—details that airborne LIDAR can't capture. The recent USGS work involved a portable tripod-mounted instrument and a truck-mounted system, with the truck-mounted device collecting information in a more continuous manner.

"Using terrestrial LIDAR in this fashion has the possibility of helping us quickly assess high-water marks, current water levels and, to some degree, flood damage, in a very short time," said Athena Clark, director of the USGS Alabama Water Science Center. "We're always looking for better, more-efficient and cost-effective ways of advancing the science, and this technology has some great possibilities."



USGS

A terrestrial LIDAR scan shows the I-510 bridge in New Orleans just three days after Hurricane Isaac made landfall. USGS scientists are using such imagery to produce 3-D maps that could aid storm planning and assessment.

Research Tool Puts Old Geology Maps to New Use

Technical information products provider Elsevier is collaborating with the Society of Economic Geologists (SEG) to include thousands of maps from the society's *Economic Geology* journal in Elsevier's Geofacets research tool.

The move should make "hard to find" scientific maps more readily available for Geofacets users working in metals exploration, mining, and oil and gas industries. By the beginning of 2013, the joint venture should add nearly 15,000 maps to the Geofacets collection, with maps collated during the last 107 years from SEG's journal. The deal will bring the tool's total number of maps to more than 240,000.

"A significant part of SEG's mission is to disseminate geological information and aid those working in exploration, mineral-resource appraisal, mining and metal extraction," said Brian Hoal, executive director at SEG. "Collaborating with Elsevier to make our maps and information much easier to discover, and therefore easier to apply to their work, will help geoscientists combat specific industry challenges such as low drilling-success rates and the increasing difficulty in finding new orebodies."

Time-sensitive *GeoWorld* departments such as NetLink, PeopleLink, Product News and Business News now are maintained solely at the GeoPlace.com Web site. Check there often for the latest updates as they happen.

Satellite Launch Advances Climate-Modeling Work

The Metop-B spacecraft was launched in mid-September 2012 by the European Organization for the Exploitation of Meteorological Satellites (EUMETSAT) at Baikonur Cosmodrome in Kazakhstan. This new satellite should allow the National Oceanic and Atmospheric Administration (NOAA) to continue receiving data for models used to forecast U.S. weather and climate.

Metop-B will serve as the second of three polar-orbiting satellites launched by EUMETSAT, which in 1998 teamed with NOAA under the U.S./European Initial Joint Polar System partnership, which calls on each agency to fly sensors on each other's polar-orbiting satellites that circle the planet 14 times per day in different orbits. Metop satellites fly in a mid-morning orbit, while NOAA's polar-orbiting environmental satellites fly in an afternoon orbit.

The satellite partnership provides the majority of global data for numerical weather forecasts. It also provides observations that help predict environmental phenomena from volcanic eruptions to snow cover to sea-surface temperatures.

The Metop satellites include advanced sensors for greater accuracy of atmospheric temperature, water vapor and ozone soundings, which are vital for improving weather forecasts, as well as special sensors for search and rescue operations. NOAA has comparable sounding capabilities on the Joint Polar Satellite System, the agency's next generation of polar-orbiting satellites. On behalf of NOAA, NASA managed the development, testing and integration of five U.S. instruments flying on Metop-B.

NOAA

The second of three key polar-orbiting satellites heads for space from the Baikonur Cosmodrome in Kazakhstan. Data gleaned by the satellite should help improve the forecasting of U.S. weather and climate.

"This launch is another milestone in a partnership that continues our wide-ranging ability to detect the early signs of severe weather, climate shifts and distress signals from emergency beacons in the U.S., Europe and around the world," said Mary Kizca, assistant administrator for NOAA's Satellite and Information Service.

European Satellite Constellation Grows

The SPOT 6 Earth-observation satellite, built by European firm Astrium and launched in September 2012 from the Satish Dhawan Space Center in India, will work in unison with the very-high-resolution Pléiades 1A satellite. Beginning in 2014, the two will form a satellite constellation with future satellites Pléiades 1B and SPOT 7.

This constellation will be able to view each point of the globe once per day in high and very-high resolution. SPOT 6 and SPOT 7—each expected to have a service life of 10 years—will provide a wide picture over an area, while the Pléiades craft offer products with a narrower field of view and an increased level of detail (at 50-centimeter resolution).

"With four satellites phased 90 degrees apart in the same helio-synchronous quasi-polar orbit, we will be able to offer our customers geoinformation products in record time, in as little as six hours," said Eric Beranger, CEO of Astrium Services, one of Astrium's three key business units. "With four satellites, we obviously have more freedom in terms of the revisit interval, for better change detection or faster coverage. Users can choose between very-high-resolution data capture at a specific point and high-resolution data capture over a larger area."

Ahead of Merger, DOJ Seeks More Information from DigitalGlobe and GeoEye

As two goliaths of imagery and geospatial solutions prepare to merge in a deal valued near $900 million, the U.S. Department of Justice continues to perform due diligence ahead of regulatory approvals.

The planned merger of DigitalGlobe Inc. and GeoEye Inc. received the go-ahead from the corporations' leaders in July 2012, when the boards of both companies unanimously approved the merger. The regulatory approval process, however, still is underway, and, on Sept. 21, 2012, the U.S. Department of Justice (DOJ) requested additional information from the two companies as part of a "Second Request."

DigitalGlobe described the request as "a standard aspect of the regulatory process" and announced that the requests extend the waiting period for closing the transaction—until 30 days after DigitalGlobe and GeoEye complied with the Second Requests or until the waiting period is otherwise terminated by the DOJ.

"DigitalGlobe is working cooperatively with the DOJ and looks forward to closing the transaction in the fourth quarter of 2012 or the first quarter of 2013," the company said in a statement.

Completing the transaction remains subject to shareholder approval from both companies. In addition, the merger must receive regulatory approval from the Federal Communications Commission as well as the National Oceanic and Atmospheric Administration. After the planned merger, the combined company will retain the name of DigitalGlobe and continue to trade on the NYSE under the symbol DGI.

GEOEYE INC.

Imagery such as this 2012 high-resolution GeoEye Inc. scene from Lower Manhattan will fall under the offerings of a "new" DigitalGlobe Inc., the result of a planned merger between the two companies.

Apple Statement Acknowledges Need for Map App Improvement

The CEO of Apple Inc. issued an apology of sorts after the company's new Maps application for its latest iOS operating system received heavy public criticism.

After its release in mid-September 2012, the latest Apple Maps app—powered by an Apple-developed mapping system rather than the original Google-powered app—drew user and media criticism for functionality shortfalls, such as lack of a "streetview" function as well as various errors.

"At Apple, we strive to make world-class products that deliver the best experience possible to our customers," wrote Apple CEO Tim Cook in an open letter published on the company's Web site in late September. "With the launch of our new Maps last week, we fell short on this commitment. We are extremely sorry for the frustration this has caused our customers, and we are doing everything we can to make Maps better."

Cook also said in the letter that "the more our customers use our Maps, the better it will get, and we greatly appreciate all the feedback we have received from you."

The letter suggests that while the company works to improve the Maps app, users can try alternatives such as other map apps in the Apple App Store or Web maps from companies such as Google or Nokia. GW

Just How Crooked Are Things?

BEYONDMAPPING

BY JOSEPH BERRY

In a heated presidential election month, this seems an apt title, as things appear to be twisted and contorted from all directions. But politics aside and from a "down to Earth" perspective, how might one measure just how spatially crooked things are?

My benchmark for one of the most crooked roads is Lombard St. in San Francisco—it's not only crooked but devilishly steep. How might you objectively measure its crookedness? What are the spatial characteristics? Is Lombard St. more crooked than the eastern side of Colorado's Independence Pass connecting Aspen and Leadville?

A Complicated Definition

Webster's Dictionary defines crooked as "not straight," but there's a lot more to it from a technical perspective. For example, consider the two paths along a road network shown in Figure 1.

A simple crooked comparison characteristic could compare the "crow-flies" distance (straight line) to the "crow-walks" distance (along the road). The straight-line distance is easily measured using a ruler or calculated using the Pythagorean Theorem. The on-road distance can be manually assessed by measuring the overall length as a series of "tick marks" along the edge of a sheet of paper successively shifted along the route. Or, in the modern age, simply ask Google Maps for the route's distance.

The vector-based solution in Google Maps, like the manual technique, sums all the line segments' lengths comprising the route. Similarly, a grid-based solution counts all the cells forming the route and multiplies by an adjusted cell length that accounts for orthogonal and diagonal movements along the sawtooth representation. In both instances, a *diversion ratio* can be calculated by dividing the crow-walking distance (crooked) by the crow-flying distance (straight) for an overall measurement of the path's diversion from a straight line.

As shown in Figure 1, the diversion ratio for Path1 is 3.14 kilometers / 3.02 kilometers = 1.04, indicating that the road distance is just a little longer than the straight-line distance. For Path2, the ratio is 9.03 kilometers / 3.29 kilometers = 2.74, indicating that Path2 is more than two and a half times longer than its straight line. Based on crookedness being simply "not straight," Path2 is much more crooked.

Need a Diversion?

Figure 2 depicts an extension of the diversion ratio to the entire road network. The on-road distance from a starting location is calculated to identify a crow's walking distance to each road location (employing Spatial Analyst's Cost Distance tool for the Esri-proficient among us). A straight-line proximity surface of a crow's flying distance from the start is generated for all locations in a study area (Euclidean Distance tool) and then isolated for just the road locations. Dividing the two maps calculates the diversion ratio for every road cell.

The ratio for the farthest-away road location is 321 cells / 117 cells = 2.7, essentially the same value as computed using the Pythagorean Theorem for the straight-line distance. Use of the straight-line proximity surface is far more efficient than repeatedly evaluating the Pythagorean Theorem, particularly when considering typical project areas with thousands of road cells.

In addition, the spatially disaggregated approach carries far more information about the area roads'

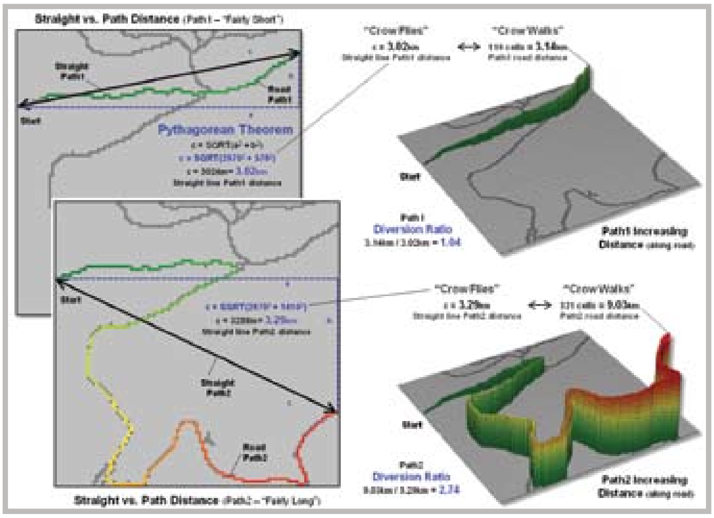


Figure 1. A diversion ratio compares a route's actual path distance to its straight-line distance.

Joseph Berry is a principal in Berry & Associates, consultants in GIS technology. He can be reached via e-mail at *jkberry@du.edu.*

crookedness. For example, the largest diversion ratio for the road network is 5.4—a crow-walking distance nearly five and a half times that of crow-flying distance. The average ratio for the entire network is 2.21, indicating a lot of overall diversion from straight-line connection throughout the set of roads.

Summaries for specific path segments are easily isolated from the overall diversion ratio map—compute once, summarize many. For example, the U.S. Forest Service could calculate a diversion ratio map for each national forest's road system and then simply "pluck off" crookedness information for portions as needed in harvest or emergency-response planning.

Now for Something Different

The *deviation index* in Figure 3 takes an entirely different view of crookedness. It compares the deviation from a straight line connecting a path's endpoints for each location along the actual route. The result measures the route's "deflection" as the perpendicular distance from the centerline.

If a route is perfectly straight, it will align with the centerline and contain no deflections (all deviation values = 0). Larger deviation values along a route indicate an increasingly non-straight path.

The left side of Figure 3 shows the centerline proximity for two paths. Note the small deviation values (green tones) for Path1, confirming that it's generally close to the centerline. It's much straighter than Path2, which has a lot of deviation values greater than 30 cells away (red tones). The average deflection (overall deviation index) is just 3.9 cells for Path1 and 26.0 cells for Path2.

But crookedness seems more than just longer diverted routing or deviation from a centerline. It could be that a path simply makes a big swing away from the crow's beeline flight—a smooth curve and not a crooked, sinuous path. Nor is the essence of crookedness simply counting the number of times that a path crosses its direct route. Both paths in the examples cross the centerline just once, but they're obviously very different patterns.

Another technique might track the above/below or left/right deflections from the centerline. The sign of the arithmetic sum would note which side contains the most deflections. The magnitude of the sum would report how off-center (unbalanced) a route is. Or perhaps a roving-window technique could be used to summarize the deflection angles as the window is moved along a route.

The bottom line (pun intended) is that spatial analysis is still in its infancy. Although nonspatial math/stat procedures are well developed and understood, quantitative analysis of mapped data is fertile turf for aspiring minds. Are any bright and inquiring grad students out there up to the challenge?

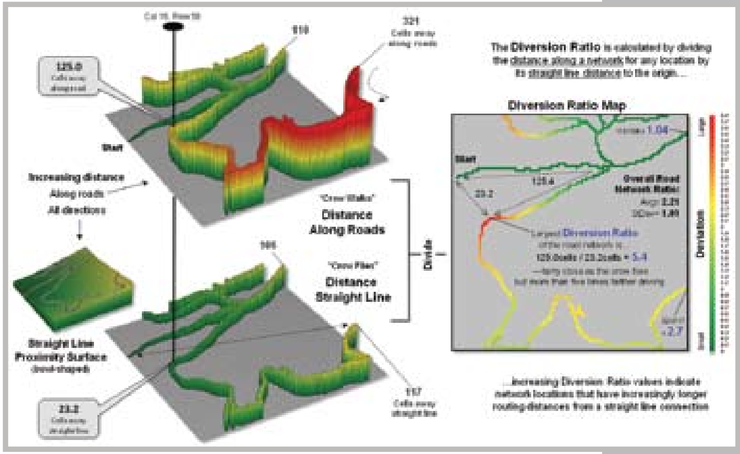


Figure 2. A diversion ratio map identifies the comparison of path vs. straight-line distances for every location along a route.

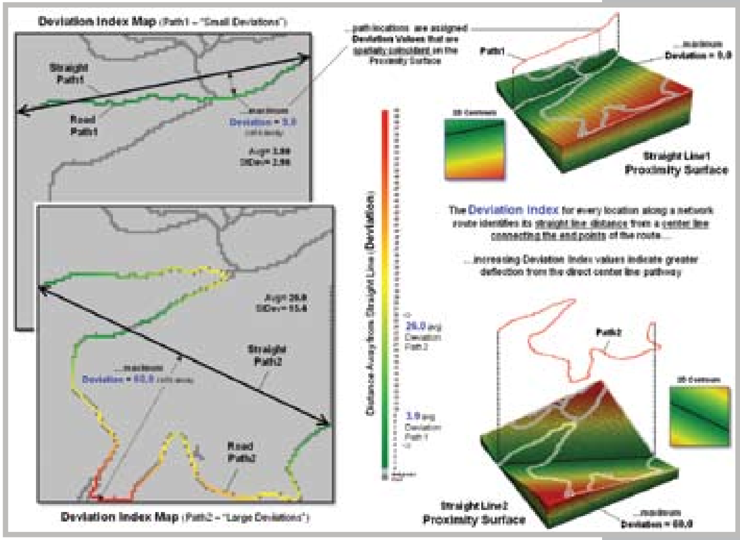


Figure 3. A deviation index identifies the deflection from a path's centerline for every location along a route.

Author's Note: *For a related discussion characterizing the configuration of landscape features, see the online book, Beyond Mapping I, Topic 5: Assessing Variability, Shape and Pattern of Map Features, at* www.innovativegis.com/basis/BeyondMapping_I/Topic5.

The Web Index 2012: Lessons for a GIS Index in 2013?

EDGENODES

BY NIGEL WATERS

Recently, the World Wide Web Foundation published the Web Index 2012 (*thewebindex.org/2012/09/2012-Web-Index-Key-Findings.pdf*), which combines new primary data from a survey with secondary data. The index's goal is to rank countries according to their "progress and use of the Web."

In this first-ever survey, 61 countries were included, although the publishers hope to expand the list to about 100. Of the countries included in the 2012 survey, 18 were from Africa, nine from the Americas (including all three North American countries: United States, Canada and Mexico), 14 from the Asia/Pacific region, 15 from Europe (including the United Kingdom (UK)), and five countries from the Middle East and Central Asia.

How the Data Were Gathered

These countries primarily were chosen because of data availability. Primary data collection involved finding and paying recognized in-country experts to score the survey's questions. Secondary data came from a number of highly regarded sources, including the United Nations, Freedom House, the World Bank, the World Economic Forum, the International Telecommunication Union, the CIA World Factbook, the International Energy Agency (for electricity availability), Reporters without Borders and the Wikimedia Foundation, among others.

Survey data were gathered only during 2011, but the secondary data were gathered from 2007-2011. The recruited organizations had to be reliable, producing data on a multi-year basis for at least two thirds of the included countries to show cross-country consistency.

Nigel Waters, editor of *Cartographica*, is a professor of geography and director for the Center of Excellence for Geographic Information Science, George Mason University; e-mail: *nwaters@gmu.edu.*

How the Index Was Constructed

The composite index was composed of three sub-indices:

1. Communications and Institutional Infrastructure (C&I)
2. Web Use and Web Content (WU/WC)
3. Political, Social and Economic/Developmental Impact (S&EDI)

Secondary data for these sub-indices included the following:

1. C&I: Information on political rights and civil liberties; the proportion of population with access to electricity; Internet bandwidth availability (megabits per second per user) and the percentage of broadband subscribers and households with computers; mobile phones per capita; Internet subscriptions; cell-phone affordability and cellular-network coverage; an index of press freedom; expected number of years of schooling and literacy rates; Internet servers per person; tertiary education rates. There also were survey questions on access to digital content, the extent of business adoption of new technology, freedom of the press, quality of education, school Internet access, the burden of government regulation, importance of Information and Communication Technology (ICT) in government's vision, and government prioritization of ICT.

2. WU/WC: Percentage of population using the Internet, indices of government online services, public participation in these services, and a survey question on the number of Wikipedia articles in the local language.

3. S&EDI: ICT as a percentage of Gross Domestic Product (GDP). Survey questions for this sub-index included a question on the use of virtual social networks; the impact of ICT on citizens' access to basic services and business-organization models, services and products; extent of business Internet use; and the extent to which ICT use had increased government efficiency.

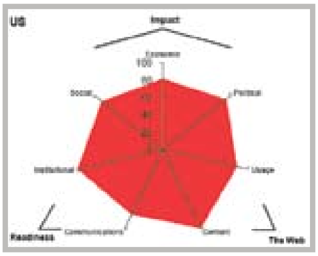


Figure 1. A graphic indicates the scores for the United States on the seven components of the Web Index (*thewebindex.org/2012/09/2012-Web-Index-Key-Findings.pdf*).

Primary data collection involved a survey that had 256 questions (many of which had two or three parts) that helped construct the indices.

Index Problems

Any such index has two major difficulties. First, there's concern over how many questions and sub-indices are used to represent the impact of a given aspect of the Web Index. Two, three or more similar questions will lead to double or triple counting (i.e., weighting one aspect too heavily).

The second problem is the weighting of the three sub-indices. The report's authors gave a weighting of 0.2 to the Readiness sub-index (one-third to

Communications and two-thirds to Institutional Infrastructure), a weighting of 0.2 for Web Content and Use (a half each) and a weighting of 0.6 for Impact (Social, Economic and Political each receiving equal weights of one third). The seven parts of the Web Index and the sources of information were presented as a tree diagram (*http://thewebindex.org/data/all/tree-diagram).*

Different weights would obviously change the results. This problem is similar to that faced by Ian McHarg, often considered one of the fathers of GIS, when he developed his overlay method for determining the best alignment for a transportation route that would minimize social and physical environmental impacts (see his iconic book, *Design with Nature*). This methodology later was adopted in GIS studies that also sought to minimize the environmental impact in creating utilities' transportation routes.

The solution to the problem of choosing variables and applying weights was to do what McHarg did (Waters, 2002) and what the authors of this Web Index did: consult the experts for answers. The effect of different weighting systems is described in the report, and the Web Index appears robust to various weighting schemes.

Who Was First and Last?

All the individual variables were normalized, and their standardized scores were clustered together into seven components presented on a scale from 1 to 100, using a visualization device shown in Figure 1 (for the United States). Figure 2 shows the countries that were in the top and bottom 10, and it shows the highest and lowest-scoring country in each region. Sweden, the United States, the UK and Canada take the first four places, respectively.

A GIS Index also might include these nations in the top four. The United States would probably be No. 1 because of Esri's influence on the industry as well as the impact on academia of the National Center for Geographic Information and Analysis and other organizations such as the University Consortium on Geographic Information Science.

The UK would be there due to the influence of Ordnance Survey on making digital maps available to the general public and industry. The UK's Regional Research Laboratories also are important for their influence on academia. Sweden was one of the first countries developing land information systems and digital road data banks, and Canada is acknowledged as developing the first GIS, the Canada Geographic Information System. Each of the four countries benefitted from their own pioneering innovations.

Africa lags all the other regions on the overall impact of the Web, but, within Africa, Tunisia is a leader, and Zimbabwe has the lowest score, perhaps reflecting the

TOP 10 OVERALL

1 – Sweden
2 – United States
3 – UK
4 – Canada
5 – Finland
6 – Switzerland
7 – New Zealand
8 – Australia
9 – Norway
10 – Ireland

BOTTOM 10 OVERALL

52 – Nepal
53 – Cameroon
54 – Mali
55 – Bangladesh
56 – Namibia
57 – Ethiopia
58 – Benin
59 – Burkina Faso
60 – Zimbabwe
61 – Yemen

REGIONAL OVERALL

AFRICA
Leads – Tunisia
Lags – Zimbabwe

EUROPE
Leads – Sweden
Lags – Russia

AMERICAS
Leads – US
Lags – Ecuador

MIDDLE EAST/C ASIA
Leads – Israel
Lags – Yemen

ASIA-PACIFIC
Leads – New Zealand
Lags – Bangladesh

Figure 2. Countries with the highest and lowest scores on the Web Index are listed (*thewebindex.org/2012/09/2012-Web-Index-Key-Findings.pdf*).

political activism in the former country and the limited political freedom in the latter. Indeed, political restrictions on access to the Internet are a major reason for low scores throughout the 61 countries.

A rank correlation of 0.92 and an ordinary least-squares regression reveal a strong, positive relationship between GDP per capita and a high score on the Web Index. However, the relationship isn't linear, so after a per capita GDP of about $20,000, increases in Web Index scores become more dependent on the political will to allow access to the Web and create Web content.

A GIS Index Is Needed

In the report, Tim Berners-Lee, widely regarded as the father of the Web, argues that access to the Web—being part of the information society—is "as important as access to water and vaccinations." I'll argue that access to spatial information is a major reason that this is true, and that's why we need a GIS Index.

In addition, the next calculation of the Web Index itself should incorporate two new, important components:

1. Access to spatial information through such products as Google Maps, Wikimapia and smartphone map apps.

2. The extent to which Geographic Information Science is taught throughout the educational system.

When asked to comment on the value of the index, Jeff Jaffe, the non-executive director of the World Wide Web, opined: "When you consider the criticality of the Web … it's maddening that no one ever thought to [calculate a Web Index] before." I would argue that this is true for a GIS Index.

References

Waters, N. 2002. "Modeling the Environment with GIS: A Historical Perspective from Geography," *Geographic Information Systems and Environmental Modeling*; edited by K.C. Clarke, B.O. Parks and M.P. Crane; pages 1-35; Prentice-Hall; Upper Saddle River, N.J.

BY NICK O'DAY, CHRIS WHATLEY AND ISSAC STANDARD

FOLLOW 5 KEY TIPS FOR BUILDING COLLABORATIVE GIS

GIS data collection, maintenance and quality control are the most time-consuming tasks GIS staff undertake. They're essential for map accuracy, but can be an utterly mind-numbing activity. But how can the need for high-quality GIS data be balanced with the need to deliver to internal and external customers? The answer is collaboration.

This realization led to founding the Fulton GIS Collaboration Group (FGCG) in January 2010. The group is comprised of GIS professionals and "power users" from cities, county governments, school systems, the Atlanta Hartsfield International Airport, and the state Department of Transportation based in Fulton County, Ga. All municipalities and government agencies participate voluntarily and work together to solve common issues within Fulton County, lending assistance where necessary.

To foster this effort, members of FGCG work together to find solutions that streamline GIS operations, improve data quality and enrich staff. This is accomplished by focusing members' efforts on GIS issues rather than larger political interests.

Following are the key experiences of this group, which may serve as tips and tricks to create a successful, volunteer-based, collaborative GIS group among municipalities and/or government agencies.

TIP #1
Identify Potential Partners for Collaboration

The first step to collaborating with GIS colleagues is to find them. Many GIS professionals manage or work in their own GIS unit with little interaction with nearby GIS professionals. Just like any new relationship, start slowly. Make connections through professional organizations such as a local Urban and Regional Information Systems chapter, a larger municipality or common acquaintances. Most likely, the data or help individuals seek are closer than they realize.

When FGCG founders first started talking about building a collaborative group, they developed a list of GIS managers from each city in the county. It turns out they had already met many of these people. That was the easy part.

The difficult task was trying to determine who to invite from cities the founders didn't know as well as people from cities that don't have their own GIS. In such cases, the group contacted director-level staff at these cities in the IT, Community Development/Planning and Tax departments. These people know their staff and forwarded the founders' messages to the right people.

During this process, it may be difficult to contact all key staff from all cities in the desired area. Don't be overly concerned with this initially. As the group begins to form, word will spread, and GIS users from non-participating agencies will contact participants. Although organizations may not be managing a GIS operation of their own, they often have an ongoing interest or partnership that's GIS-related.

A map shows all cities comprising the Fulton GIS Collaboration Group membership as well as surrounding counties within the metro Atlanta region.

TIP #2
Sell the Benefits of Collaboration

After an initial contact list is developed, it's time to sell your colleagues on the idea of collaboration. To many, collaboration is a fancy word that conjures up memories of late nights in 5th grade struggling to complete a group project—alone.

Clearly, the most important benefit of GIS collaboration across jurisdictions is the elimination of redundant work. There's no need for a county to capture the same information as one of its cities, and vice versa. This wastes resources and keeps the county and city from the truly valuable work: producing high-quality analysis and intuitive mapping products.

The FGCG is founded on the principle that each municipality is its own expert. Any base data developed by staff at the city of Johns Creek, for example, are treated by other cities and Fulton County as the most up-to-date, accurate and authoritative source of information on Johns Creek available. There's no need for any other jurisdiction to spend resources capturing and maintaining data that Johns Creek are responsible for maintaining. Local ownership of data leads to better data maintenance by staff and a sense of responsibility when sharing such data with others.

Fulton GIS Collaboration Group members collaborate at one of its meetings.

Local ownership of data also equips the county with the ability to serve accurate data countywide that have been maintained locally. This gives partners and consumers a singular place to obtain the best-quality data for information that's usually maintained at the county level, such as land records and street centerlines.

Users of Web applications built by the county or city also benefit. If a citizen performs a query in a Web application built by the county, the result should be the same as performing this query in a Web application built by any of the cities using the data. Without collaboration and data sharing, identical queries might produce different results and confuse users.

TIP #3

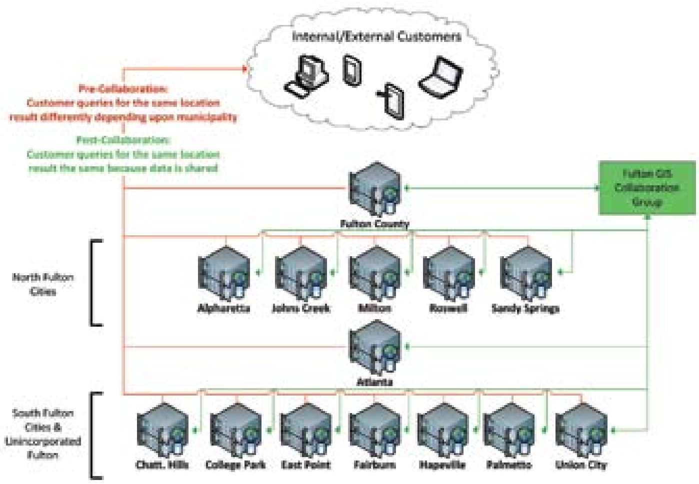
Start Simple and Work toward More Complex Collaboration

A collaboration effort is only sustainable if all members feel responsible for and to the group. This sustainability is developed slowly through a series of small successes.

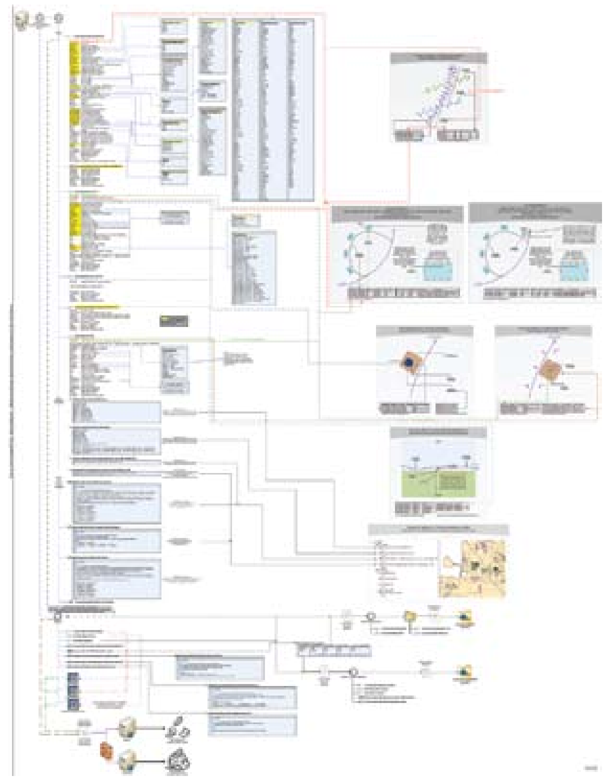
It's difficult to avoid diving into a complex task right away, but this will probably overwhelm the group and slow the process. By working on smaller tasks first, the group will develop a rapport that will facilitate larger tasks in the future. By working on smaller tasks and successfully completing them, the new group also will see results from their efforts and be energized to return to the table.

The first real task FGCG tackled was reconciliation of various versions of city limits floating about. Multiple new cities were formed from 2005 to 2007, and existing cities undertook vast annexations. Each city had its own way of reconciling these changes into its official city-limits map layer, but none consulted with each other to reconcile gaps and overlaps among the layers.

It's important to note that these gaps and overlaps were never more than two feet in either direction, but, in the world of GIS, two feet can mean the difference between accurate results and flawed analysis. With the Fulton County GIS team acting as facilitator among cities, discrepancies were identified and fixed, and a cohesive city/county boundary fabric was developed. This layer then was pushed out to all municipalities to be integrated into their individual GISs.



A diagram describes the flow of GIS data and services to internal/external customers. Lines in red describe data flow pre-collaboration and the query-response variability. Lines in green describe data flow to/from the Fulton GIS Collaboration Group, enabling data sharing among all municipalities. Such data sharing eliminates redundancies and provides consistent, predictable query responses to all internal/external customers, regardless of data or site source.



A full street-centerline schema diagram was developed through the Fulton GIS Collaboration Group.

TIP #4

Standardize Data Schemas to Facilitate Collaboration

Integration of city boundaries was simple. In most cases, a city's boundary is only a single polygon with no specific attributes. Yet collaboration beyond simple layers is the goal. This requires the development and adoption of standardized data schemas.

All members in the group have local responsibility for their data, but sharing isn't easy when each city collects and stores data differently. Developing one cohesive way to store specific datasets is essential to collaboration. The key here isn't to force one city's needs on all other cities in the group. Instead, the goal is to find a collaborative solution that serves all city and county needs.

For example, a collaborative solution was needed for street centerlines throughout Fulton County. This core data layer serves everyone from E911 dispatching for police and fire staff routing to asset-management tracking for Public Works and Transportation departments. Each city in Fulton County had a unique street-centerline schema that served its own needs,

Tip #4 Continued:

but the way the data were developed and maintained was the same.

Slowly, and after many other smaller tasks were completed through the collaboration group, a unified data schema was developed. This one robust data schema serves each city and the county's needs, but it also allows for different levels of implementation. One city can take the schema and only use the core attributes, while a different city might use all the attributes and table relationships. Either way, the core data are maintained at the local level and shared back out to the group.

TIP #5
Stay Motivated to Collaborate, not Obligated

As with any group, there will be small issues that threaten to derail the collaborative process. The group's founders, for example, might initially be responsible for most of the work. Common ground among cities and the county might be difficult to find. Personalities might not initially interact well.

The point is to keep moving forward and push through these difficulties. As the group accomplishes its small goals, members will see these successes and become more motivated. As this happens, personality incompatibilities will diminish. This is essential if the group is comprised of members who participate voluntarily. If the group's founders stay motivated and try not to feel obligated or resentful of their initial effort, the group will eventually come together and begin to operate as envisioned.

The first true test of FGCG's resolve came during the second year of its existence. The group was trying to achieve consensus on how to store street centerlines in a manner that was sufficiently robust to meet each city's and the county's enterprise system needs, yet was simple enough for less-experienced GIS professionals at each city to edit and maintain.

After much discussion, the choice came down to an Esri-developed linear referencing schema or a more-traditional centerline schema developed by the group. Since FGCG was founded on the principle of finding commonalities and collaborative solutions that would meet everyone's needs, the group needed a unanimous decision. Having all cities in Fulton County use the same centerline schema was essential to data sharing. A cohesive fabric of centerlines for the entire county—with all cities participating except one—wouldn't work.

The solution was to incorporate elements of the linear referencing model into the new schema that was developed. The simple schema originally envisioned became much more capable through the use of related tables and more-robust attributes.

Images show the efforts of city-limit boundary reconciliation among two cities and Fulton County.

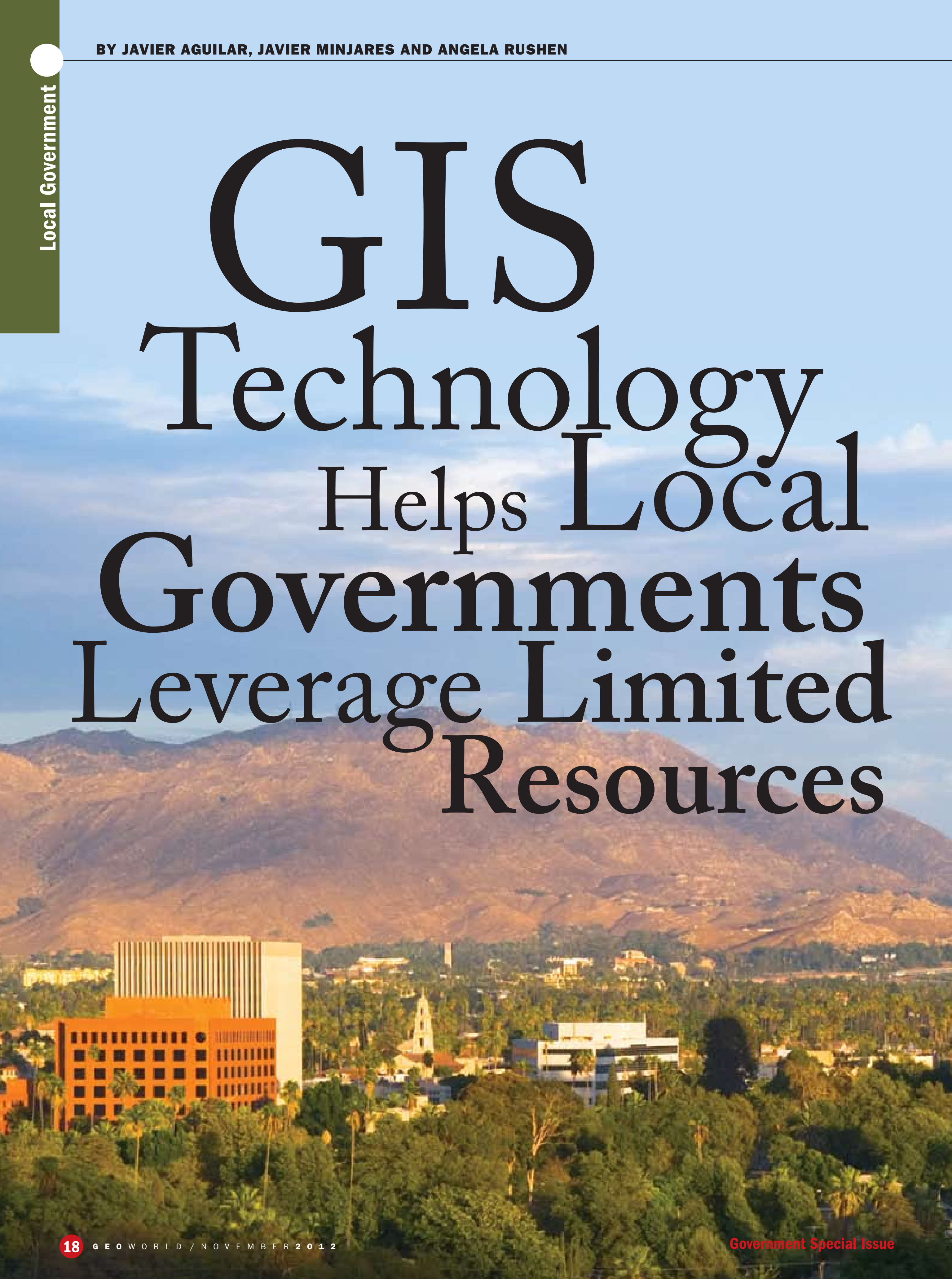
Was the final product a true linear referencing system? No, it was not. But the final product was a truly collaborative solution that worked for all the cities of Fulton County, and it continues to serve the diverse needs of all the other government agencies that developed it.

This first major FGCG project proved the value of collaboration. Seemingly different cities and counties can find innovative solutions that meet everyone's needs and keep everyone moving forward together.

Nick O'Day is GIS manager, city of Johns Creek, Ga.; e-mail: *nick.oday@johnscreekga.gov*. **Chris Whatley** is GIS supervisor, and **Issac Standard** is GIS manager, Fulton County Government, IT GIS; e-mail: *Christopher.whatley@fultoncountyga.gov* and *issac.standard@fultoncountyga.gov*, respectively.

BY JAVIER AGUILAR, JAVIER MINJARES AND ANGELA RUSHEN

GIS Technology Helps Local Governments Leverage Limited Resources



The deadline was tight at the city of Indio, Calif. Street-sweeping schedule exhibits had to be ready in time for the start of the new fiscal year. Like many cities across the nation, Indio had been impacted by the recession and faced the challenge of maintaining quality services for residents with fewer human and financial resources available to get the job done.

A situation like this can set off panic, but there was no need for worry. Indio had an ally: the Southern California Association of Governments (SCAG) GIS Services Program.

"Due to the city's significant reduction in staff, we would not have been able to implement the street-sweeping schedule by July 1, 2012," says Juan Raya, city of Indio's principal civil engineer, regarding SCAG's GIS Services Program. "There was also a significant cost savings to the city, as we did not have to outsource to a consultant."

Figure 1. SCAG represents six counties and 191 cities across a land area of 38,000 square miles in Southern California.

What's SCAG?

SCAG is the nation's largest Metropolitan Planning Organization (MPO), representing six counties and 191 cities across a land area of 38,000 square miles in Southern California (see Figure 1). Under federal and state mandates, SCAG develops a Regional Transportation Plan and a Federal Transportation Improvement Program to address the region's increasing transportation infrastructure needs.

SCAG launched its GIS Services Program to develop accurate land-use and planning data to help comply with the Sustainable Communities and Climate Protection Act of 2008 (SB 375). Under the legislation, jurisdictions need to integrate transportation planning with land-use and socio-economic data.

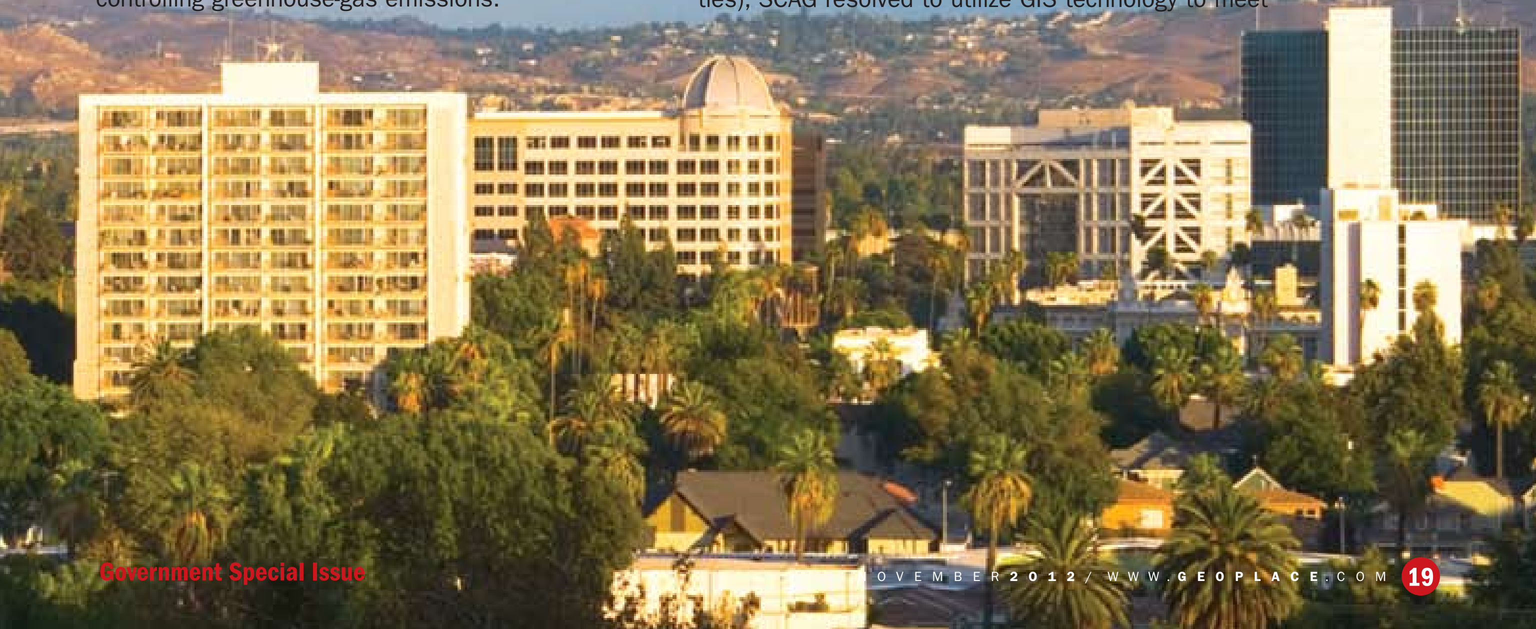
Moreover, the law encourages local jurisdictions to actively use current land-use and socio-economic assumptions to enhance regional planning efforts in growth monitoring, protecting sensitive habitats and controlling greenhouse-gas emissions.

In addition, SCAG needed to develop datasets that would be used to create the region's Sustainable Communities Strategy. Such data include existing land use, zoning, prime farmland, natural-resource areas, open space and other related layers.

To abide by the mandate, SCAG uses GIS technology to digitize all planning information, such as zoning, general plan and existing land use. SCAG also uses existing spatial data from federal and state agencies for open space and other elements.

Equal Access for All

With nearly half of California's population (18.2 million) residing in the SCAG region (Imperial, Los Angeles, Orange, Riverside, San Bernardino and Ventura counties), SCAG resolved to utilize GIS technology to meet



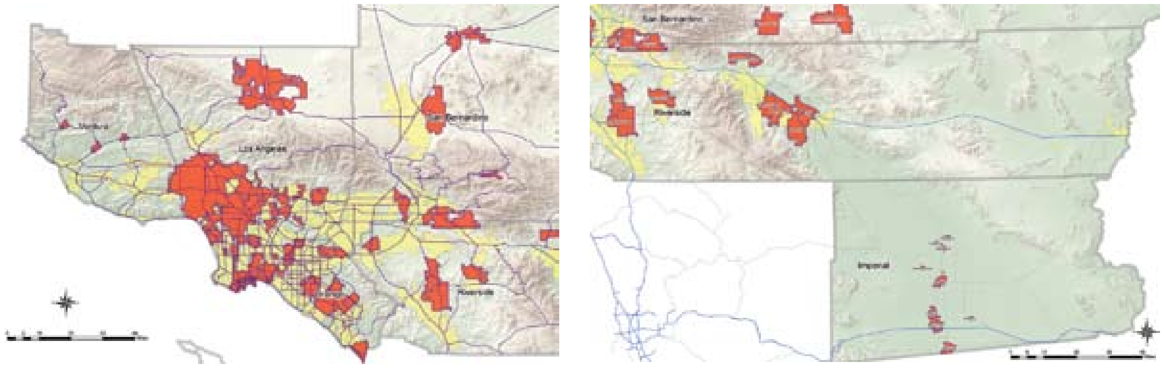


Figure 3. Two maps illustrate the spatial distribution of SCAG's 79 GIS Services Program participants.

the new legislative mandates. But the MPO found that a large portion of jurisdictions lack GIS accessibility. In fact, some cities had limited or no GIS resources.

SCAG concluded that equal GIS access by all municipalities would meet the state's new data mandate as well as help monitor growth patterns and enhance transportation utility. As a result, SCAG implemented the GIS Services Program in February 2010 to promote GIS technology and data sharing, updating and standardization as well as establish stronger working relationships with member jurisdictions to facilitate future planning efforts.

One unique feature of the program is the customization of work scopes to meet the needs of each participant. The individualized work scopes covered GIS training, data sharing, data conversion, simple application development and other services, according to each agency's needs.

This customized scope development resulted in more than 16,000 miles of travel for SCAG staff. In exchange, the participating agencies agreed to provide SCAG their updated GIS data. Figure 3 illustrates the spatial distribution of the 79 GIS Services Program participants.

SCAG GIS Services Participant Jurisdictions

County	Participating Jurisdictions	Total Jurisdictions	Participation %	Total %
Imperial	**8**	8	**100%**	10%
Los Angeles	**35**	89	**39%**	44%
Orange	**9**	35	**26%**	11%
Riverside	**12**	29	**41%**	15%
San Bernardino	**12**	25	**48%**	15%
Ventura	**3**	11	**27%**	**4%**
Total	**79**	**197**	**40%**	**100%**

Figure 2. A table shows SCAG GIS Services Program participants by county.

Training Opportunities

Nearly all participant jurisdictions (85 percent) sent staff to attend GIS training sessions (see Figure 5). More than half of the participants received data/map support, which included data conversion, geocoding, data analyses, data sharing and mapmaking. Thirty percent of participants had a simple desktop or Web application developed for their jurisdiction, because they didn't have GIS at their location.

Twenty-eight percent received onsite support to bolster current GIS projects. Examples include helping the city of Indio's Public Works Department to develop a street-sweeping schedule (and exhibits) and the city of Compton to develop an updated zoning map.

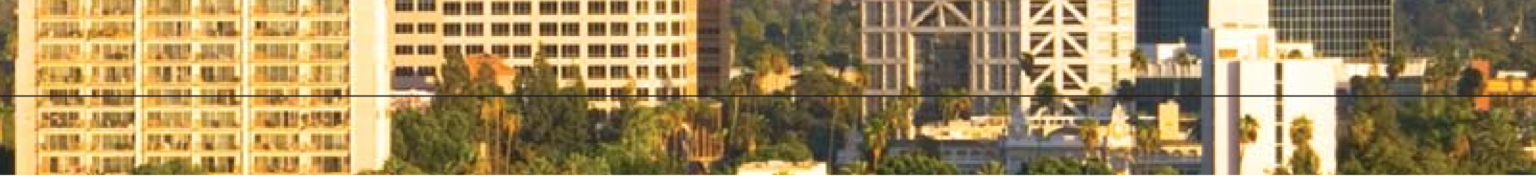
In addition, SCAG delivered free hardware, ArcGIS software and data to 16 local jurisdictions with little or no GIS resources. To ensure success, SCAG is working closely with these agencies to help develop their GIS capabilities through training and follow-up visits.

SCAG provided all participants with free customized GIS training, software, equipment, data and other services. These resources are helping local agencies better leverage their assets to become more efficient, save money and/or provide new services to their constituents.

SCAG's conservative estimate of savings to local participating jurisdictions is $2 million. These savings are on computer/plotter hardware, GIS software and professional GIS services. Direct cost to SCAG has been $200,000.

As illustrated in Figure 6, added positive impacts and benefits to local jurisdictions include the training of more than 300 participants, which is expected to surpass 500 by the end of 2012.

These participants range from planning interns, planning directors and city managers to engineers, police and fire professionals. Thirty-one training courses have been offered in 15 different venues across the region. In the case of small jurisdictions, SCAG deployed its



SCAG GIS Services Program by Service Type

Service Types	by City	by Service
GIS Training (67)	85%	40%
Data/Map Support (40)	51%	24%
Desktop/Web Application (24)	30%	14%
On-site visits (22)	28%	13%
GIS Rollout (16)	20%	9%
TOTAL (169)		**100%**

Figure 4. A table shows the distribution of services provided by service types.

SCAG GIS Services Students

Courses	Total		2012 Planned	
	Courses	Students	Courses	Seats
Advanced GIS	2	16	3	48
Intermediate GIS	5	52	5	80
Intro. to GIS	22	208	6	92
Transcad	2	28	2	32
Number @ SCAG	13	130	9	144
Number Outside SCAG	18	174	7	108
Total	**31**	**304**	**17**	**259**

Figure 6. SCAG helped train more than 300 people to better use GIS technology.

mobile GIS lab, comprised of eight laptops and a projector for the training.

Courses include Introduction to GIS, Intermediate GIS and Advanced GIS as well as Transcad (a transportation modeling software with a GIS base). The program is free to SCAG member agencies.

Positive Feedback

"The city of San Clemente is grateful to be a part of the SCAG local government GIS Services program," notes Christopher Wright, city of San Clemente's associate planner.

Wright describes the program as invaluable for the following reasons:

1. The SCAG program gave staff a point of contact to work through GIS issues. With San Clemente's limited resources, it was tremendously helpful to have free tech support during tough economic times. The tech support and training gave San Clemente staff more knowledge, at critical times, to work with its consultant on developing a General Plan and existing land-use data.

2. Through the process, SCAG helped San Clemente get its data in much better shape when it generated General Plan, zoning and existing land-use Shapefile data from paper maps and tabulated data. Because of the SCAG local-government program, San Clemente was able to improve the data's accuracy to make better forecasts.

3. SCAG training gave San Clemente staff more knowledge to assess computer software and hardware, GIS procedures, and GIS data.

4. The program put San Clemente in contact with other cities that have experience upgrading a similar GIS. This helped identify what San Clemente can do, with current resources, to improve its data and establish a foundation for a system upgrade in the future.

"The city [of Perris] has recently been certified to receive Community Development Block Grant funds," adds Ilene Paik, assistant planner, city of Perris. "The manner in which [SCAG] conducted business has been very professional and timely. These services helped us greatly in tracking and distributing funds to the people that will need them most."

The program's next steps are to provide more GIS training and follow-up visits to participating members. SCAG plans to provide hardware and software to four additional members and enroll 10 more jurisdictions by the end of 2012.

In the longer term, the program hopes to involve the region's remaining jurisdictions, implement a GIS Portal for data sharing, provide transportation modeling training (in Transcad) and publish a quarterly e-newsletter for GIS program participants.

Author's Note: *For more information about SCAG programs, plans, initiatives and services, visit* www.scag.ca.gov *or call 213-236-1800.*

Figure 5. Javier Aguilar teaches an Introduction to GIS class created by SCAG.

Javier Aguilar is senior regional planner, **Javier Minjares** is senior regional planner specialist, and **Angela Rushen** is manager of media and public affairs, Southern California Association of Governments; e-mail: *aguilar@scag.ca.gov*, *minjares@scag.ca.gov* and *rushen@scag.ca.gov*, respectively.

BY BRANDON THOMPSON

New Technology and Time-Honored Traditions

Mapping a Bright Future for the Huu-ay-aht First Nations

In spring 2012, a camera team from CloverPoint, under the direction of filmmaker Brian Park, spent two days at the House of Huu-ay-aht in Anacla, British Columbia, Canada, with members of the Huu-ay-aht First Nations. The village bears the name of the sole survivor of a massive earthquake and tsunami that destroyed the entire Huu-ay-aht settlement in 1700.

The crew was filming a short documentary about how the Huu-ay-aht, having reclaimed portions of their traditional lands, were implementing a cutting-edge land-registry system unlike anything developed before. This highly visual system would leverage the nation's years of work invested into mapping the region's biologically and culturally sensitive areas to unlock the wealth of their lands. Through responsible management and stewardship, the Huu-ay-aht government endeavors to revitalize its economy and rebuild a community that had long been displaced by natural disaster and colonial politics.

What began as a mid-week professional curiosity soon became an adventure into the heart of a small community committed to transcending adversity. At its center was the inspiring story of the Huu-ay-aht people committed to restoring their reclaimed lands and culture. What the team witnessed during its stay suggested that the confluence of traditional Huu-ay-aht philosophy with modern technology will ensure a bright future for the region.

The team had been invited to stay with Huu-ay-aht Master Carver Ed Johnson, and would be led by Larry Johnson, director of Lands and Natural Resources.

The Huu-ay-aht First Nations

Anacla (formerly Anacla Reserve) lies in Pachena Bay at the head of the world-renowned West Coast Trail, approximately 12 kilometers south of the Bamfield Marine Station on the west coast of Vancouver Island.

"We are based in Barkley Sound," noted Larry Johnson. "From Coleman Creek all the way to Cape Beale down the coast of Vancouver Island to Suziette Waterfalls … and out as far as the North Wind blows: that's the traditional territory of the Huu-ay-aht First Nations."

The Huu-ay-aht are one of five of the neighboring Maa-nulth Nations, and one of 14 Nuu-chah-nulth (meaning "all along the mountains and sea") Nations on Vancouver Island.

Larry Johnson, whose traditional name is *Aniitsachist* (ah-neet-sah-ch-ist), meaning "Keeper of the Sea," woke the film crew before sunrise to experience the dawn creeping over Pachena Cone and gently pulling at the fog that had blanketed the valley as everyone slept.

Being located on the wild and beautiful west coast of Vancouver Island, it's no wonder why the Huu-ay-aht culture would be so intimately linked with the surrounding forests and waters.

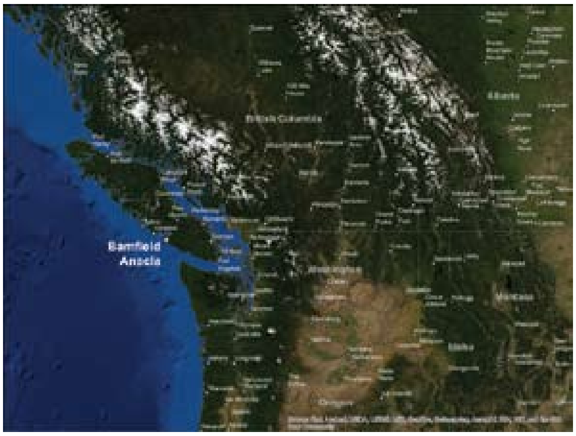
Visitors to the area often are struck by the palpable feelings of being merely tiny elements of an unimaginably large and truly awesome ecosystem. For city-dwellers such as the CloverPoint camera team, the environment was strangely comforting, yet demanding of respect.

Not surprisingly, this sentiment echoes what Larry Johnson explained to be two important Huu-ay-aht philosophical principles: *Iisaak* (ee-sock) and *Hishuk Tsawak* (heh-shook sah-wock).

"*Iisaak* is interpreted as 'respect' these days, but it's much more than that," he explains. "It's a way of life; it's how you carry yourself; it's how you want people to treat you.

"The word *Hishuk Tsawak* means everything is connected, and what you do here will impact over there," continues Larry Johnson. "So, when you combine those two philosophies, you come up with, to me, what it means to be a Huu-ay-aht—what it means to be connected to our land and resources."

Although most of us have stood up on the soapbox at one time or another to declare how we would lead our country, few have ever earned the opportunity to



The village of Anacla straddles the Pachena River as it joins the Pacific on the west coast of Vancouver Island.

do so. In April 2011, the Huu-ay-aht emerged as a self-governing First Nation faced with the task of managing the lands they had reclaimed.

"We are going to use technology to our advantage," says Larry Johnson. "We are going to use education to our advantage. And we're going to help Canada and British Columbia. Going forward, in treaty we have negotiated eight different licenses as well as some money to buy more access to these resources, so that our future generations will still have that connection to the ocean, like I grew up with."

Emergent Government

On April 1, 2012, the Huu-ay-aht First Nations (HFN) celebrated the first anniversary of its return to self-governance and the management of its own lands.

"The first year has been overwhelming, but we will persevere in these proudest of times for our people," says Larry Johnson.

The Huu-ay-aht are one of five First Nations of the Maa-nulth Treaty, which granted them self-government on April 1, 2011. Although more than 50 British Columbia First Nations currently are engaged in treaty negotiation, the Maa-nulth is only the second to have reached Final Agreement stage and bring closure for five of the 14 Nuu-chah-nulth Nations that began the negotiation process more than 20 years ago.

Having emerged as a self-governing First Nation, the people are committed to embracing technology to rebuild, restore and revitalize their community, culture and economy. A data-rich GIS helped demonstrate rights and title during the treaty process to reclaim portions of their traditional lands. But now they had to manage them.

The treaty agreement specifies many requirements that must be met before a First Nation can be deemed self-governing: one is the ability to demonstrate an effective method of managing the lands within its borders. Larry Johnson explains, however, that there's a simpler and more important reason to do so—and do it well.

"Managing our lands and natural resources is a vital part of creating a better life for present and future Huu-ay-aht citizens," he notes.

When faced with the choices of how to manage their reclaimed traditional lands, the Huu-ay-aht chose to not settle for the lumbering paper behemoths that current Canadian land registries had become, but to demand more from the system that would help them unlock the wealth of their lands. In doing so, it helped develop a Web-based land-registry system unlike anything ever produced.

The land-registry system is based on Huu-ay-aht First Nation laws. It was designed to be simple enough to be quickly mastered by a small office staff, as they also work to develop community infrastructure and cultivate administrative capacity. A holistic and spatially accurate view of the nation's interests provided Huu-ay-aht leaders with clear information to make decisions early in the nation's rebirth that would shape its future trajectory.

This technology allows a small Land Office staff to unlock the wealth of the lands and oceans by leveraging the nation's prior GIS investment as well as use consultation and referral processes to ensure accommodating and responsible land management. The system also can track applications as well as create and manage zoning according to the HFN Land-Use Plan.

In recent years, the Huu-ay-aht Nation's population has spread out across British Columbia, so the Huu-ay-aht government is keenly aware of the need to track information well away from its homelands.

"In order to bring our people home, we need to build an economy," adds Larry Johnson.

The Huu-ay-aht also are looking to adopt Internet voting to achieve quorum and ensure democracy for its 683 citizens (according to Indian and Northern Affairs Canada, February 2011) scattered across Vancouver Island and mainland British Columbia as they work toward rebuilding their community in Anacla.

"We have always shared these lands," he notes. "We just want to benefit from it this time."

Unlocking the Land

"Since effective date (of treaty), we are now owners of our land once again," continues Larry Johnson. "We would like to unlock the wealth of the land and bring our people back to our homelands. We would like to tell the world 'we are open for business.'"

The total land area to be managed currently comprises 1,077 hectares. The size and complexity of the managed areas will grow in coming years, however, as the Huu-ay-aht purchase more land and develop greater capacity for forestry and aquaculture management.

The House of Huu-ay-aht and the new administration building overlook Anacla and Pachena Bay.

The land registry is based on the Insight security framework, which provides the modular flexibility and scalability required to meet the growing and changing needs of an emerging government. This Web-based deployment allows lands officers to access the system on- and off-site. Permission-based viewing with 256-bit SSL certificate security ensures that only authorized eyes can view sensitive information.

The Huu-ay-aht Land Registry translates the nation's laws and regulations into straightforward workflows that allow lands officers to multitask across many applications at different stages of approval without missing a step. Where appropriate, workflows are automated to reduce pressure on the small lands office from time-sensitive deadlines, especially those concerning consultation and referral.

The rich, visual interface is powered by ArcGIS Server 10.0 (SP2), SQL Server and Silverlight. It's accessible through any modern Web browser (e.g., Internet Explorer 8+, Mozilla FireFox 8+, Safari 5+, Chrome, etc.) with an active Internet connection.

Map elements within the land-registry system allow permitted users to access a complete set of GIS tools with which to search, query and draw without any specialized software on their computer. These tools include pan, zoom, extent, identify, feature query, drawing tools, point, line, polygon, screen capture and display assets.

Building for the Future

"We are now one year old, in terms of a nation, and we are trying to rebuild," adds Larry Johnson. "So we have a lot of stories to tell. We would like to share with other First Nations who are embarking on the same journey, whether you're going for a treaty or you're just going for self-government, you want to be able to manage your own lands and affairs."

The Huu-ay-aht First Nations have emerged as a progressive government with an eye to the future "not only for their children, but the children's children … and their grandchildren." They have embraced cutting-edge technology to take on the challenge of creating a new government on the world stage.

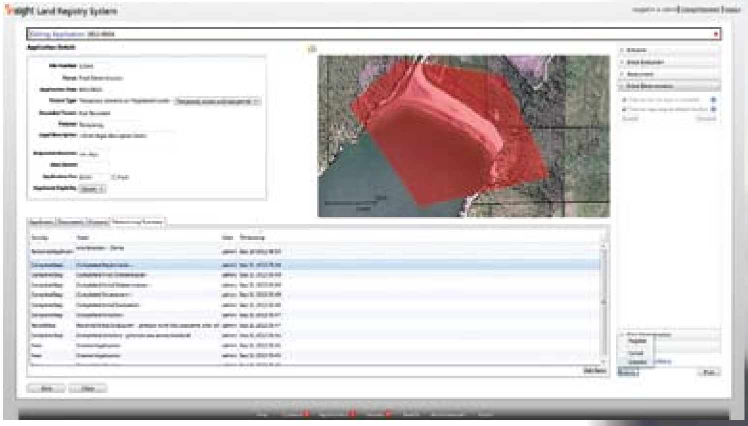
The Huu-ay-aht want to share the story of their journey to self-governance with the hope that they can inform and inspire other First Peoples to unlock their lands and build a bright future for generations to come.

Larry Johnson sums it up best: "We have been here since the beginning of time; we will be here until the end of time."

Author's Note: *To find out more, watch* Unlocking the Land, *the story of how the Huu-ay-aht First Nations have begun to unlock the wealth of their lands using the Insight Land Registry, at* huuayaht.org, www.nuuchahnulth.org, www.maanulth.ca *and a video link at* cloverpoint.com/land-registry.

The Huu-ay-aht land-registry interface provides a rich visual overview of the nation's lands and interests.

One-click drilldowns through cadastral, orthophoto and basemap layers empower Lands Office clerks to demonstrate rights and title quickly and within the context of surrounding interests.



A secure Insight framework translates Huu-ay-aht laws and regulations into clear, straightforward workflows.

Brandon Thompson is business development and marketing coordinator, CloverPoint; e-mail: *brandon@cloverpoint.com.*

BY KEITH PARKER

Can SDI 3.0 Deliver Real Societal Change?

Ever since the widespread proliferation of computers in the 1990s ushered in the "Information Age," there's been an explosion in the amount of information that's collected, stored and analyzed. Petabytes of data flood into public and private enterprises daily.

Many experts, such as *Time* magazine's Steven James Snyder, believe we're exiting the Information Age and entering the "Understanding Age." Although technology has powered the collection of vast archives of information in even the most remote areas of the world, the true challenge ahead is in understanding and using such information to make interconnected public and private institutions more efficient and effective.

Working toward this goal, governments worldwide use spatial data infrastructures (SDIs) to link GISs of disparate public entities, including utility, emergency response, telecom and infrastructure networks along with natural and cultural resources.

SDIs typically go further to link these systems as well as incorporate the institutional and governance elements necessary for effective and reliable information sharing and coordination across traditional administrative and political boundaries. The information typically held by a GIS is, by nature, location based. Location-based information can be structured, stored or combined with other information resources in a variety of ways to answer many different questions related to "place."

As SDIs herald in a new era of leveraging and cross-linking information from traditional and non-conventional sources such as crowdsourcing, people are encountering what Mark Sorensen, president of The GPC Group, calls "SDI 3.0."

The Age of SDI 3.0

"We are approaching a new era that could fundamentally reposition SDI from a framework for sharing information and applications services to a new way of looking at governance and public engagement," says Sorensen. "Modern GIS is much more than computerized mapping. With the right technical and institutional frameworks, it can provide a multi-sector, interdisciplinary, regional information infrastructure for bringing all manner of data together geographically to support integrated and multi-sector decision making as well as strengthen the ability of diverse interests to better understand complex natural and socioeconomic systems and the interactions among them.

"This infrastructure will ultimately help develop more sustainable and resilient communities, support wise management of resources and aid in the conservation of cultural and natural heritage," he adds.

Sorensen is referring to a new wave of SDIs built to link existing systems as well as address real, pressing issues facing all governments, such as social unrest or environmental upheaval.

For example, an SDI 3.0 might find that a particular neighborhood's displeasure with the government, found by analyzing geotagged twitter "tweets," is directly linked to a higher-than-average rate of unsolved burglaries for that area. Or it could identify a link between a spike in health-related emergency call rates for a particular area and a water pipeline that serves that community.

The convergence of telecommunications, location-based services, mobile computing, citizens' volunteered geographic information, and information gathering and sensing networks all provide a rich and diverse information environment that can be tapped with new tools and techniques to derive useful results. This environment also provides a basis for establishing multiple channels of two-way engagement with public- and private-sector enterprises as well as institutional and civil society sectors in a manner that will transform how government actually functions.

Through such a massively connected and dynamic information environment, it should be possible to identify environmental and socioeconomic trends as well as their multiple causative factors and interdependent issues far in advance. Then entities can initiate the coordinated interventions needed to tackle problems and take advantage of opportunities.

Ubiquitous Applications

For the average person, SDI 3.0 allows unparalleled levels of engagement with governments and governing entities. For example, citizen-reporting applications, such as City Sourced, provide software solutions that allow citizens to report civic issues (e.g., public safety, quality of life, environmental issues, etc.) to the appropriate government agency by taking and submitting a geotagged photo through a custom app on their smartphone.

Government entities then can provide status feedback to the citizen who lodged the complaint, ensuring that citizens feel engaged instead of annoyed by all-too-common "black hole" government-feedback forms.

Private, commercial enterprises with access to real-time SDI 3.0 information can help stimulate the economy by capitalizing on growth opportunities that may not have been otherwise identified. For example, home-security firms might best spend marketing budgets in areas where security-related terms are most often used on Twitter, who have relatively high spending patterns according to census data and are furthest from police stations. This information might already be available through disparate sources, but the era of SDI 3.0 aims to enable easy one-stop access to this information for the masses.

ERIC FISCHER

Data mashups allow for insightful GIS "infographics," such as this one showing race and ethnicity in the San Francisco Bay Area.

The Evolution of SDI

SDI 1.0: Reduce duplication of data

SDI 2.0: Spatially enable the government

SDI 3.0: Provide location-based services for the public to establish a spatially enabled society

Governments with access to information that has been cross-referenced and analyzed against citizen-generated information will be able to more-effectively direct government resources to where they're needed most.

Current SDI Developments

The government of the Emirate of Abu Dhabi, located in the United Arab Emirates (UAE), is starting to explore this new horizon, including pursuing the implementation of an "Executive Dashboard" as one initial facet of a more-broadly defined Decision Support System (DSS).

The Abu Dhabi Systems & Information Centre was mandated by the Abu Dhabi Executive Council to promote and facilitate information and communications technology development across Abu Dhabi society in and outside of government, and part of that included implementation of a new Public Call Center inclusive of a location-based service for public reporting and complaint management. Discussions are ongoing with the concerned authorities to explore how the SDI can be leveraged to support the tracking and monitoring of the Emirate's substantial investments in infrastructure and as a basis for performance assessment through time.

In another example, the interim government in Libya, although in its infancy, has promoted the notion of "eLibya," utilizing information technology, communications and SDI as key building blocks in a nation-building process. Although the Libya SDI master plan was developed back in 2005-2006, the use of accurate and current information as the basis for prioritizing investment in social and physical infrastructure is seen as key to the success of moving the country forward.

Abu Dhabi, in the UAE, is exploring new ways to leverage GIS data.

SDI Trends at a Glance

The term SDI 3.0 indicates the third generation of SDI development. The first two generations, SDI 1.0 and SDI 2.0, made today's advancements possible. For perspective, it's important to have an understanding of this background.

Throughout the 1990s, governments began to recognize the need for SDIs as formal mechanisms for sharing information across government entities. Emphasis in the SDI 1.0 era was on data sharing and metadata, with an initial focus primarily on national, small-scale information and the needs of national agencies.

Selected groups of federal or primary stakeholders were required to participate, while others may have had an option to follow or participate as second-tier "observers." Communities established basic GeoPortal and supporting data-clearinghouse environments as initial common repositories for use.

However, not all fundamental data requirements were covered, and there were ongoing projects that needed to be aligned to ensure government investment could fill the gaps in an efficient and coordinated manner. During this era, data custodians began the process of periodically updating the clearinghouse data with "snapshots" of information, which may or may not be updated in real time.

From 2003-2012, the era of SDI 2.0 saw enterprise GIS at the entity level largely optimized in all the key stakeholder organizations, while additional emphasis was placed on providing application services within the community. The breadth of the stakeholder community was widened to include users who weren't primary data providers, and there often was more official engagement with government stakeholders beyond federal agencies, including institutional, private and civil society sector actors. At this point, there was at least passive improvement in coordination across government entities, because each agency became aware of what others were doing through their data.

The era of SDI 3.0 represents a transformational leap to a time when SDI has a highly significant, direct influence on those outside of the core group of stakeholders traditionally involved in SDI projects. Entities now aim to establish spatially enabled societies by providing location-based services to the public.

What Success Looks Like

When planning an SDI, or any project for that matter, one must consider what "success" means. Success in the field of SDI continues to evolve with the communities of practice.

Previously, these communities measured the success of an SDI development effort in terms of the number of stakeholders served as well as the amount and quality of authoritative and well-documented data available. But there's been a shift toward additional demand for application services and proof of demonstrable, measurable and compelling impacts on policies, decision making and operations on the ground.

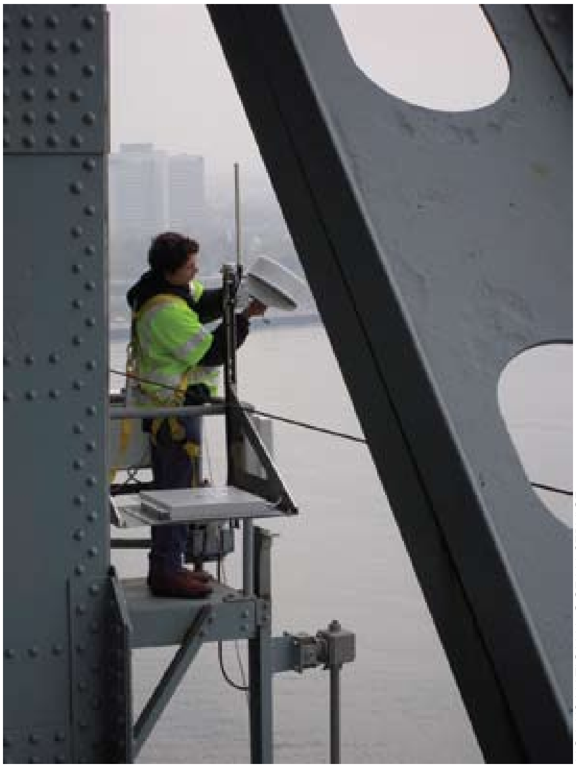
Such "demand-side" expectations bring a need to address institutional issues, opportunities and constraints that, if not addressed, can seriously constrain successful outcomes of an SDI initiative, even when the most elegant technical solution has been implemented. Resolving these institutional factors requires significantly different techniques and skill sets from "supply side" technical infrastructure matters, where much of the legacy SDI attention has been focused.

Inventing the Future

"One may argue that the persons and organizations that have traditionally supported SDI development do not have the professional background and experience to guide such a transformative process, and should rather focus on establishing a solid infrastructure and let others tackle the macro societal and governance matters," notes Sorensen. "This has some truth, but it must also be acknowledged that there are significant gaps and deficiencies in understanding geospatial information and thinking among the planning, strategy and policy-making communities.

"Perhaps a new kind of organization that comprises an interdisciplinary team to facilitate engagement and integrated strategic planning across the government, inclusive of SDI, is needed," he adds. "There may be many viable models, depending on the form and configuration of existing government and other factors, but it is clear we are on the cusp of a convergence of technologies and perspectives that are already changing the world around us."

Author's Note: *The content of this article was taken from a white paper collectively developed by GPC Group.* GW



NOAA'S NATIONAL OCEAN SERVICE

Data collection has become ubiquitous; the challenge for the next generation of SDI developers is in leveraging such data for societal gain.

Keith Parker is outreach consultant, The GPC Group; e-mail: *keith.parker@gpc-gis.ae.*

It Takes a Process to Monitor Gradual Change

DYNAMIC DECISION POINTS

BY ERIK SHEPARD

When discussing temporal databases, people often think about events. These are discrete changes that happen at specific points in time (e.g., an installation or an incident) or are at least recorded at specific points in time (e.g., inspection, sampling or survey).

Asset databases are built on discrete changes; equipment is installed, replaced or upgraded on a certain date. Aerial photos are taken annually or biannually and have a specific capture date that drives metadata (e.g., leaf on or leaf off). Social media, the disruptive force behind crowdsourcing, is generated with a timestamp reflecting the author's state of mind at that point in time, but also reflecting the thoughts and norms of the larger social consciousness at that time.

It Still Makes a Sound

But the worldview that "all changes are discrete and created or observed at specific times" reflects a bias toward anthropocentrism. If a tree falls in the woods and no one is there to hear it, does it still make a sound?

The truth is that change often is gradual and based on processes only partially seen or understood. Tectonic shifts happen gradually over centuries or millennia. Infiltration of pollutants into groundwater happens over years. Climate change happens over time—perhaps decades for anthropogenic change or millennia for naturogenic change such as an interglacial period. Component inputs to this gradual change may be understood, but not the complete processes.

Such gradual changes are studied by building models of the process, to the best of our ability. Geospatial tools are key to these types of models, because changes happen in place as well as time and often are affected by changes nearby.

Antarctic glaciers undergo faster erosion at the sea boundary, because of the sea's saltiness. Random inputs are modeled with stochastic processes. Samples and surveys, taken at discrete points in time, provide input to develop continuous time models.

These models, in turn, become inputs into activities performed by geospatial systems. Model-driven risk

The vision of dynamic GIS and decision support is driven by the ability to describe gradual changes that occur through ongoing processes.

is used to perform planned maintenance activities. Model-driven inputs are used to inform sustainable design. Real-time inputs from sensor platforms are used to build dynamic systems that respond to change, which update and calibrate the models. Incorporating models as output and input helps realize the vision of dynamic GIS. GIS is the technology for interfacing business with the world, which is ever-changing.

Real-World Calibration

Of course, all models need calibration, which requires real-world inputs. For gradual processes, infrequent surveys look more like discrete events than slowly changing shifts. One way to address this deficiency is by collecting data more frequently; instead of a year, collection in near real time.

The best way to currently do this is through wireless sensor networks, which work together and can be deployed using several different strategies. Sensors can collect data at fixed time intervals (e.g., once per second) or can be programmed to respond to changes in the environment. For example, a sensor measuring temperature may record data each time the temperature changes by five degrees. Technically speaking, this is still discrete time, but the closer it gets to continuous recording, the closer it gets to being able to measure gradually changing values.

Using data from these sensors as model input, there are duel benefits: a model of gradual change as well as continuous calibration as additional data are collected. For a model of a single variable, this is nice to have.

But real systems in the real world are complex, comprised of many variables—often interdependent, co-varying attributes. The ability to use sensor data for each of these variables fine tunes models using near-real-time inputs. Calibrating these models via infrequently sampled data would make fine tuning difficult and real-time fine tuning impossible.

The vision of dynamic GIS and decision support is driven by the ability to describe gradual changes that occur through ongoing processes as well as discrete changes driven by events. Models that describe processes—and dynamic, near-real-time inputs from field-deployed sensors—will become more critical as the challenges from our increasingly resource-constrained world are faced.

Erik Shepard is director and principal of Waterbridge GeoDesign Inc.; e-mail: *erik@waterbridge.biz.*