ArcNews

Esri | Fall 2015 | Vol. 37, No. 3

Briefly Noted

Local Governments Simplify Property Surveys
Esri and the City of New Orleans created Photo Survey, a web application for local governments to publish street-level photo collections and conduct focused property surveys to identify blight, damaged structures, or construction activity. To learn more, visit solutions.arcgis.com/local-government.

Data creation for sustainable development
In collaboration with the Global Partnership for Sustainable Development Data, Esri will provide the ArcGIS platform to the least-developed countries to aid with data collection, management, monitoring, and use—all essential components of achieving the United Nations' Sustainable Development Goals.

Earth science lessons on ArcGIS Online
Esri and Silver Tier partner GISetc released the Earth Science GeoInquiry Collection, a free set of 15 ArcGIS Online mapping activities and instructional materials intended to augment middle school earth science lessons. Additional lessons are slated to be released later this year. Access them at esri.com/connected.

Get access to live aviation data
Flight tracking data from FlightAware is now available on the ArcGIS platform, giving users the ability to view and analyze large amounts of accurate, live aviation data using Esri software.

Awakening the World to the Power of Geography

"GIS is waking up the world to the power of geography, this science of integration, and…creating a better future," proclaimed Esri founder Jack Dangermond at the 2015 Esri User Conference.

So much so that we appear to be entering a period of geographic enlightenment, or *geoenlightenment*, according to Dangermond.

"What we do *here* affects *there*," he said during his speech at the conference's Plenary Session July 20. "Geoenlightenment is about understanding this interconnectedness and also applying this knowledge everywhere—applying it to make the world a better place," he continued, echoing the theme of the conference, Applying Geography Everywhere.

GIS is becoming essential infrastructure for so much of what we do—helping us be more efficient, make better and smarter decisions, and communicate more effectively. The ongoing evolution of technology—faster computers, big data, cloud computing, smart devices, and increased capacity to measure things—is giving rise to a new pattern of GIS. We call this pattern web GIS, and it integrates and leverages all the investments that have already been made in GIS data and technologies.

This pattern is rapidly expanding the application of GIS across organizations and beyond.

"It's something that is opening and extending our existing ways of doing things, integrating and simplifying everything," says Dangermond. "It allows us to take our existing GIS systems of record—our traditional server and desktop technologies—and create a system of systems that focuses on engagement by everyone in an organization and beyond. Individuals interact with the system via maps and apps and can participate in a larger network of groups that share and collaborate in the language of maps. This system of engagement can be implemented for a department or an organization and extended to the entire Internet."

↑ Web GIS is a transformational architecture that opens, integrates, and simplifies everything. It brings together our systems of record into a GIS-based system of engagement.

At the heart of web GIS is exactly what GIS professionals already do every day. However, web GIS changes how they operate. It is connecting them with many more users across the organization and allowing easy access to powerful GIS capabilities, employing simple app technology to create innovative applications of GIS. The result of this will be better geographic understanding and more awareness of the world's interconnectedness, ultimately engendering more informed decisions and actions.

The following examples from the Plenary Session demonstrate how this is already happening.

Maintaining Airport Safety—In 3D

The Hartsfield-Jackson Atlanta International Airport has built a real-time enterprise GIS that helps it manage 250,000 passengers per day, 200 aircraft gates, five runways, 115 taxiways, 16,000 slabs of concrete, and more than 18,000 airfield lights. This requires a robust enterprise GIS solution.

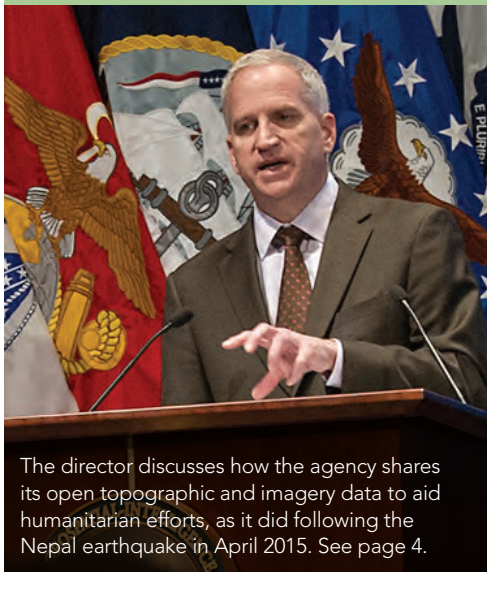
At the Plenary Session, GIS analyst Anthony Vazquez and the City of Atlanta's GIS manager David Wright showed the audience how the airport uses ArcGIS Online and a handful of mobile apps to inspect and maintain runways, taxiways, green space, streetlights, and more. They also demonstrated how the 3D capabilities in ArcGIS Pro helped them determine which trees were penetrating airspace near runways so the airport could ensure that they stay trimmed to Federal Aviation Administration regulations.

↑ GIS helps us be smarter by improving how we manage and make decisions.

And 3D data can be delivered anywhere—to web browsers or mobile devices—as Esri's Craig McCabe demonstrated. Using the newest Scene Viewer, ArcGIS Runtime SDK for the Microsoft .NET Framework, and ArcGIS Runtime SDK for Android, McCabe showed how Esri users can do 3D spatial analysis outdoors, indoors, from a first-person perspective, and in hypothetical situations to determine, for example, viewshed gaps.

continued on page 3

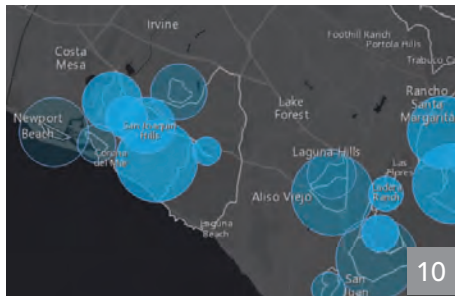
Robert Cardillo on NGA's Expanding Role


The director discusses how the agency shares its open topographic and imagery data to aid humanitarian efforts, as it did following the Nepal earthquake in April 2015. See page 4.

ArcNews

Esri | Fall 2015 | Vol. 37, No. 3

With Survey123 for ArcGIS, nonprofit Direct Relief diagnosed, treated, and collected medical records on more than 1,000 Syrian refugees in just six days.



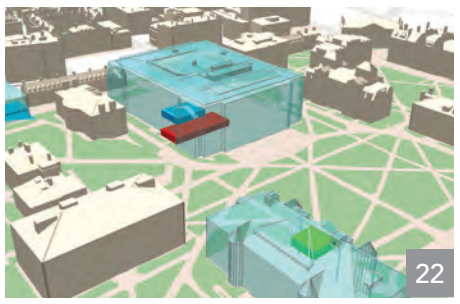


Table of Contents

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ArcNews (ISSN 1064-6108) is published quarterly by Esri at 380 New York Street, Redlands, CA 92373-8100 USA. *ArcNews* is written for the Esri user community as well as others interested in mapping and geographic information system (GIS) technology. It contains material of interest to planners, foresters, scientists, cartographers, geographers, engineers, business professionals, and others who use spatial information.

Awakening the World to the Power of Geography

continued from cover

Precision Agriculture, Redefined

GIS ensures that customers of Beck's Hybrids, a seed and technology company in Atlanta, Indiana, have no gaps in their farming techniques.

"By bringing farming and GIS together, Beck's provides precision *[agriculture]*, simplified, to every farm," said Brad Fruth, Beck's Hybrids' information systems manager.

Presenter Craig Rogers demonstrated Beck's Hybrids' FARMserver, a map-enabled web application that helps farmers maximize yields and keep costs low. Using maps, spatial analysis, and big data from live sensors and farm equipment, software users can monitor data, such as soil composition and weather, to ensure that their Beck's Hybrids' corn and soybean seeds thrive.

Farmers can also use ArcGIS to conduct detailed and prodigious analyses of where to plant various seed varieties. Esri senior software engineer Mansour Raad used the forthcoming Big Data GeoAnalytics extension for ArcGIS for Server to figure out where to plant 87 varieties of Beck's Hybrids' corn, depending on variables such as soil type, heat, moisture levels, and specific planting windows. That resulted in 300 billion spatial and temporal calculations being done in all of 10 minutes. Now, that's precision.

Outsmarting Wildfires

Comparable care is needed to fight fires, and that's what Anthony Griffiths and Anthony Burgon of the Victoria, Australia, Department of Environment, Land, Water, and Planning exhibited in their plenary presentation.

"Victoria's flora, topography, and climate make it one of the most brushfire-prone areas in the world," said Griffiths.

After more than 400 wildfires raged across the state on Black Saturday in February 2009, agencies all over Victoria realized that they needed to be ready for the next wildfire before it sparked.

They worked together to create eMap, a collaborative, cross-departmental emergency mapping system for fire-related information. Using one map, built on a common database and accessible on any device, the State of Victoria is now able to proactively respond to and manage wildfires using predictive technology. By employing near real-time imagery and a fire modeling and prediction system called Phoenix Rapid Fire, responders and incident commanders from various agencies can forecast potential impact zones.

Having maps in the field for emergency operations is crucial as well. AppStudio for ArcGIS, demonstrated by Esri's Ismael Chivite, Sathya Prasad, and Elvin Slavik, makes it easy to develop native apps that run on any device. For example, volunteer firefighters in Australia could use simple apps—created without coding anything—to take photos of a fire, add a location and description to the incident, and submit a quick report back to the fire department. Various agencies could also use AppStudio to configure secure mobile apps that replace many of their paper forms.

Sustaining Healthy Water Systems

The Southwest Florida Water Management District (SWFWMD) streamlined many of its workflows by revamping its GIS infrastructure to bring together industry, agriculture, environmental organizations, and Florida residents.

SWFWMD bureau chief Steve Dicks showed the plenary audience how web GIS helps manage a range of water issues, from keeping Florida's winter strawberries hydrated while ensuring that residents retain their water resources to analyzing how new housing developments need to plan around flood zones.

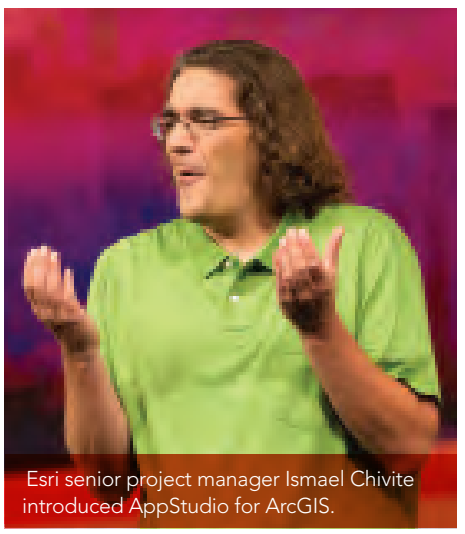
Leigh Vershowske, the district's GIS database and server analyst, also demonstrated what he called the agency's "most important map": an online form that makes it easy to apply for well, water use, and construction permits to plan future water development. And senior environmental scientist Kris Kaufman illustrated how SWFWMD used GIS to clean up a very polluted Tampa Bay and bring back ecologically vital seagrass in record numbers.

Monitoring water quality levels across such an aqueous state requires sophisticated analysis. Esri program manager Steve Kopp unveiled the new ArcGIS integration with R, which enables users of each system to access the capabilities of the other. For instance, to understand water quality in all areas of Florida's Peace River system, ArcGIS users can employ the statistical capabilities of R to use stream geometry and landscape variables to forecast water quality values throughout the stream network—even in the most remote and hard-to-analyze areas.

At the Forefront of Change

As these plenary presenters demonstrated, ever-expanding use of GIS creates connections within and across companies, agencies, and communities. Web GIS, especially, allows GIS professionals to expand their impact by developing applications that foster deeper understanding not only within the GIS department but amid executives, knowledge workers, and citizens alike.

"What I really want you to do is think about how you can take that knowledge and get it across to everybody else," said Dangermond. "That, to me, ladies and gentlemen, is going to be the big thing that changes everything."



Esri senior project manager Ismael Chivite introduced AppStudio for ArcGIS.

A New Network for Budding GIS Professionals

The notion of limitless possibilities was the overarching theme of a series of events put on by the Young Professionals Network (YPN) at the 2015 Esri User Conference in San Diego, California.

The YPN, in its inaugural year, offers budding GIS professionals—of any age—the opportunity to network with peers and meet some of the most dynamic and influential people in GIS.

"It's about bringing as many people as possible together to share their experiences," said Esri account manager John Dombzalski about the network, which he helped launch. "It truly originated out of the need to grow a younger generation of GIS professionals."

YPN events, which included two social gatherings and three panel discussions, revolved around familiarizing GIS neophytes with the diverse backgrounds and multiple perspectives that constitute this wide-reaching field.

Esri account manager John Dombzalski (left), who helped launch the Young Professionals Network, speaks with young GIS professionals at a social event.

"I think it's a good opportunity to network and find out what other people are doing," said Joel Carter, a software developer for Cardno, an infrastructure and environmental services company.

"I've especially liked seeing all the different ways people approach the field," said Rachael Sclafani, a senior in environmental studies at Pennsylvania's Dickinson College, who learned GIS for a class and plans to continue using it in her career.

Attendees heard from Esri leaders who got involved in GIS in a myriad of ways—via startups, graphic design, and even sports. They also got a sense of how much the field is growing, with big data getting even bigger and university GIS programs becoming more conventional.

At a question-and-answer session, Esri founder Jack Dangermond expressed his hope that these GIS newcomers and their mentors would build strong connections sowed in friendship.

"I want to see a great network occur…where you get together again and again and you have fun, actually, and you learn from your friends," Dangermond said. That is because he believes that the best way to learn things is in the context of good friendship, as camaraderie begets trust.

"There's nothing like hearing from your friends," he continued, "because they actually share…experience to experience."

By the end of the week, the roots of a durable network were taking hold.

"I think it's a good idea to have this *[organization]* because it's cooperative," said María Pinheiro, a GIS analyst for the Instituto Pereira Passos, the research department for Rio de Janeiro's city government. "It's good to know I have some friends and expectations for my career in GIS."

Stafin Duncan, who built the GIS network for his company, Belize Electricity Limited, without prior experience with the technology, was ready to take on the role of mentor. "I'm a firm believer in fostering the youth as the next generation of developers," he said.

While the directors of the YPN collate ideas for how to best grow the network, they are putting together a packet on how to be a GIS mentor, especially for primary and secondary school students around the globe. This, along with other materials and information about events, will be posted at esri.com/ypn.

To stay informed about the YPN, register online and follow @EsriYPN on Twitter.

Operating in an Increasingly Open Environment

The US military first experimented with aerial surveillance during the American Civil War (1861–1865) when both Union and Confederate armies used manned balloons to conduct reconnaissance and artillery spotting. This vantage point also enabled increasingly accurate mapmaking by combining observations from the air with photos taken from the ground.

From that humble beginning, military mapmaking has evolved significantly in both its use of technology and the essential part it plays in mission success. Today, it is central to all phases of operation planning, execution, and logistics.

Because of the strategic importance of mapmaking to the defense and intelligence communities, a number of different government agencies have been tasked with producing and maintaining maps over the years. To minimize redundancy and potential inaccuracies, many of these agencies were consolidated into the National Imagery and Mapping Agency (NIMA) in 1996. To better reflect its primary mission in geospatial intelligence (GEOINT), the agency was renamed the National Geospatial-Intelligence Agency (NGA) in 2003.

The Four Cs of Effective Leadership

Robert Cardillo is the director of NGA. He began his career in geospatial intelligence as an imagery analyst in the Defense Intelligence Agency (DIA). Prior to his current post, he was the first deputy director for intelligence integration at the Office of the Director of National Intelligence. He has also served as the deputy director of DIA, as well as its deputy director for analysis.

Robert Cardillo, director of the National Geospatial-Intelligence Agency, is overseeing the agency's expanding role in the US national security community.

Cardillo bases his leadership on principles he has developed over the years that he calls the four Cs: conveyance, content, and context, which combine to produce consequence—the ultimate goal of NGA.

"We exist for one reason, and that is to enable mission consequence for our customers," said Cardillo. "We are shaping everything we do to ensure that we are delivering the optimum potential for their success."

Team NGA

Best-in-class solutions are critical for NGA to maintain its edge in national security. This requires a skilled and experienced government workforce, as well as business partners that can provide the tools to maintain large datasets and perform sophisticated geospatial analysis. NGA works closely with commercial software vendors through Cooperative Research and Development Agreements to ensure that their offerings align with NGA technical requirements.

To expand industry contacts and bring the latest technical innovations more quickly into the agency, NGA recently implemented the GEOINT Solutions Marketplace. It functions as an online exchange for the agency, vendors, partners, and academic institutions.

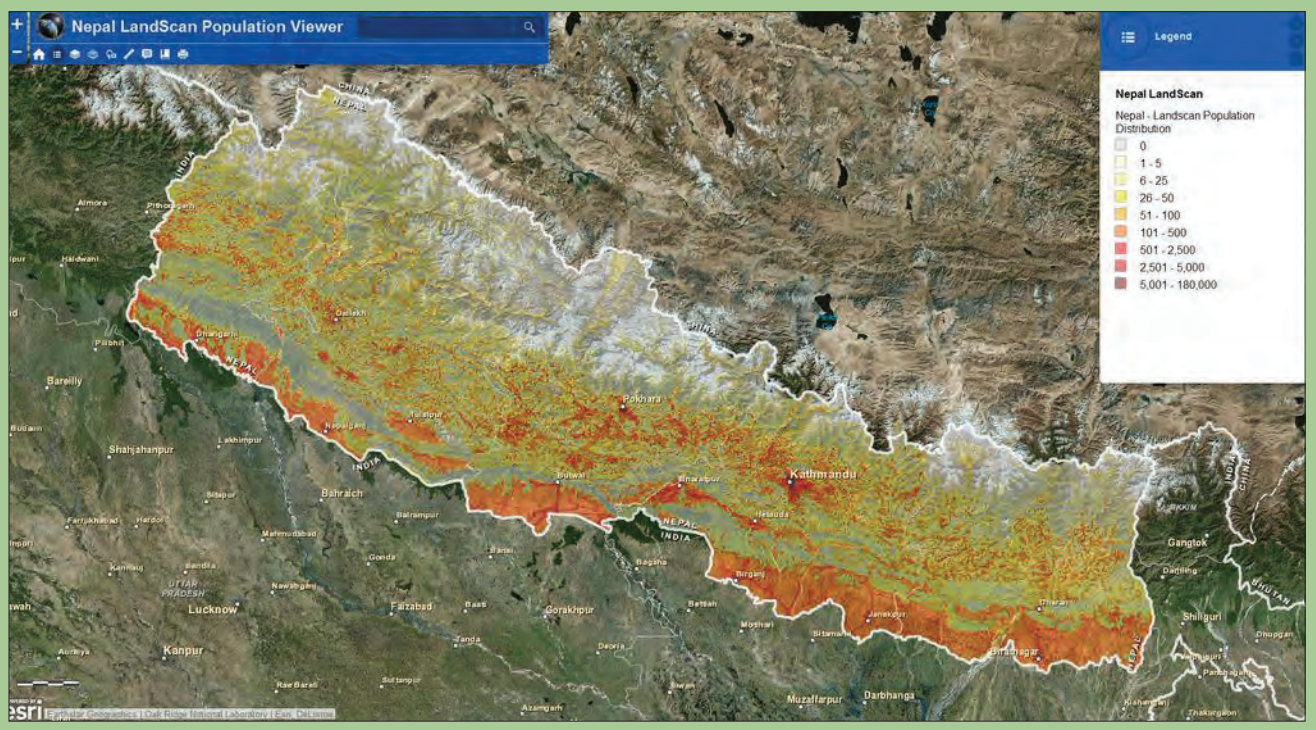
"This helps ensure that our agency maintains its transparency for acquisitions and allows us to implement them much quicker," said Cardillo. "It's a partnership that I refer to as Team NGA. I meet with industry leaders often so that they have a better understanding of our needs and expectations, which will help guide their research and development."

NGA's Expanded Role in the US National Security Community

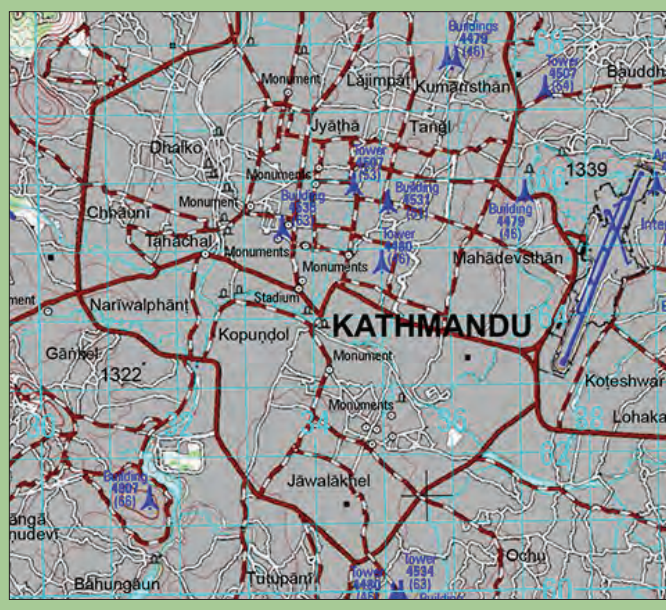
Because of the nature of their work, the 17 agencies that comprise the US Intelligence Community have traditionally maintained and safeguarded their own data. However, with a need to simplify data access for quicker analysis and decision making throughout the community and a mandate to reduce costs, they decided to implement a common IT platform. In 2011, work began on the Intelligence Community Information Technology Enterprise (IC ITE), a shared-services infrastructure based on cloud computing. Earlier this year, NGA and DIA consolidated agency-specific portals into a common IC ITE platform on Portal for ArcGIS with the goal of the entire Intelligence Community eventually being able to collaborate around this shared service.

"A key to better data analysis is the incorporation of georeferenced information because it can connect data that seemingly has no connection," said Cardillo. "So as part of the IC ITE, NGA collects, maintains, and serves geospatial data to the rest of the community."

NGA has deployed Portal for ArcGIS to the Amazon Web Services Commercial Cloud Services (C2S) as part of the IC ITE environment for the first time on behalf of the Intelligence Community in a move that enables government agencies to better share geospatial intelligence. The deployment of the portal provides a single environment for analysts to securely organize



↑ NGA is increasing assistance for worldwide humanitarian efforts by making more of its data open.



↑ Leveraging the current state of technology is allowing NGA to transform into a provider of dynamic content and services—as evidenced by the maps and data it released related to the earthquake in Nepal.

and share data throughout the Intelligence Community and the Department of Defense. It is also the foundational step in consolidating multiple geospatial intelligence portals into a single NGA-provided portal, resulting in technology and license cost savings.

"It is helping transform our agency from a traditional provider of static maps, charts, and analytic products to a dynamic content and services provider," said Cardillo. "Rather than submit requests to our agency, users will be able to access, depending on their security clearance, the maps and data they are looking for by themselves. This is a self-service model, but if you are uncertain about exactly what you are looking for, we are there to help you.

"Because NGA is both a combat support agency under the US Department of Defense and a member of the US Intelligence Community, our mandate is clear regarding national security," he continued. "However, we also have a responsibility to support those international events that require our expertise but fall outside military operations. For example, when the president declared Ebola to be a national security issue, we supported the deployment of the 101st Airborne Division, and we have a great history of supporting the uniformed military. But we were also required to support the medical staff treating the Ebola victims, and this was very different for us. They didn't have military ID or clearance cards; they just had an urgent need for the data we could provide to them. And the solution was providing access to our extensive unclassified data via the World Wide Web."

On October 23, 2014, NGA established its Ebola support page (ebolaopendata.nga.opendata.arcgis.com) using ArcGIS Online to provide public access to known outbreak locations, treatment centers, airports and seaports, and hundreds of other maps and data services. This public-facing website allowed relief agencies and other responders to access detailed information on the geography and infrastructure of Liberia and Guinea and build maps that include layers of information on Ebola treatment centers, mobile phone coverage, power grids, airfields, and more.

Anticipatory Intelligence and the Future of Data Acquisition and Analysis

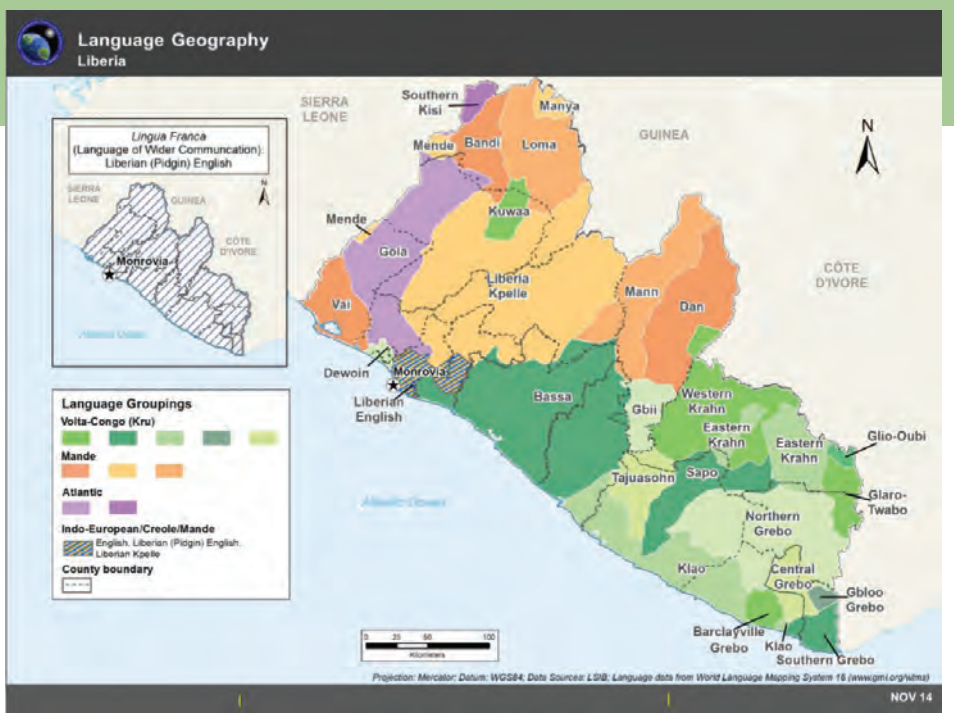
While NGA has been very successful in maintaining national security using methods such as Activity-Based Intelligence, the increasing complexity of its mission requires an ever-refined granularity in its analytical methods. Anticipating and neutralizing an event before it can occur is the ultimate goal of any security agency, and NGA is beginning to apply anticipatory intelligence in its analyses.

"Anticipatory intelligence is a methodology," said Cardillo. "Using our big data collection (and making certain assumptions and hypotheses), we can analyze the past behavior of an adversary in such a way that it will allow us to make a fairly accurate predictive model of its future activities. It's important to understand that we are not reinventing the intelligence business. We are just leveraging the current state of the technology and our connectivity to it in a new way.

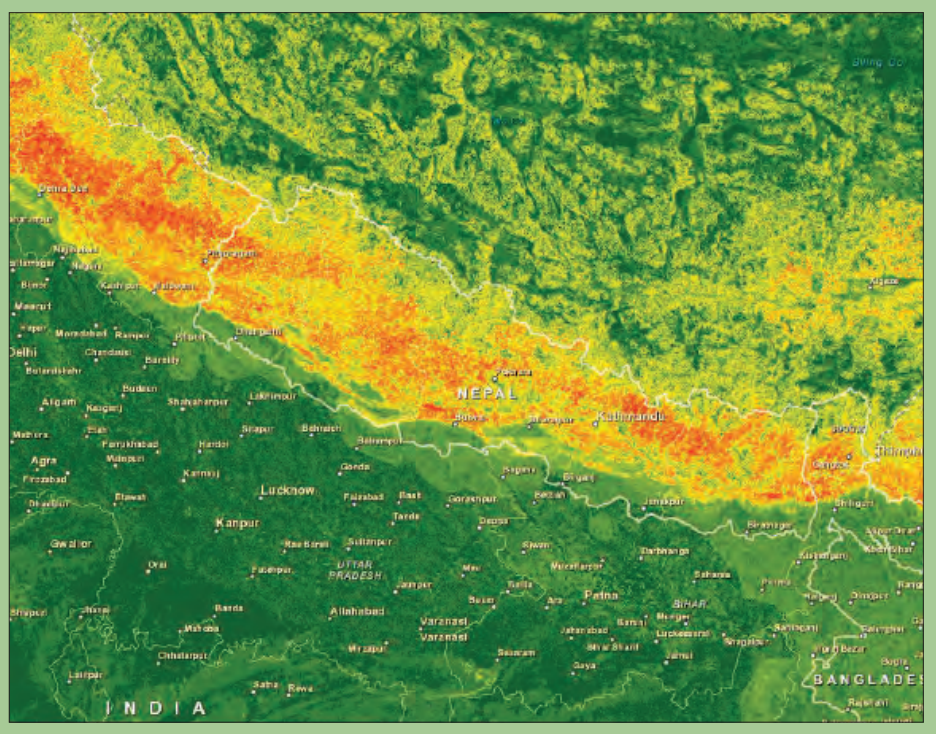
"Social media will be playing an increasingly large part of our analyses. In the event of an emergency, it can provide immediate local insights and a ground truth of the current situation," continued Cardillo. "However, as the nation's definitive source of authoritative geospatial intelligence, NGA has to be very careful with our analyses and distribution of crowdsourced data. The data needs to be carefully vetted and verified so that we can provide it to our customers with confidence. I have high expectations for its potential value, but we are being very thoughtful about how we will implement it.

"For example, during the Arab Spring, we were getting inputs of all kinds. Some were from our traditional classified sources, but most were nontraditional, unprotected sources, such as social media, local news coverage, blogs, etc. Information that is misinterpreted or presented in a confusing way can result in an inaccurate or incomplete operational picture. So we worked hard to carefully analyze, confirm, clarify, and present our findings in a coherent manner so that whether you're a policy maker or warfighter, you could clearly understand the situation as it pertains to you and your responsibilities.

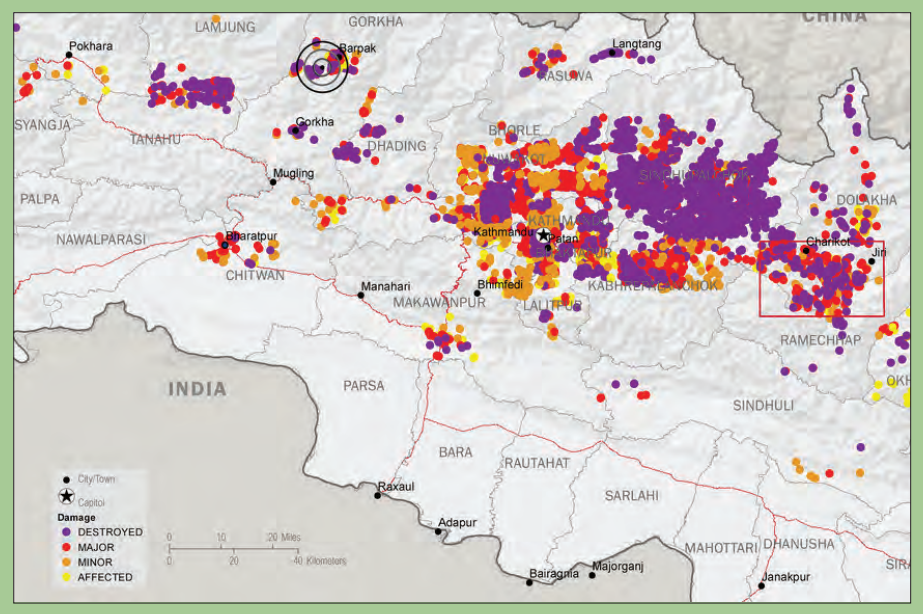
"Because of the changing conditions in the world, NGA is increasing its support of worldwide humanitarian efforts, such as the recent Ebola outbreak in Africa and the devastating earthquake in Nepal. This requires that we operate in an increasingly open environment. While we have been very successful operating in a closed environment in the past and we will continue with those initiatives, we are trying to better understand our responsibilities in this new open environment. How do we structure our data collection and management to support an open environment? What kinds of analyses are needed? We clearly understand our responsibility, but we are approaching our expanded role with careful consideration."



↑ NGA's Ebola support page gave the public access to maps and data about known outbreak locations, treatment centers, language geography, and more.



↑ Immediately following the April 2015 earthquake in Nepal, NGA opened a public website to share unclassified geospatial data, products, and services.



↑ NGA carefully analyzes, confirms, clarifies, and presents information in a coherent manner so that all parties involved in a situation understand how the agency's findings pertain to them and their responsibilities.

GIS Day: For Kids and Grown Geogeeks

Geography can be applied to everything that can be understood. But the world isn't being understood quickly enough to keep pace with the sustainability challenges of a growing population. That is why GIS Day, happening this year on November 18, is so crucial.

On and around this day, advocates of geography as a powerful extension of science and governance evangelize the wonders of geospatial technology, showing how GIS is the platform that enables geography to radiate more widely into the world.

There will be hundreds of GIS Day celebrations around the globe this year. Here is a brief sampling of those events.

Bangladesh: GIS for Humanitarian Aid

The United States Agency for International Development (USAID) in Bangladesh will commemorate GIS Day by hosting an event on November 18 at the US Embassy in Dhaka. The organization, which strategically allocates resources by geographically targeting aid investments, has invited partners to exhibit maps at a map gallery and will open the event to university students and kids.

GIS helps USAID geographically monitor overall aid effectiveness and upholds the organization's open data and transparency goals. As such, GIS is an integral tool for helping USAID make evidence-based decisions. That is why Deena Wahid, program development specialist at USAID Bangladesh, will enlighten her audience about the value GIS presents to humanitarian aid.

"Unfortunately, there's a relative scarcity of geospatial data, data quality, and awareness about the strength of GIS to serve humanitarian aid organizations," said Wahid. "More awareness through GIS Day—especially targeting youth—will improve this situation. Our main purpose for this event is to spread the message about the power of GIS by sharing our GIS activities, maps, devices, and software."

In addition to demonstrating how GIS improves the lives of Bangladesh's citizens, USAID will provide stalls for GIS vendors and have a GIS Corner with interactive games.

United Kingdom: An Ashcloud Apocalypse

Interactive games are a key component of GIS Day because they accelerate people's—especially kids'—understanding of a concept. Ask a child to map the effects of a large-scale explosion, such as one from a fictional mega-volcano, and you've got that kid's attention.

Raphael Heath, head of geography for The Royal High School Bath in the United Kingdom, will exploit this fascination with world destruction by hosting a global mapping exercise that will run throughout Geography Awareness Week (November 15–21) with support from Esri UK. Dubbed Ashcloud Apocalypse, the exercise—which is expected to engage thousands of participants all over the world—is based on the idea that there are mega-volcanoes scattered around the globe and that people living in different areas are prone to different risks, depending on geography. Students will contribute data that shows the risks to their communities, and that information will be used to create a large-scale hazard risk map for any fictional eruptions—the goal being to teach students how to use GIS for disaster risk analysis.

"It will also provide a range of opportunities to examine data patterns for a range of social and economic data," said Esri UK education consultant Jason Sawle. "Last year's event attracted more than 11,000 students. We're anticipating even higher numbers this year."

To get involved in Ashcloud Apocalypse, visit gisevent.wix.com/gisday2015.

United States: Tours and Learning Labs

There will be no shortage of interactive games for youths around the United States, though a vast number of these GIS Day events aim to edify grown-ups. Many events in the United States are being organized by universities, government offices, and public safety agencies and include learning labs for the hard-core learners.

The State of Indiana already prepped the area for GIS Day by hosting the 2015 Indiana GIS Day Conference on September 22. GIS users from a number of departments demonstrated how the state uses geography to distribute services and open data portals to share vital information. Attendees also got a tour of the State of Indiana's Emergency Operations Center, where Esri software has been integrated into daily operations.

To keep the GIS awareness momentum going, Indiana University-Purdue University, Indianapolis, will showcase its geography department's GIS courses and forthcoming drone program a week prior to GIS Day, on November 13.

Get Involved

Across the United States and around the world, GIS Day events will be held in a vast array of thought-provoking settings. Although it is primarily designed to steer youths into the vocation of geographic science, GIS Day also does its fair share of educating armchair epistemologists about what makes the world tick.

Learn more about GIS Day at gisday.com.

Esri Introduces New, Fast Global Geocoding as Service and Appliance

Location is becoming increasingly critical for many businesses. It can help find new customers and better support existing ones.

Whether a business deals with patient records, utility bills, real estate properties, city services, or crime, most of its data contains location information. Leveraging this location information allows an organization to provide smarter access to health care, supply higher quality utility services, more aptly evaluate a property's market potential, and more easily manage a city's field operations and police patrolling.

The most important step in making sense of location information is to turn business records into points on a map so the data can be analyzed spatially and business owners can gain critical location-driven insights. The process of converting location data into the latitude and longitude coordinates that are used to visualize data on a map is called geocoding.

Equally vital to doing geocoding is being able to do it fast. This is why Esri recently increased the speed of its World Geocoding Service in ArcGIS Online by 230 percent, which also improves geocoding in other ArcGIS products that use the service, including ArcGIS for Desktop, ArcGIS Pro, and various SDKs. Additionally, for people who work behind firewalls, Esri is planning to release the World Geocoder for ArcGIS in the next few months, which will allow these users to geocode global addresses using one locator.

Address Format Challenges

Location information in business data is usually recorded as street addresses, city names, and postal codes—all of which take many forms that are frequently inconsistent. *East Main Street* could be abbreviated as *E. Main St.*, some places exist outside city boundaries, and some addresses have ZIP codes while others don't.

Additionally, location information is often collected in the local language and its Romanized equivalent, which can be cause for confusion. *Tour Eiffel* in French is the *Eiffel Tower* in English, and the German word for *street*, *straße*, is actually *strasse* when transliterated into English.

At times, people also prefer to search for locations by their names rather than their addresses, such as when someone looks for *Starbucks* in Los Angeles, California.

Mapping volumes of business data—when a coffee shop wants to analyze information about 50,000 customers, for example—adds other complexities.

Good News: ArcGIS Can Help

The ArcGIS platform has very fast, global geocoding capabilities that take care of address formatting issues. And there are myriad ways businesses can use Esri's geocoding capabilities to visualize their information.

Keep Tabs on Global Operations. International businesses tend to have offices and distributors in various countries and customers all over the world. To help these organizations gain a complete picture of their global operations, ArcGIS can geocode at city level in 247 countries and territories and at address level in 107 countries in key markets, including North America, Europe, and Oceania.

Let Local Offices Map in Local Languages. Employees at offices in different countries usually work in their native language. Thus, mapping capabilities for businesses need to work with various languages, alphabets, and writing customs. Esri's geocoding crosses these language barriers by automatically understanding addresses in Roman and local alphabets, as well as making sense of local address formats. That way, businesses can build mapping applications that support international offices in the languages and address formats in which they are most comfortable. Esri has worked with its international distributors and partners to define the addressing for many key countries with complex addressing systems, including Japan, Thailand, and Israel.

Ensure Analytical Accuracy. If location data is incorrectly mapped, spatial analytics and insights will be wrong, adversely affecting business decisions. Esri's geocoding uses the most up-to-date and best available reference data from authoritative sources, such as HERE, TomTom, and local land authorities, assuring that organizations get the most precise, accurate, and reliable results globally.

Use in Maps and Apps Straightaway. Organizations don't need to process and build their own reference data; Esri has already gathered and processed global reference data—including streets and places—in one locator. This means that Esri's geocoding is integrated with existing ArcGIS workflows. Using most ArcGIS products, users can input one address or place at a time to locate it on a map or enter multiple addresses at once to get their latitudes and longitudes and then put those on a map. Developers can also use the World Geocoding Service to add geocoding to the apps they build.

Get Consistent Geocoding Results

Esri's geocoding capability is fast and works across the ArcGIS platform. As a unified, ready-to-use service, it yields a consistent experience and uniform results. In the ArcGIS Online map viewer, users can search and locate addresses and places using the search bar, or they can drag and drop a spreadsheet of addresses onto the basemap to have them displayed. In ArcGIS for Desktop, the geocoding toolbar in ArcMap contains the geocoding services. And in ArcGIS Pro, geocoding can be accessed using the locate tool or by clicking on the binoculars.

To make global geocoding easier for users operating behind a firewall, the World Geocoder for ArcGIS, currently in development, will enable them to geocode global addresses at a fixed cost using a single locator. This product will likely be available for purchase by the end of 2015 or beginning of 2016. Organizations with firewalls will still be able to geocode relevant business data by applying country-specific locators from StreetMap Premium for ArcGIS, as well as building and using locators based on their own reference data.

For questions about geocoding, email geocoding@esri.com.

↑ With Esri's geocoding capabilities, businesses can build mapping applications for international offices that use local languages and address formats.

A Fresh Take on Addressing

Around the world, addressing is inconsistent at best and nonexistent at worst. Latitude and longitude are useful when devices talk to devices, but getting humans to remember geographic coordinates is impractical. That is why what3words, a London-based geocoding startup, is on a quest to readdress the entire globe.

The organization, an Esri emerging partner, has divided the surface of the earth into three-meter-by-three-meter squares and, using an algorithm, has allocated three random words to each one of those squares, yielding 57 trillion unique and unambiguous addresses. The northwest corner of the Washington Monument in Washington, DC, for example, is clubs.grace.hike; Cape Point in South Africa is snooze.cheater.crewmen; and the Pacific Ocean's pole of inaccessibility (the spot that's farthest away from any land) is chefs.gritting.suspected. The service is currently available in five languages—English, French, Portuguese, Spanish, and Swahili—and the team is working to launch 13 more, including Arabic, German, Japanese, Turkish, and Urdu.

"We're really talking to the masses, and we're doing it in a way that's understandable," said what3words director of strategy Steven Ramage, who left his post as managing director of Ordnance Survey International to join the startup. "Being able to communicate location in a very simple, language-based method empowers communities because we can speak the language of that community."

what3words can be used by individuals—to find friends in a park, for example—as well as businesses, governments, and other organizations. A nonprofit conducting an emergency aid mission could use what3words to communicate the precise locations of remote refugee camps, water distribution sites, and makeshift clinics to workers and partners out in the field. If a utility had 80,000 electricity meters in a database, it could batch convert the latitudes and longitudes of each location into three-word addresses to make it easier for technicians to find them.

"The whole point about what3words is that latitude and longitude can be easy," said cofounder and CEO Chris Sheldrick. "It communicates for the first time over the phone and in writing and reading."

The what3words locator is available as a geocoding service for use with ArcGIS Online, ArcGIS for Desktop, and ArcGIS for Server. what3words has also developed an SDK so developers can build the geocoder into mobile apps.

The purpose of integrating with Esri, according to Sheldrick, is to facilitate communication between ArcGIS users and people around the world. With Esri's aspiration to bring GIS into the mainstream, Ramage envisions that the two companies can work together in a number of ways—from fostering e-commerce in developing countries to continuing to improve smart communities.

"This is elegant in its simplicity," said Ramage. "That's the brilliant part."

For more information on what3words, visit what3words.com.

↑ As of September 2015, more than 620,000 Syrian refugees had fled to Jordan—to refugee camps such as Zaatari, pictured here—since the Syrian civil war began.

← With Survey123 for ArcGIS, surveys can be prepared ahead of time, completed offline, and then uploaded to ArcGIS Online.

Survey123 Helps Direct Relief Provide Medical Care to Refugees

Collecting, Tabulating, and Disseminating Georeferenced Field Observations

Since the Syrian civil war began in March 2011, more than four million Syrian refugees have fled their country, with more than 620,000 seeking safety in neighboring Jordan, according to the United Nations High Commissioner for Refugees as of September 2015. Many—especially the estimated 20 percent housed in refugee camps—lack access to basic necessities, such as clean water, food, and shelter.

Living in extreme and uncertain conditions often precipitates health problems. Even seemingly benign cuts, scrapes, skin cracks, and burns can lead to more serious complications when left untreated.

"Skin care is a neglected area of public health," said Andrew Schroeder, director of research and analysis at Direct Relief, a global nonprofit that works with health care professionals and local organizations to provide emergency medical assistance to populations in need. "It's not something traditionally top of mind for most serious or life-threatening conditions, but it can lead to very troubling issues for people with tough circumstances."

That is why Direct Relief embarked on a mission in April 2015 to treat and document skin conditions among Syrian refugees in Jordan. Working with Esri's Survey123 for ArcGIS app, Direct Relief was able to rapidly diagnose, treat, and collect medical records on more than 1,000 refugees—in just six days.

A Day in the Life

The two teams sent on the mission to the Zaatari refugee camp in northern Jordan each consisted of a dermatologist, a translator, and a scribe. Each team was set up with its own tent, table, and basic medical supplies.

Early every morning, a line of people would form and extend past the camp's borders. When there was enough light, the Direct Relief teams began working as swiftly as possible to examine, diagnose, and prescribe treatments for as many people as they could before daylight ran out.

Each team spent about three minutes with a patient from start to finish. The doctor first examined the patient and made a verbal assessment of symptoms and diagnosis. The doctor then told the translator the patient's condition and the recommended treatment, and the translator relayed the information to the patient. Throughout this process, the scribe used an Android tablet to record everything in Survey123. This created a medical record for the patient on the spot, complete with information about who they were, where they were from, what symptoms they had, and any recommended treatments.

Getting Survey123 Up and Running

Survey123 is a data collection app designed to meet the unique challenges its users face in demanding field situations. Surveys can be prepared ahead of time, completed offline, uploaded to ArcGIS Online to analyze patterns, and shared with an array of interested partners.

To create the survey it used in Jordan, Direct Relief first downloaded Survey123 Connect. The program uses as its foundation the XLSForm specification—a standard format that makes it easy to set up form-based data collection. Once the GIS practitioners finished building the survey, they saved it to the Survey123 website under My Surveys so teams could access it whenever they needed.

From there, users could retrieve the survey on their Android tablets via the Survey123 app, downloaded from the Google Play store. With the app open, the field teams could see all the surveys that had been shared with that account and download them directly to the device for offline use later.

The scribes accessed the survey each day at the refugee camps. Using the Android tablets, they input data quickly into a preset form (using multiple languages when needed), embedded audio and images, and even included advanced logic and branching when respondents' answers led them down various paths of questioning.

"We want doctors in the field to take and rapidly add photos to a medical record, even when working offline, so we know exactly what kinds of conditions were seen," said Schroeder.

All the capabilities of Survey123 helped scribes keep up with the doctors' rapid-fire pace, which is what enabled the teams to see so many people with such limited time.

"With Survey123 for ArcGIS, our goal was to see as many people as possible presenting skin conditions at the refugee camps," Schroeder said. "Although the need is endless, the trip was a short-term success. Our team was able to provide treatment for everyone who showed up and needed help."

Not only that, but after the six-day mission, Direct Relief was able to share the survey data with local partners so they could conduct follow-ups with patients. This was made possible by having the scribes save each survey directly to their Android tablets and then, once they had Internet access, upload the surveys to ArcGIS Online, where Direct Relief could do analysis and share the datasets with others.

Additional Benefits

To provide emergency medical assistance, Direct Relief relies on material and financial contributions from medical equipment manufacturers, pharmaceutical companies, and private donors. As such, it is imperative that the organization allocate its resources based on reliable data.

"The mission to Jordan yielded practical outcomes, but it was also kind of an experiment for us," said Schroeder.

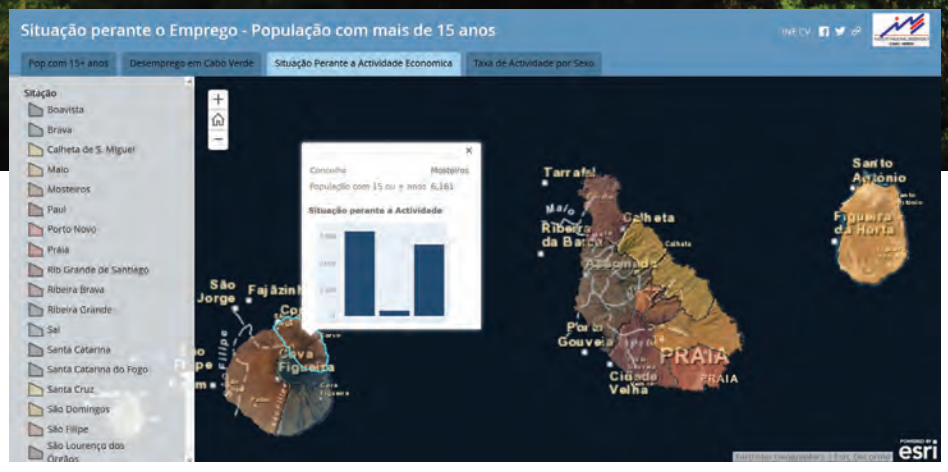
Besides treating patients, the organization wanted to answer some ancillary questions as well: "What range of conditions showed up? How do we refine our mix of medical supplies in the future? How do we work with local organizations to be more effective? The data we collected will help us make better decisions for the next mission," said Schroeder.

Direct Relief is now looking to use the data collected with Survey123 to build web applications and story maps, leveraging ArcGIS Online to share the results of its work even more widely so that additional organizations can use it to plan other, longer-term relief efforts.

"In the future, we foresee that tools like Survey123 for ArcGIS will be incredibly useful for disaster response situations—or anything time sensitive that requires us to collect and share data extremely quickly from offline environments," said Schroeder.

Direct Relief was awarded a Special Achievement in GIS (SAG) Award at the 2015 Esri User Conference for its work developing map applications for the One-Million Community Health Workers campaign.

↑ Highlights from Cape Verde's census data are available to the public via a scrolling image gallery.



↑ This map of employment statistics is part of a publicly available story map that walks viewers through various components of the census data.

Simplifying the Census in Cape Verde

GIS Provides Framework for Preparing, Processing, and Distributing Census Data

Until 2010, the African island nation of Cape Verde, located about 350 miles (560 kilometers) off the western coast of Africa, used paper maps to conduct censuses. Aside from the typical challenges of orchestrating a census of more than 500,000 people on nine volcanic islands, the use of paper maps with varied scales made things more complicated: It was difficult to identify enumeration areas (the geographic locations canvassed by census representatives) and challenging to make maps of small areas. Moreover, preparing and working with these paper maps was time consuming and required significant additional staffing.

During the 2010 Census, however, the National Statistics Organization in Cape Verde, known by its Portuguese acronym *INE*, worked with Esri to understand how location-based technology could benefit its staff across the entire organization. INE also looked to the United Nations' *Handbook on Geographic Information Systems and Digital Mapping* (now called the *Handbook on Geospatial Infrastructure in Support of Census Activities*) to better understand census cartography and improve planning, data collection, and analysis.

"We understood that it was time to follow United Nations recommendations *[on]* the use of new technologies and GIS in the census," said Clodomir Pereira, the team leader of INE's cartography and GIS department. "Also, we wanted to further improve the information we produce with spatial analysis and meet the demand for georeferenced statistical information."

INE decided to use the ArcGIS platform—including ArcGIS for Desktop, ArcGIS Online, and several mobile solutions—to improve its workflows and business processes. The ultimate goal was to produce and disseminate authoritative statistical information to help Cape Verdeans better understand their resources, economy, culture, and ever-changing society.

Automating the Whole Census Process

For the 2010 Census, INE used ArcGIS in all stages of the operation: planning, enumeration, and data dissemination.

To prepare for data collection, INE used ArcGIS to make its census cartography because, as Pereira pointed out, it is fast and reliable.

"For a census, it is necessary to determine statistical units or information collection areas—enumeration areas or census *[blocks]*...where the inquirer collects information, so that there is no duplication or omission," said Pereira. "The census blocks should be easily recognizable, so *[their]* limits must be clearly visible and represented in a clearly visible scale."

Thus, INE digitally mapped Cape Verde's administrative boundaries, roads, and streams, which often serve as natural borders for enumeration areas. The statistics organization also marked each building on the digital maps with a point, gave them all unique geocodes, and classified them according to the type of use. The census blocks from the 2000 Census were put into digital format as well to help with georeferencing. The agency was then able to use all this information to plan its enumeration areas.

During enumeration, field staff used ArcGIS to collect data and report it to management for quality assurance. For data collection, INE worked with Esri Portugal to develop a mobile application that allowed field staff to capture the coordinates of new buildings and send that data to the central database.

"ArcGIS improved the representation of enumeration areas and allowed better control of work during the census operation," said Pereira. He also stressed the importance of creating maps of small areas, which help with estimates for specific, and often small, populations for which there aren't reliable statistics.

"Presently, statistical information available for small geographic areas or specific areas is very important and *[necessary]* for decision making; therefore, the National Statistics Organization decided to conduct a census that responds to this need, so all information collected in the census *[was]* georeferenced," Pereira said.

After the enumeration phase, INE used ArcGIS Online to deliver web maps to the public, since the majority of Cape Verde's population has access to the Internet and it is a cost-effective and easy way to get information to people. These online maps are also of great benefit to government agencies that use census data in their missions, as well as the business community, which needs to understand the nation's demographics. To satisfy demand for thematic maps by the likes of researchers and university students, INE incorporated interactive maps and story maps into its census website, inecaboverde.maps.arcgis.com. There, visitors can view engaging information on population counts and change, as well as housing and employment data.

More Accurate Data and Optimized Workflows

While, according to Pereira, the greatest benefit of using GIS during the 2010 Census was improved data accuracy, he also pointed out that doing everything digitally enabled INE to optimize its operational, managerial, and analytical workflows. In fact, for the 2010 Census, INE reduced the number of staff required to prepare census cartography by 50 percent compared to the 2000 Census. It also took INE about 40 percent less time—a few weeks as opposed to a few months—to produce maps with the census data, meaning that the public had access to the 2010 Census results much quicker than it did a decade earlier.

These advantages, coupled with improved internal communication and collaboration, have induced INE to use GIS for an agricultural census and make the technology a critical component of other upcoming censuses.

Leading the Way in Africa

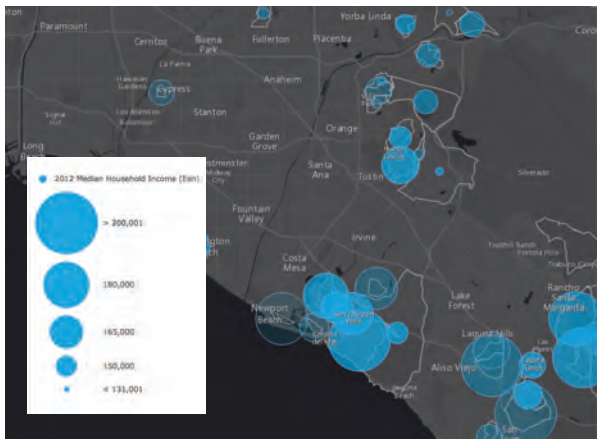
Cape Verde is a technological leader in Africa, where many nations continue to conduct censuses using paper-based processes. INE hosted a Regional Workshop on the Use of Mobile Technologies for Data Collection and Statistical Production in Africa, in partnership with the African Centre for Statistics of the United Nations Economic Commission for Africa, the Partnership in Statistics for Development in the 21st Century, and the African Development Bank. This is among Cape Verde's many efforts to share knowledge and best practices with other statistical organizations in the region.

Nine Enhancements to ArcGIS Online

The July update to ArcGIS Online includes a number of enhancements and new features to make it easier to use—many of which were based on your feedback. Here are nine highlights from the update. For more details and helpful resources, visit links.esri.com/agolhelp/whatsnew.

Smart Mapping Transparency

Use Counts and Amounts (Size) to vary the transparencies applied to numeric-based attributes by location. When used with polygon layers, the tool can even adjust the size range automatically so the symbols look better across zoom levels. Border widths and transparencies also self-adjust when mapping polygon layers, which improves a map's usability.



↑ New smart mapping capabilities include the ability to set the transparency per feature and auto adjust polygons' widths and transparencies.

Workflows and Design

To better document and communicate the authority of your data, you can now enable standards-based metadata for items and configure the editing and viewing of the metadata.

In terms of improved design, several basemaps—including Imagery with Labels, Dark Gray Canvas, Light Gray Canvas, World Oceans, and Terrain with Labels—now display feature layers between two layers so the basemap labels are more legible.

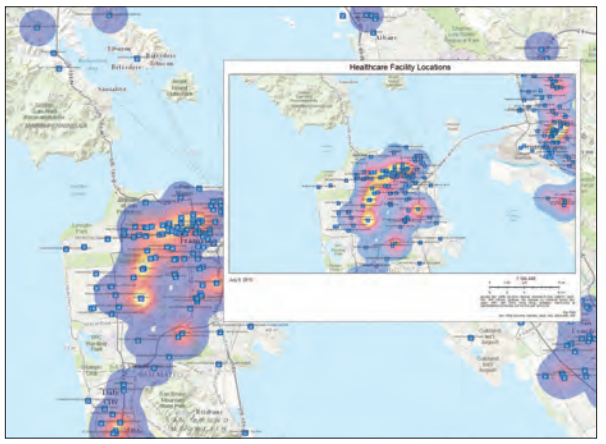
Map Viewer, More Adaptable

You can now sign in to ArcGIS Online directly from the map viewer, so you won't lose any work done in the map viewer prior to logging in.

Once inside, you'll notice that some buttons have moved and been enhanced. The Change Style and Show Table buttons appear directly under the layer name in the layer menu, alongside a button to open the full set of actions for the layer. The New Map button includes a drop-down list of your recently viewed maps.

When searching within a map, you can now scour all available resources or choose a single resource. Searchable feature layers support integer fields as well, and search results can be added to a map notes layer.

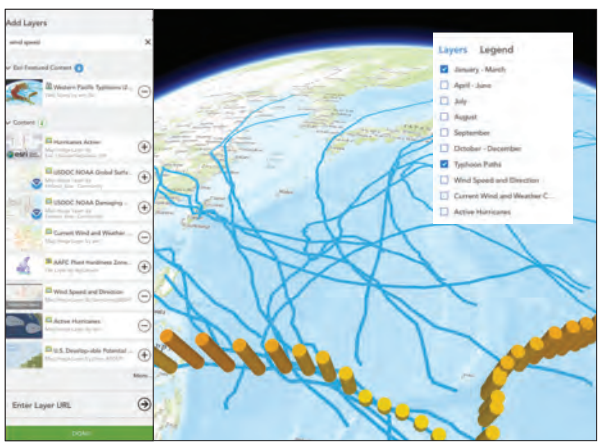
You can now use data fields for labels, and embedded maps are more responsive to different browser sizes and devices. When printing, you can also include custom print layouts from ArcGIS for Server for a more tailored print experience.



↑ You can include and configure your custom print layouts in the map viewer.

3D Scene Viewer Improved

As with maps you create in the map viewer, scenes can now be embedded in a website or shared via email or social media. You can view scenes in full-screen mode; use OpenStreetMap as a basemap; store sun and shadow settings; and, with the new 3D extrusion symbol, change 2D polygon symbols to display as 3D volumes. It is also now possible to see underground layers by turning on See Through Ground (in beta). In Add Layers, there's now a remove option, so you can delete layers you added from your scene. And if you speak Arabic or Hebrew, you can experience scene viewer in those languages as well.



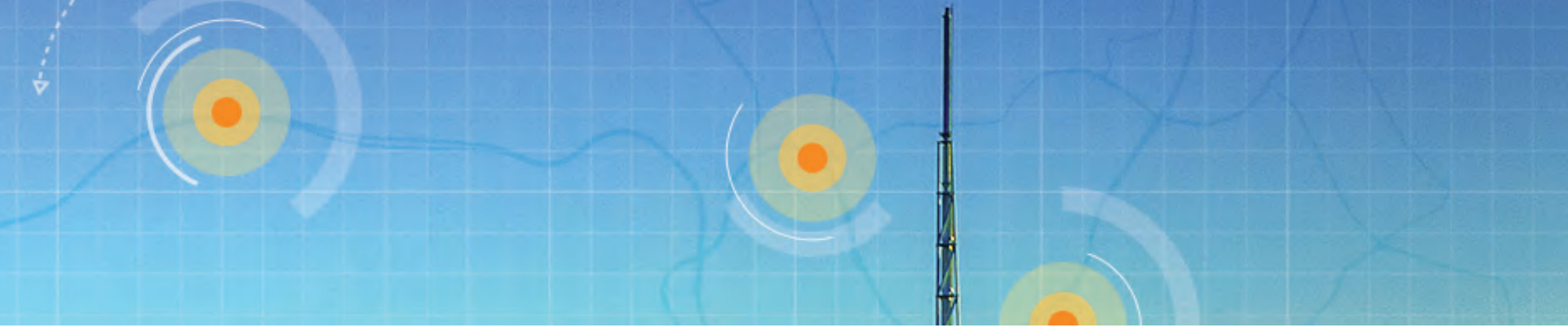
↑ Share 3D scenes just like web maps: Embed scenes in a website, send them via email, or post them on social media.

Enhanced Analysis

There's a new analysis layers gallery for the Living Atlas of the World, a rich set of high-quality maps and layers of imagery, boundaries, demographics, and more from Esri and ArcGIS users. It is now easier to discover and add these dynamic layers—which include common geography layers such as country, state, and census boundaries—to your analysis workflow.

For directions and proximity analysis tools, configure travel modes to yield better routes and analytical results. You can also define your organization's transportation network settings and vehicle standards so you don't have to select these each time you use them.

Additionally, we've improved how you interact with analysis features. There is now an Analysis button at the top of the map viewer to make analysis easier to find. You can interactively specify the starting points for Create Viewshed, Create Watersheds, and Trace Downstream. And Find Hot Spots is now more intuitive.



Feature Layer Updates

If your source data is updated frequently, there's now a better way to maintain the URL and layer properties in the hosted feature layers you use in maps and apps: You can overwrite features in hosted feature layers published from CSV files (as well as file geodatabases, shapefiles, and GeoJSON files) that contain latitude and longitude information. A new set of data collection templates is also available for creating hosted feature layers used with Collector for ArcGIS.

Growing Content

The Living Atlas of the World is now easier to access through the Gallery. Esri Featured Content, also in the Gallery, now includes a more comprehensive set of maps from the Living Atlas, including maps for your local region. The map viewer also features a Browse Living Atlas Layers option for adding these layers to your maps. Also new is the Living Atlas contributor app (livingatlas.arcgis.com/contribute), which you can use to nominate your map or app to become part of the Living Atlas.

We updated basemaps and imagery services as well. The World Street Map has new data for Europe and dual-language labeling for several countries, including Russia and Greece, and now includes detailed content for South Korea. The Arctic area basemaps, including Arctic Imagery and Arctic Ocean Basemap, are no longer in beta. National Agriculture Imagery Program (NAIP) image services have been updated with NAIP 2014 imagery, and World Imagery has been updated at large scales (L14–L17) with NAIP 2013 and 2014 imagery for most of the continental United States. World Elevation Layers now includes 30-meter data for Asia and Australia. And this same data is available in the Terrain 3D layer used in the Scene Viewer and other apps. Finally, standard global demographics for 45 countries have been updated with more current data.

Amplified Apps

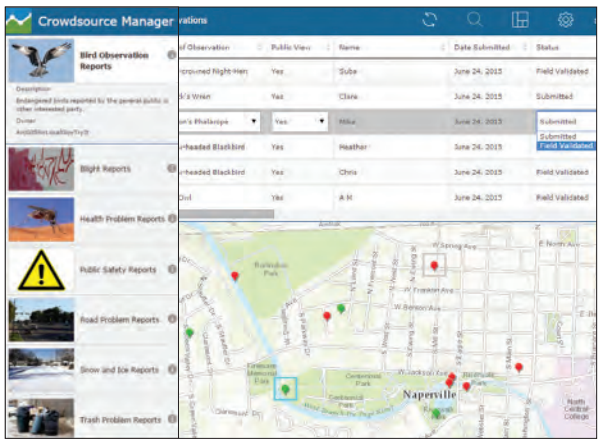
In Web AppBuilder for ArcGIS, there are five new themes to choose from, along with several new widgets, including a Stream widget for visualizing and controlling real-time data feeds from streaming feature layers.

ArcGIS Open Data now has feedback loops that let the public comment on your data so you can engage with citizens, more easily identify data that needs to be updated or improved, and understand where to focus your maintenance efforts. We also included support for standards-based metadata.

In Operations Dashboard for ArcGIS, administrators can now add extensions to their organizations, which publishers can use inside their operations views. Developers and partners can write new widgets, map tools, and feature actions using ArcGIS API for JavaScript.

Don't forget to check out our new apps. Navigator for ArcGIS improves workforce mobility, while AppStudio for ArcGIS (in beta) lets you build native apps that work on Android, iOS, Windows, OS X, and Linux devices—no developer skills needed.

We also updated the Crowdsource Manager and Crowdsource Reporter app templates; made a new version of the Time Aware app template; and renamed the Chrome-Twitter app template to just Twitter.



↑ With Crowdsource Reporter, you can submit problems and observations and then review them with Crowdsource Manager.

Better Administration

With enterprise logins, you can now configure the sign-in page to either show only the enterprise login option or both the enterprise login and the ArcGIS account sign-in options. To make it easier to manage users and groups, administrators can also assign new members in bulk to multiple groups as part of the invitation workflow or the group's configuration setting. Moreover, in addition to being able to manage your ArcGIS Pro licenses in ArcGIS Online, you can now manage your Navigator for ArcGIS licenses there.

The Open Data tab provides a high-level summary of the Open Data sites an organization has created, as well as a list of the organization's Open Data groups. Administrators also have the option to add Open Data curators to groups from the Open Data tab.

If you have ArcGIS Online workflows that require several members of your organization to update the same map, you can allow members of the group to modify items shared with that group. That means that people working in emergency operations centers, for example, can update the maps, item details, and content that form the basis of their apps and dashboards. They can also have full editing control over hosted feature layers that have been shared with the group, even if the layer appears uneditable to the rest of the group. During a disaster, for instance, members of the group could use their authoritative data to update a public-hosted feature layer that shows available resources, and while others would be able to see the updates, they wouldn't be able to make them.

On the View Status page, administrators can now view service credits reports or data range reports for a one-year period rather than just 90 days. New drill-down and drill-through reports also reveal specific information as you interact with them, such as the number of new or modified items that have been added. Service credits reports for premium content have been expanded as well to include subscriber content, imagery maps, and landscape maps. And additional member reports are available for login activity, service credits usage, and role information.

Web GIS: A Mission-Critical Technology for Emergency Management

By Bob Greenberg, Founder and CEO, G&H International Services

For years, GIS has been an important tool for improving situational awareness, especially in emergency preparedness and response. During a crisis, having a clear, real-time understanding of the situation as it unfolds is critical for making decisions that help save lives. The challenge for decision makers has always been to acquire and analyze meaningful information so they can make timely and informed decisions. GIS—with its capacity to mash up and visualize multiple datasets in a single platform—makes it easier to identify the data you need to make those decisions.

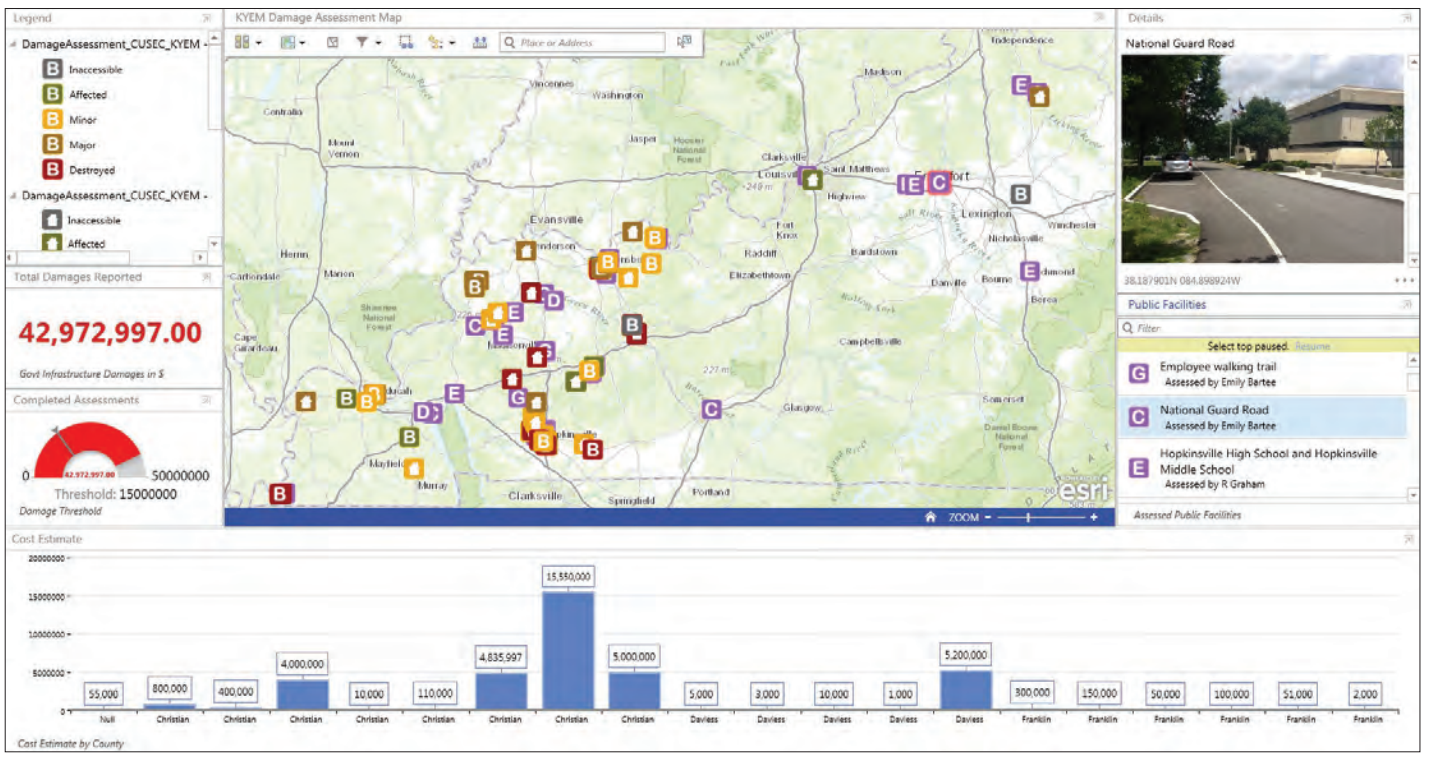
The advantages of GIS were demonstrated time and again during projects carried out as part of the Department of Homeland Security Science and Technology Directorate's Virtual USA (vUSA) initiative. Launched in 2009, it was designed to establish and demonstrate best practices for situational awareness. An important part of the success of that program—which, to date, has engaged more than 30 states, hundreds of cities and counties, and various federal agencies—has been the use of GIS to create situational awareness platforms, or "viewers," and applications that provide emergency management personnel with real-time information visualization so they can make better use of the data at hand.

To a certain extent, the vUSA program accounts for the increasingly widespread use of GIS across the homeland security enterprise over the last five to seven years. But the role and importance of GIS have dramatically changed.

Within the last year, GIS has become a foundational, mission-critical technology for homeland security and emergency preparedness and response missions. The creation of the web map format, coupled with the deployment of web GIS, was a game changer. Now, homeland security and emergency management professionals have unprecedented capabilities to obtain, share, make sense of, and use information in increasingly more effective ways.

CAPSTONE-14 Provides the Evidence

This became stunningly apparent during last summer's Central US Earthquake Consortium CAPSTONE-14 exercise, which centered on the very real possibility of a catastrophic earthquake impacting the New Madrid Seismic Zone in the southern and midwestern United States. That exercise, supported by the Department of Homeland Security's Science and Technology Directorate (DHS S&T) and the National



↑ Operations Dashboard for ArcGIS, used in conjunction with Collector for ArcGIS, is a vital tool for monitoring damage assessment in an emergency.

← A dashboard at the Illinois Emergency Management Agency shows the status of Mission Ready Packages and Essential Elements of Information for preparedness and response.

Information Sharing Consortium (NISC), was designed to create and demonstrate real-time information sharing, near real-time situational awareness, and mutual aid coordination across eight primary states (and 12 associated states); more than 420 counties; and 45 companies, nonprofit organizations, and federal agencies.

The challenge for participants was to figure out how to coordinate activities by sharing imperative information housed and owned by different agencies—each with different, and sometimes proprietary, systems of record. With technical support from Esri and its Silver Tier partner G&H International Services, planners had to develop data interoperability networks that functioned seamlessly across organizations. They ended up integrating data from scores of systems, sharing more than 2,500 datasets, producing over 13,000 dynamic information alerts, and handling more than a dozen mutual aid requests.

The technical team—composed of GIS specialists from various states, as well as staff from G&H and Esri—also created an assortment of applications to improve cooperation and collaboration, including the Mission Ready Package tool, which enables users to find mutual aid resources in real time. They deployed Collector for ArcGIS in more than 20 counties as well so they could assemble real-time situation reports.

After CAPSTONE-14, the National Emergency Management Association (NEMA) officially adopted the automated Mutual Aid Support System (MASS) that was tested during the exercise, which uses an organization's existing resource management software to find aid resources. NEMA is now creating an updated version of MASS, or Emergency Management Assistance Compact System 2.0, as a national capability to improve mutual aid across all 50 states. Moreover, NISC has adopted a standardized approach for identifying Essential Elements of Information for preparedness and response. The consortium is now working with DHS S&T and others to proliferate the method, which will improve information sharing abilities across the country.

And here's the crucial aspect of all this: It was GIS—specifically web GIS and the web map format—that made everything possible.

One Hub for Integrating Information

ArcGIS Online served as the interoperability platform, or hub, that allowed participants to integrate information housed in so many different systems of record. The web map was the building block of that effort because it made it possible to turn each dataset into a web service and then share that with all participants. Thus, once enabled, the tools provided on Esri's web GIS platform let participants use data in numerous ways, resulting in a dramatic improvement in coordination, force multiplication, and decision making.

CAPSTONE-14 was an enormous advancement for the homeland security community, but it wasn't an isolated one. Many other exercises and projects have further demonstrated the critical importance of GIS. In June 2015, NISC concluded its First Responder Implementation Project that was designed to test the lessons learned from CAPSTONE-14 and apply them at a local level. Unlike CAPSTONE-14, which was a state-to-state emergency management exercise, the NISC project began by identifying information-sharing challenges at a local level—where all incidents begin. This enabled NISC to identify, map out, and address issues that arise first within a local organization, then across multiple disciplines within a locality (such as fire, emergency management, and law enforcement), and, finally, across various local agencies (including cities and counties). Having to work with numerous organizations that have their own policies and procedures increased the complexity of the challenge. Yet, once again, GIS became the cornerstone of the solution. As James City County emergency management coordinator Kate Hale said during the after-action briefing, "ArcGIS Online *is* our interoperability platform."

Sharing Is the Key

The opening line of US president Barack Obama's "National Strategy for Information Sharing and Safeguarding" says, "Our national security depends on our ability to share the right information, with the right people, at the right time." As we have seen in nearly every major incident—from the terrorist attacks on September 11, 2001, to natural disasters such as hurricanes Katrina and Sandy—lack of authoritative, actionable, and timely information leads to unnecessary suffering, excessive property damage, and the tragic loss of lives.

The importance of information sharing cannot be overstated. The proven role of GIS as a conduit of information sharing makes it a mission-critical technology for preparing for, responding to, recovering from, and mitigating any incident—whether it is in an emergency situation or has to do with business planning, monitoring public health, analyzing crime, or any number of other, distinct situations.

GIS has always been good to have, but now it is a must-have. While there is still much hard work to do to realize GIS as a truly ubiquitous interoperability platform, the pathway to achieve it has never been clearer.

About the Author

Bob Greenberg is the founder and CEO of G&H International Services, which helps organizations build lasting operational capacity and become more self-sufficient. He can be reached at rgreenberg@ghinternational.com.

Local Governments Geospatially Enable Operations Management

Local governments are now seamlessly merging operations management and spatial analytics.

Software company Cartegraph, a leader in helping state and local governments solve day-to-day operational problems, has integrated more closely with Esri by creating the ArcGIS Identity, which all Cartegraph customers must use to log in to Cartegraph's systems. This lets Cartegraph and Esri users share more information, which leads to more accurate and efficient decision making.

"It allows them to have more seamless interaction between their traditional GIS workflows and their asset management workflows," said Esri director of business development Jim Higgins. "It brings together all the different workers in an organization"—GIS practitioners with field staff with knowledge workers.

Combining the asset management capacity of Cartegraph's Operations Management System and the spatial analysis capabilities of the ArcGIS platform means that local governments can manage enterprise assets for facilities, public spaces, and infrastructure in tandem with the work, resources, and requests they normally administer. It also gives users more context.

"We can now answer more questions about why," said Cartegraph president and CEO Jake Schneider.

If a wastewater utility notices that sewer pipes in a certain area are failing, it can overlay its data with a map of soil types to see whether the soil in that area is corroding sewer pipes. If a particular part of town tends to experience more vandalism than other areas, a local government can use a streetlight map to determine if the least-lit areas are more prone to deliberate property destruction.

And, crucially, Cartegraph—an Esri Gold Tier partner—doesn't have to build this new functionality from scratch; it's already there via Esri.

"This yields on-demand, real-time decision-making power," Schneider continued. "Information that wasn't connected or wasn't even thought to be connected is now being connected."

Cartegraph's Esri consultant, Brant Scheidecker, expressed the significance of this move, saying that aligning with Esri takes this kind of technology to the next level.

"We are now giving our users the ability to access a ton more content that may not have been available to them previously," he said. "It opens up a world of possibilities from a spatial analytics toolbox."

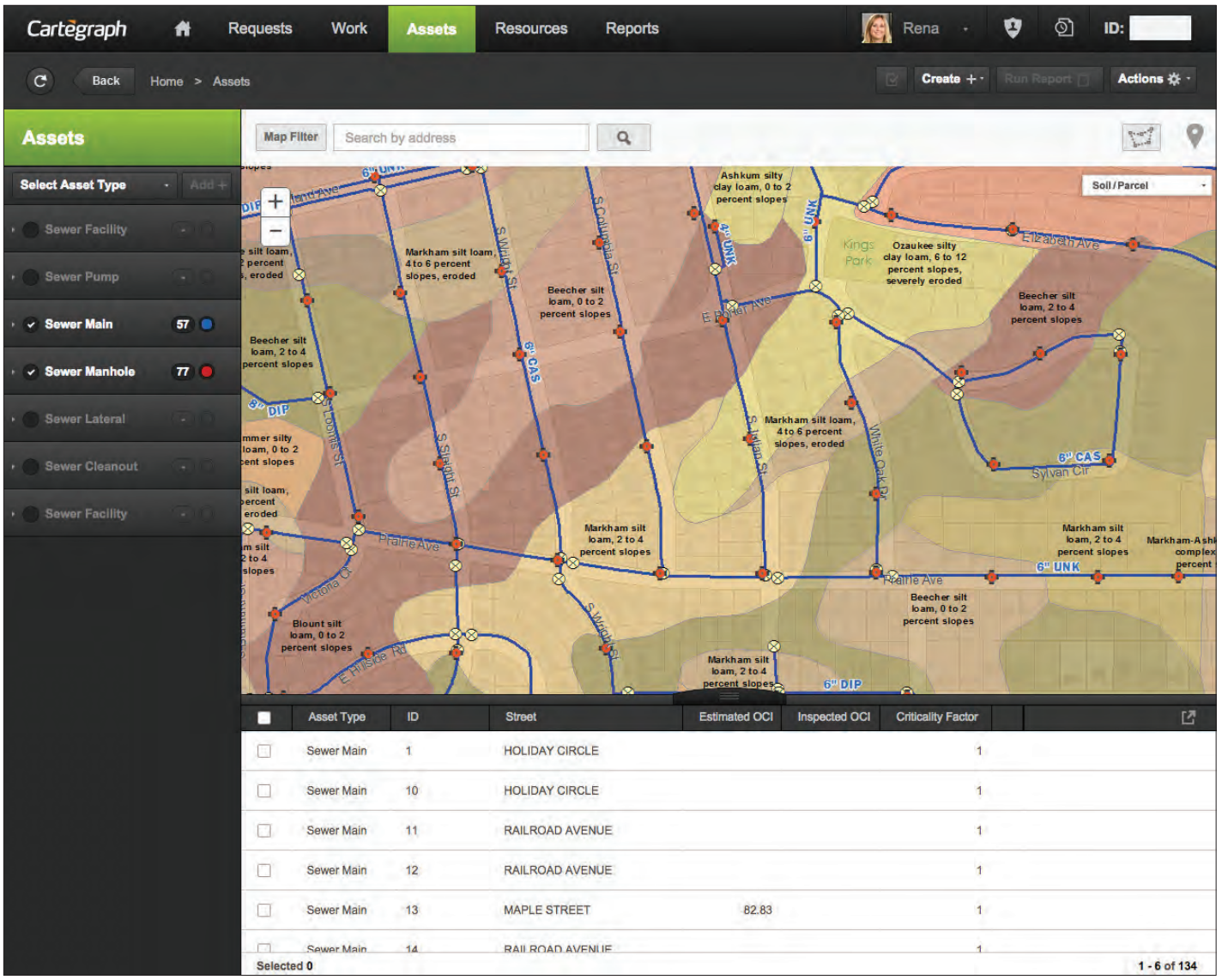
This new business relationship also increases awareness about both companies and their products.

As Scheidecker outlined, if a local government is taking asset inventory, it can consult Cartegraph to figure out which tools would be most useful. GIS specialists might make better use of Esri's Collector for ArcGIS, while fieldworkers may be more comfortable using some of Cartegraph's mobile devices. Either way, the tools communicate adeptly with one another, allowing for real-time exchange of information between platforms.

The ArcGIS Identity is just the beginning of the Cartegraph-Esri connection. Cartegraph is currently exploring how additional ArcGIS capabilities can serve its customers in an even more fine-tuned way.

"We're making sure that we stay on the cutting edge of technology as advancements come out," said Scheidecker.

For more information on how the Cartegraph and Esri platforms work together, visit www.cartegraph.com/arcgis.



↑ The new Cartegraph-Esri connection enables local governments to better integrate operations management workflows with spatial analysis.

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Polish Town Makes Community Smarter with Broadband and GIS

By Magdalena Jablonska, Suntech S.A.

By 2020, every European is supposed to have access to the Internet with a minimum download rate of 30 megabits per second, according to the Digital Agenda for Europe. Poland is currently the biggest broadband network construction site in Europe, with both municipalities (*gminy*) and provinces (*voivodships*) building these networks.

The municipal office in Bielsko-Biala, a picturesque town in southern Poland, has implemented an Esri-based system to inventory all the resources in its broadband network, including devices, cables (their location, size, type, and attenuation parameters, for example), and infrastructure (such as buildings, cabinets, cable chambers, manholes, and utility poles). Suntech S.A., an Esri Silver Tier partner, used its SunVizion Network Inventory to map out the municipality's entire broadband network so that, as the municipality expands its Internet services, it will be able to better manage its network infrastructure, reducing maintenance costs and streamlining business processes.

A Well-Functioning System

Bielsko-Biala's broadband network was actually built in 2014. It has a high-performance fiber-optic backbone, and its distribution network has radio access elements and access nodes for future broadband operator installations.

The network is designed to meet an array of local government requirements, including providing public e-services, such as online permitting; hooking up municipal administration buildings to one another; and connecting schools to other educational institutions, including social assistance centers, cultural organizations, and libraries. It also advances the idea of Bielsko-Biala being a smart city by allowing the future installation of more than 90 monitoring points that can be used to intelligently manage road traffic by, for example, notifying drivers of commute times and alternate routes and showing estimated bus arrival times. Additionally, part of the network's passive infrastructure makes portions of it available for other telecommunications operators to lease at market value so they can offer broadband services to their customers.

To ensure that the broadband serves the town's population effectively, the telecommunications companies that offer network-based services need access to detailed information about network assets, including the layout of the cables and data about where network devices are located, as well as the devices' parameters. And they need this information on the spot.

This kind of access can only be provided by a network inventory system.

Mapping an Entire Network

It is difficult to conduct network inventories of municipal and provincial networks because various public and private entities are involved in managing and operating them. In Bielsko-Biala, for example, the municipal office owns the broadband network, but a network management company runs the network and various local operators lease individual sections, or elements, of it to provide their own services. Unsurprisingly, this requires complex access rights to ensure data security and user privacy.

The SunVizion system was designed to serve networks built by local governments and is thus well equipped to handle such an assortment of stakeholders.

"Two years ago we started to develop a system version intended specifically for that market sector," said Suntech S.A. president Piotr Saczuk. "We can now offer a system that supports practically all tasks related to public networks inventory. Our solution integrates very well with intelligent transport systems and other technologies that support so-called smart cities."

SunVizion is devised to facilitate close cooperation and information sharing among the numerous entities managing and using a public broadband network. The system allows network managers to instantly see information about available network resources near a client's residence, which makes it easier to determine service options at the outset and, if a customer experiences issues, reduces the amount of time it takes to give a technical diagnosis.

"The SunVizion system allows hierarchical mapping of the entire network system, starting from the manhole and underground ducts and conduits system layer to optical fibers, inside plant resources, or even services," said Tomasz Zwinka, an inspector in the municipal office's IT department. "The SunVizion system has a friendly and intuitive interface and recognizes many data formats, allowing data to be imported and further processed."

SunVizion, which works with ArcGIS 10.3 for Server and utilizes a host of other Esri products, employs GIS for the spatial components of network management, including recording network elements. The system goes even further when a customer already uses the Esri platform because SunVizion can be integrated with the client's existing ArcGIS environment. All customers have to do is configure their feature classes and maps to appear in SunVizion and migrate selected geodata into the system's repository.

"It is not without significance that the management of all information about the physical and logical network structure, its configuration, status, and operation has been integrated within one system," continued Zwinka. "At present, a program of that kind is essential for proper management of network resources in the areas of network planning and extension, service configuration and performance, failure handling, etc."

Troubleshooting Broadband Issues

In the event of a device failure, the digital map of the network—displayed on a client's own system or on ArcGIS Online, complete with full data about the network—makes it easy to identify the location of the failure and shortens the time it takes to remove the device and fix or replace it. Using the geographic data for each device (which is collected along with its technical data), the system quickly defines the extent of the failure by showing which services—Internet and/or telephone—will be unavailable to clients in specific areas. Additionally, a swift analysis of the extent of the failure allows the system to localize the problem so it can be taken care of right away. At the same time, network operators are able to contact clients whose Internet or telephone connections were cut off and provide them with a complete picture of what happened and when they expect the failure to be remedied.

More Reliable Service

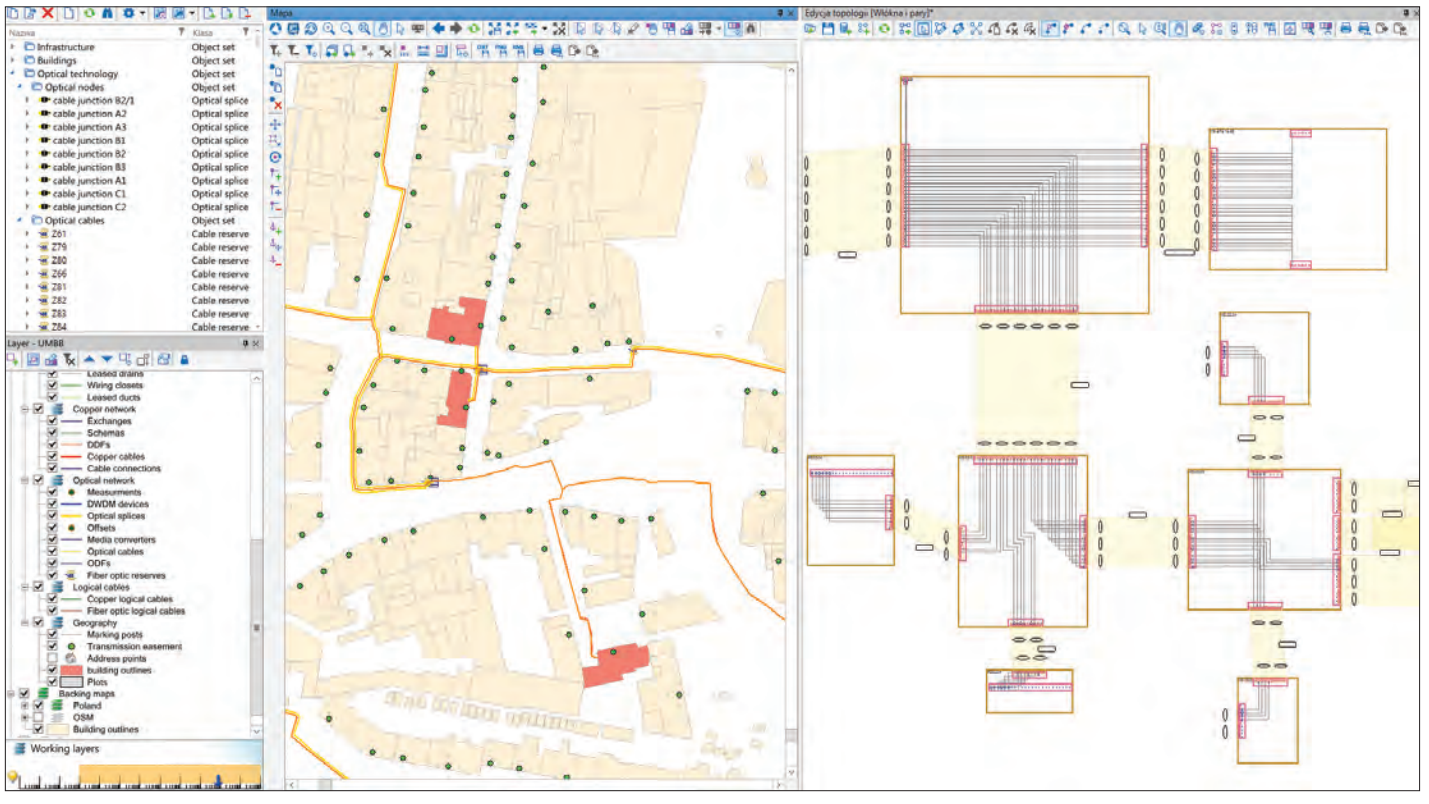
A network inventory system can be implemented in two ways: either after the network is built or when the network is under construction. Bielsko-Biala opted for the former, but in retrospect, it appears that the latter is better for the investor.

"Implementing the system at an early stage of the investment is much more favorable, as it allows *[clients]* to make use of the inventory already at the design stage," said Suntech S.A. project manager Marcin Milewski. "The data that is loaded continuously from design documentation makes it possible to monitor work progress. The system offers a global picture of the designed network and may serve as a tool for solving conflicts, if any, already at the design stage."

Specialists from the Bielsko-Biala municipal office confirm this view. But no matter when it is implemented, SunVizion streamlines service management, how device failures are handled, and general network maintenance.

In Bielsko-Biala, all entities engaged in operating the broadband network now have access to data with multiple levels of detail, but only within the rights assigned to them. This, plus accurate mapping of the entire system, not only makes it easier for regulators to prepare reports, but it also ensures faster and more reliable broadband service—which is exactly what the Digital Agenda for Europe is trying to do.

For more information, email Suntech S.A. business development director Radek Domurad at radek.domurad@suntech.pl.



↑ With SunVizion Network Inventory, which works with ArcGIS 10.3 for Server, all entities engaged in operating a broadband network have access to data with multiple levels of detail.

Smart Irrigation Helps Drought-Ridden California

In parched California, where water regulations have become stringent, public works departments are starting to map irrigation data to better evaluate water use.

The Fontana Public Works Department (FPWD) got a head start in gaining control over its water output thanks to a data hygiene project launched in 2007, when the department decided to take a fresh look at its citywide sprinkler network. FPWD corrected outdated sprinkler asset information to more accurately map its water use with GIS. Now, meticulous data on irrigation assets and visual representations of water use better inform the city's irrigation decisions.

Improving Foundational Data

Conserving civic water output entails knowing every sprinkler's performance. As Fontana's irrigation network expanded along with the city's green spaces, however, changes to city-owned sprinklers weren't always accurately recorded. With errors accumulating in the database, FPWD found it nearly impossible to get a sound picture of its water use.

FPWD's senior administrative analyst, Rogelio Matta, knew that the city could better understand civic irrigation if the department fixed its foundational information. So FPWD set on a course to improve its data.

For eight years, FPWD staff visited all the city's sprinkler meters, valves, and nozzles to record their associated information. Field staff entered that data into a model in ArcGIS for Server so it could be represented as layers in the department's maintenance management system, Lucity (an Esri Gold Tier partner), which is built specifically for public works.

"Lucity interfaces with ArcGIS for mapping our department data *[e.g., streets, fleets, parks]* and allows us to communicate tabular information visually," said Matta. "The visual element is key to the communication, since no decision maker has the time to pore over stacks of spreadsheets."

The department uses Lucity to generate work orders. The program also lets FPWD employees see the entire work history for each piece of the irrigation system on a map, making it easier to keep track of all asset maintenance activity.

A Billion Gallons

By 2014, FPWD had fixed all its sprinkler data. It now needed to determine the water output from each sprinkler zone to correct any overwatering issues.

To determine the amount of water needed for replenishment, the city accessed data from the California Department of Water Resources' California Irrigation Management Information System, a network of more than 145 automated weather stations in the state, to find the evapotranspiration rate (the rate at which dispensed water evaporates from a given space) for Fontana's particular climate.

"We have more than 24 million square feet of irrigated landscape that requires about 58 inches of precipitation annually," said Matta. "That's the equivalent of a billion gallons of water."

Controlling the pieces of the irrigation system to precisely sprinkle Fontana's greenscape would be key to not overwatering. Thus, FPWD used control devices—such as clocks that tell sprinklers how long to run and weather stations that regulate water output according to the day's temperature, humidity, and precipitation—to implement smart irrigation. Fontana has 480 automated sprinkler timers throughout the city that communicate with three weather stations.

"Flow sensors tell the computer how long the sprinklers should run," says Matta. "If it runs for longer than that, it sends back that information to the computer to alert technicians to investigate the problem and fix it."

Mapping the Metrics

With solid data, FPWD's GIS administrator, Joe Field, used ArcGIS for Server to map sprinkler information alongside the city's monthly water usage rate. Now, the department has a map of every civic sprinkler system in Fontana, with different colored dots denoting each sprinkler's output.

"If it's red, it's overwatering. If it's green, it's within target. If it's blue, it's underwatering," said Matta. "That was our goal from the beginning: reading the story of the systems without our eyes glazing over from all the numbers and decimals."

Field workers with tablets can view the maps of each assigned area and respond accordingly to what the dots tell them. With the live update capability of ArcGIS for Server, staff know that they're responding to the network's current condition rather than a situation that has worsened since the last update, which could have been taken weeks or months before.

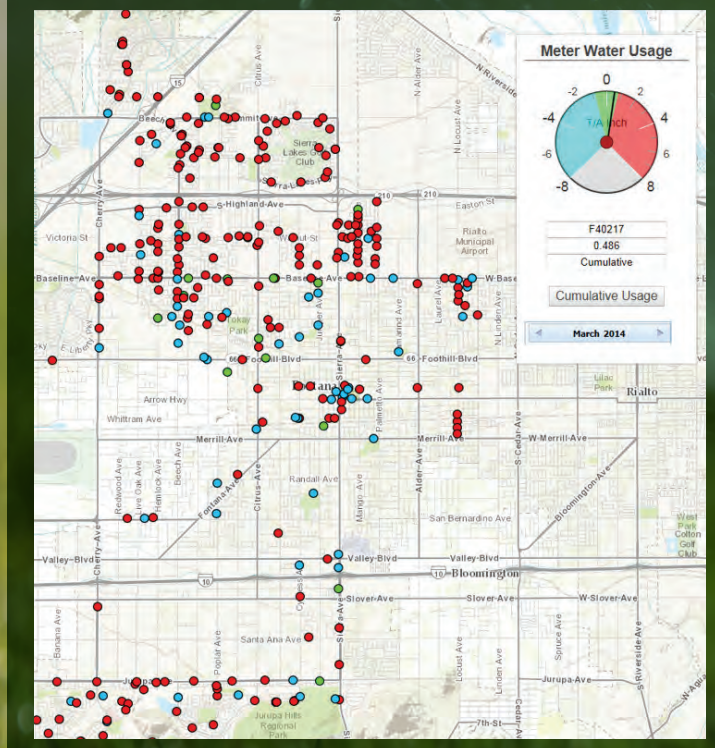
What's more, FPWD can easily compare its target water budget to actual consumption.

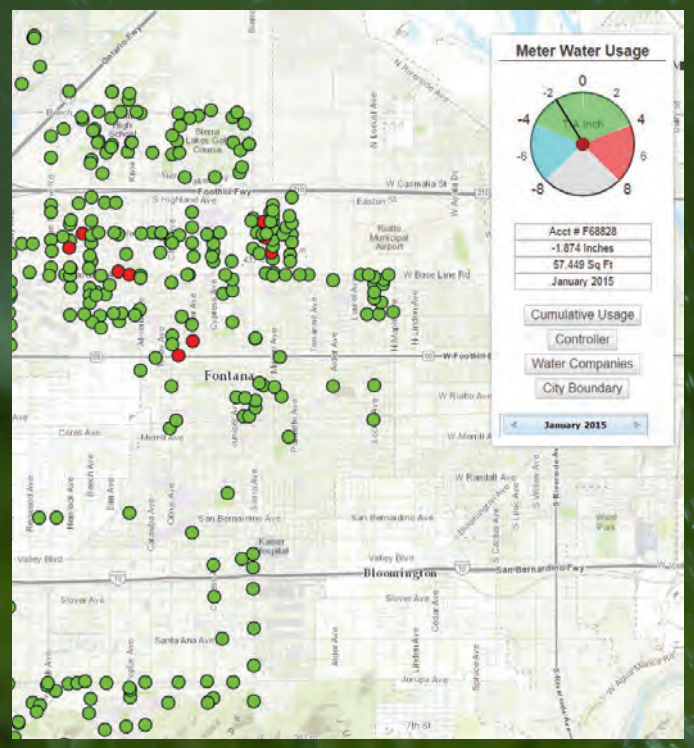
Empirical Returns

Visualization now translates Microsoft Excel tables into actionable information, saving the department water, time, and money—and helping it meet ever-tightening state regulations. Although FPWD is still calculating the total water reduction brought about by mapping its irrigation system, it has saved $200,000.

With experts predicting that the California drought will extend into the 2020s, water managers are getting their irrigation data in order. Once the information is cleaned up, GIS can—and does—help public works departments make sense of those datasets.

↓ Knowing every sprinkler's performance is key to curbing overwatering.





↑ Once the Fontana Public Works Department mapped out its sprinkler data, it could see which sprinklers were overwatering (red) and which ones were within budget (green). These two images show sprinkler data from before the mapping project began (left) and after it was completed (right).

GIS Speeds Water Service Restoration

The town of Queen Creek, Arizona, supplies water to more than 21,000 customers. Every month, the utilities department shuts off service to approximately 200 water customers whose accounts are past due to prompt them to pay their bills. To shut off the water, utilities employees place locks on the delinquent water meters until the customers pay their bills. When an account gets paid, a utilities employee removes the lock.

For seven years prior to 2014, the lockout process was done manually and was very labor intensive. So the town's GIS staff decided to improve the system by creating an interactive map that would enable the utilities staff to more easily access the information. Queen Creek's utility mapping and inspections supervisor, James Gardner, and its GIS coordinator, Shawny Ekadis, began by documenting the existing workflow and identifying the challenges that needed to be addressed.

↑ Field staff use iPads to stay informed of paid accounts in real time so they know when to lock and unlock meters.

A Disorderly Process

Meter lockout days were chaotic from the start. Up to 20 field staff members had to go to the municipal services building in the morning to pick up their lockout assignments, which were printed on work order forms and accompanied by paper maps. They then had to travel all over town, as assignments were based on the number of locks that had to be put on rather than geographic location.

Once customers' meters were locked, they had to call the utilities office to make their payments before they could get their meters unlocked. Work orders were then printed again to assign meter unlockings, and the field staff would have to return to the office multiple times throughout the afternoon to get these printouts; they then had to go back out into the field to complete the assignments. The customer service staff spent a lot of time on the phone contacting crews and supervisors while dealing with unhappy customers. The process took all day, and many customers waited hours to get their service restored.

Creating an Inclusive Solution

Working closely with employees from the utilities department, Gardner and Ekadis spent a great deal of time defining what the new workflow should be. The solution needed to accommodate both office and field staff and be accessible to anyone in the organization who might need the information. The town already had many useful resources that the GIS staff wanted to use, including water meter data, ArcGIS for Server, ArcGIS Online, ArcGIS Viewer for Flex, and iPads.

ArcGIS for Server made it possible to publish maps with real-time data showing the current status of accounts being locked and unlocked that day. The GIS team also set up ArcGIS Online accounts, which allowed field staff to view maps on iPads using the ArcGIS app for iPad. Since additional staff needed access to the data, the GIS team used ArcGIS Viewer for Flex to create a web mapping application for ArcGIS for Server. Queen Creek participates in Esri's Community Maps Program as well, so the basemap used in the utilities department's interactive map includes data that was submitted through the program.

With the foundations in place, Gardner and Ekadis rolled out the first map. They had utilities field staff test it and provide feedback, which helped them make improvements.

Smoother Sailing

The resultant map shows the location and status of each account to be locked. It is set up the night before so it is ready to use in the morning. All staff members can see the live status of each account throughout the day.

Customer service staff, who stay in the office, keep the map updated in ArcGIS Viewer for Flex. If an account gets paid overnight, it is recorded first thing in the morning so the customer does not lose water service. During the day, customer service staff update account statuses as customers pay their bills, which automatically updates the iPads. This keeps field staff informed of paid accounts in real time so they know when to unlock meters. It also curtails the customer service department's need to make multiple phone calls to field crews.

Field staff, who now total just seven, no longer have to come into the office on meter lockout days to get work orders and maps. What's more, they are assigned to specific geographic areas for lockouts, making them more efficient and allowing them to do other work in the field as well. They monitor their areas, and when they see that an account has been paid they unlock the meter without returning to the office for a second work order or waiting for a phone call from customer service staff. Supervisors also have access to the maps so they can oversee the process.

Lockouts are now completed in two hours and unlocks within 30 minutes of the account being paid.

"This has revolutionized the lockout process for the customers, front office staff, and field staff," said Queen Creek's utilities director, Paul Gardner. "Most importantly, we have taken what could be the customer's worst day and made it less stressful. We can now start the process after our customers get to work and school and then respond quickly after payment to minimize their shutoff time. In return, we save both time and money on our end."

An additional benefit of the map is that it allows staff to flag for follow-up any accounts that have not been paid to make sure customers do not go without water service. The utilities department also now has historical data that it can use to identify patterns so it can hone its customer outreach and education efforts.

The meter lockout map has been so successful that the GIS staff is looking at how to duplicate the process in other areas of administration.

For more information, contact Shawny Ekadis, GIS coordinator, Town of Queen Creek, at shawny.ekadis@queencreek.org.

Navigator for ArcGIS Helps Fieldworkers Be More Efficient

Many consumer navigation solutions can take people from point A to point B, but businesses and organizations need more than that. They require support for commercial workflows such as inspections, service and repair, and local parcel pickup and delivery.

That is why Esri developed Navigator for ArcGIS, a new app launched at the 2015 Esri User Conference that empowers entire organizations to become more efficient in the field.

Tailored to the Field

Navigator is designed for people who work in the field: service technicians, rig operators, utility inspectors, and others. The app allows users to work even while disconnected, use their own data, and integrate with other apps. It also, of course, finds the best possible route for getting from one location to another, based on many factors not considered by standard routing apps.

Workers in the field can access directions on Navigator anytime, even when disconnected from wireless Internet or cellular service. What's more, staff can do this from devices they probably already have in their purses or pockets—their smartphones—instead of carrying a second device for GPS.

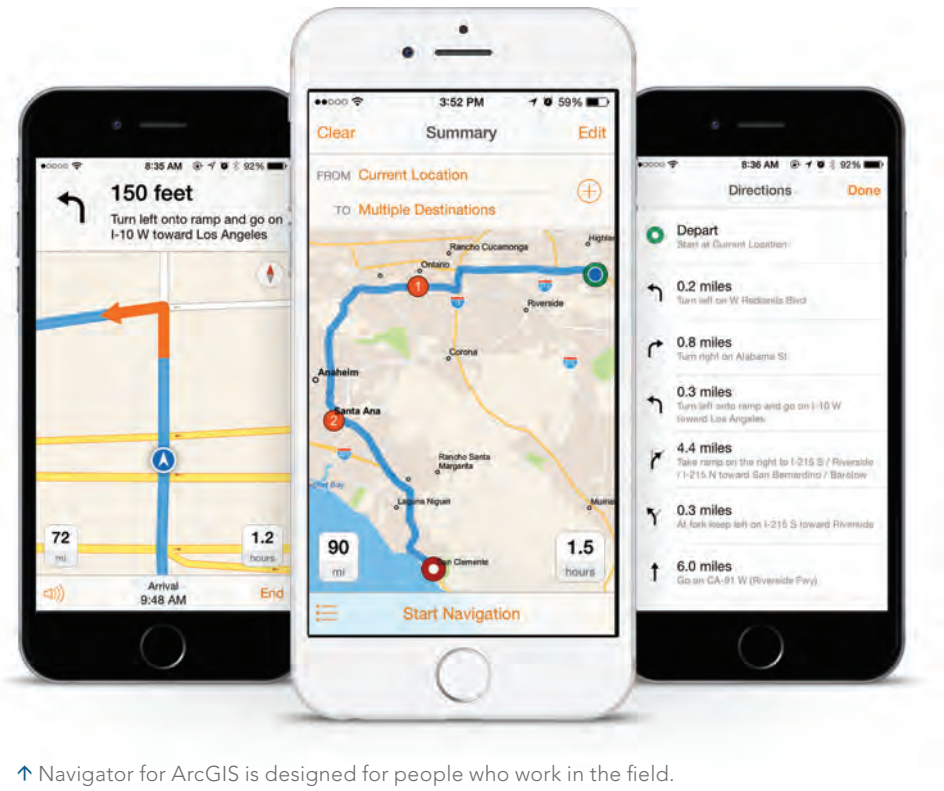
Navigator goes well beyond basic routing. The app includes commercial street data for the whole world, which users can enhance or replace with custom street network data. Thus, workers can navigate street networks that are not available from any commercial data vendor—something that is especially useful when managing assets such as oil wells, forest stands, and utility poles.

Users can search and visualize their organization's own asset and location data as well. For example, instead of going to a street address and looking around for the right fire hydrant, field staff can simply search "Fire Hydrant 126" and be directed to its precise location.

Another routing feature is vehicle mode. Users can specify what they are driving—a truck, a car, or even an emergency vehicle—and Navigator will calculate the most efficient route depending on the vehicle's road capability, height, weight, and curb-approach guidelines.

Navigator works seamlessly with other ArcGIS apps as well. Field staff can start Navigator from Collector for ArcGIS or Explorer for ArcGIS. It also works with other business apps via a simple URL scheme, which allows users to launch Navigator automatically by clicking an external link.

Once Navigator is open, field staff can access tasks created for them in other apps and see a list of all the stops they have to make. They can also plan ahead by creating a work list of all their stops for a given day. Navigator runs on all types of devices, too, from smartphones to rugged tablets.



↑ Navigator for ArcGIS is designed for people who work in the field.

Major Benefits

Navigator helps commercial organizations save money while improving performance and reliability.

When field crews have more efficient navigation, they reduce mileage and travel time. This gives them more time to perform their duties in the field. Drivers can also focus on driving rather than navigation, which decreases the risk of traffic accidents.

Organizations can also use Navigator to get more from the data they already have, which improves performance. Most companies make investments to ensure that data is accessible, accurate, and up to date. Navigator taps into the ArcGIS platform to access this authoritative data—whether provided by Esri or the organization itself—and makes it accessible to everyone. This equips field crews with the newest and best information so they can make smarter, faster decisions.

Navigator is designed to help field crews operate more quickly, be more punctual, and miss fewer appointments. These advances in operations lead to greater reliability and consistency, which, in turn, build trust and boost customer confidence.

Navigation as a Platform Capability

Navigator delivers navigation as a platform capability and a mobile solution. When an organization adds navigation to its mobile workforce applications, it extends the power of the ArcGIS platform from planning through execution and unlocks efficiency in the field.

Taking GIS to Great Depths with Full Motion Video

By Sarah Franklin and Dustin J. Myers, CSA Ocean Sciences Inc.

Marine scientists used to spend weeks or months in the field conducting surveys and mapping and imaging the seafloor—not to mention the time it took to distill, merge, and analyze datasets. Today, however, new video technology provides an easier way to survey and analyze large or previously inaccessible areas. Using the ArcGIS Full Motion Video add-in, marine scientists at CSA Ocean Sciences Inc., a marine environmental consulting firm and an Esri Silver Tier partner, integrate biological inventories with video imagery and location information to quickly and accurately appraise fish, coral reefs, ocean pipelines, and other marine features.

Synchronizing Video and Navigation

Full motion video (FMV) covers vast spaces efficiently and improves the accuracy of species and habitat identification. Not only can videos be paused and rewound, but unlike older technologies in which static time, latitude, and longitude were burned into the digital image, GIS also automatically provides the spatial and temporal information associated with the video.

Marine video data can be collected in a number of ways. For deepwater habitats, CSA combs the ocean floor using remotely operated vehicles (ROVs) controlled by scientists on support vessels, since ROVs can reach far greater depths and stay submerged longer than human divers. For subsea features in relatively shallow water, such as pipelines and coral reefs, CSA does have divers carry cameras or mounts cameras and imaging systems to the hulls of support boats and other underwater equipment. For shallow habitats and surface features, such as shorelines and coastal wetlands, CSA uses unmanned aerial vehicles to collect aerial images of the areas.

With all these methods, navigation is recorded at the same time as the video—either by a separate GPS device or using software within the camera. Navigation can be synchronized with the video during postprocessing back in the office or in real time in the field using special video-encoding hardware, which produces full motion video that's immediately compatible with the ArcGIS Full Motion Video add-in. Users can then view the video track line and digitize geographic features as the video plays.

Digitizing Features Made Easy

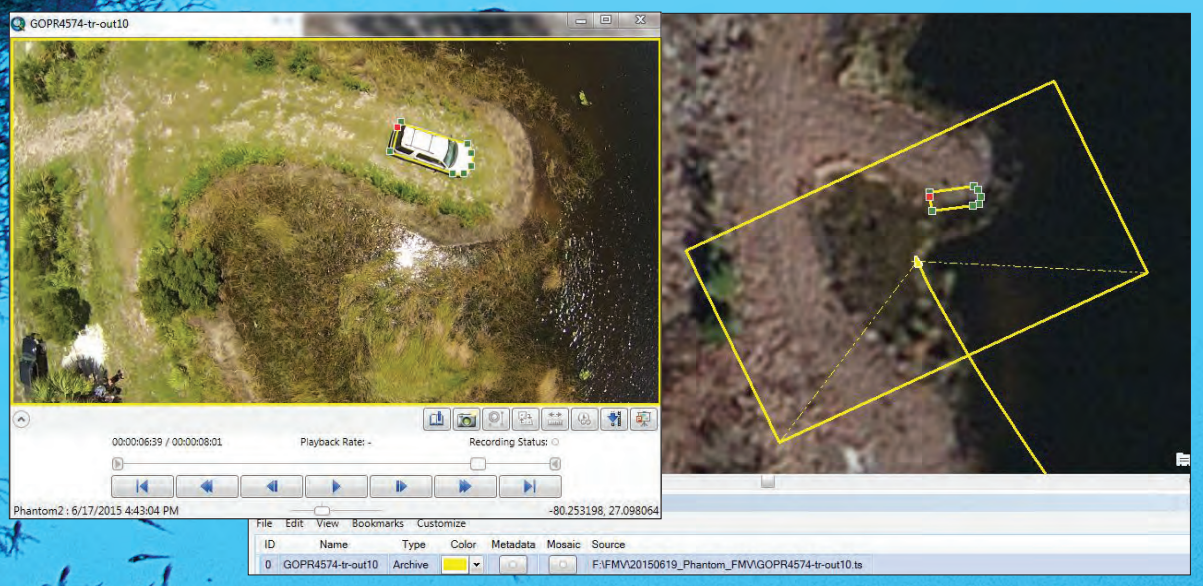
With minimal training in geospatial analysis, people with no previous experience in GIS can easily use ArcGIS Full Motion Video.

GIS analysts at CSA developed feature templates in ArcGIS for Desktop that scientists use to conduct detailed fish counts, map habitats, and classify submarine flora and fauna. These feature templates include drop-down lists that ensure data is recorded consistently.

When marine scientists return with a survey video, if the navigation data still needs to be synchronized, they use an FMV converter package that CSA developed to automatically integrate video and navigation data for use with ArcGIS for Desktop and ArcGIS Full Motion Video. The package lets users do batch calculations on the navigation data, inject the spatial information into the videos, and export a product that's ready for ArcGIS Full Motion Video.

Underwater video is often recorded continuously, so it can be cumbersome to pinpoint relevant sections of the video for analysis. To help scientists quickly find important locations, such as the start or end points for a survey, CSA's FMV converter package also creates bookmarks using point locations that are either provided ahead of time by GIS staff or collected in the field and matched to the navigation data. Linking the video to these navigational bookmarks helps scientists select a specific point of interest and view video track lines in relation to those points using ArcGIS for Desktop.

For each survey, GIS analysts create a map document and load the videos into ArcGIS Full Motion Video, along with the feature templates for each feature being surveyed, such as fish or coral species. Using ArcGIS for



↑ Users can trace objects in a video, such as this SUV, so they appear as polygons in ArcGIS for Desktop (as on the right). Using the yellow field of view bounding box, users gain a better understanding of the geographic scale of their videos.

Desktop, scientists with minimal GIS training can manually digitize data in real time as the video records or later using video playback, immediately creating a geospatial dataset with an attribute table.

To do this, scientists open the map document and play the video in ArcGIS Full Motion Video. As the video plays, a locational pointer traces the camera's path in ArcGIS for Desktop. A track line showing the camera's trajectory is automatically drawn in the map document, allowing users to clearly see the camera's path. Background features, such as imagery, bathymetry (water depth), and survey points, can be loaded into the map document to aid in orientation, analysis, and visualization. At this point, users can begin an editing session. They then use feature templates to digitize features—such as submarine cables, fish and coral species, ocean bottom types, shoreline shape, and coastal habitat types—by clicking in the video window or on the map document to record feature locations.

Evaluating Video Scale

A significant challenge of traditional full motion video analysis is that it is difficult to estimate the scale of the video. Without accurate measurements of the camera's field of view, the extent of quantitative analysis that can be conducted (such as feature density and video coverage area) is limited.

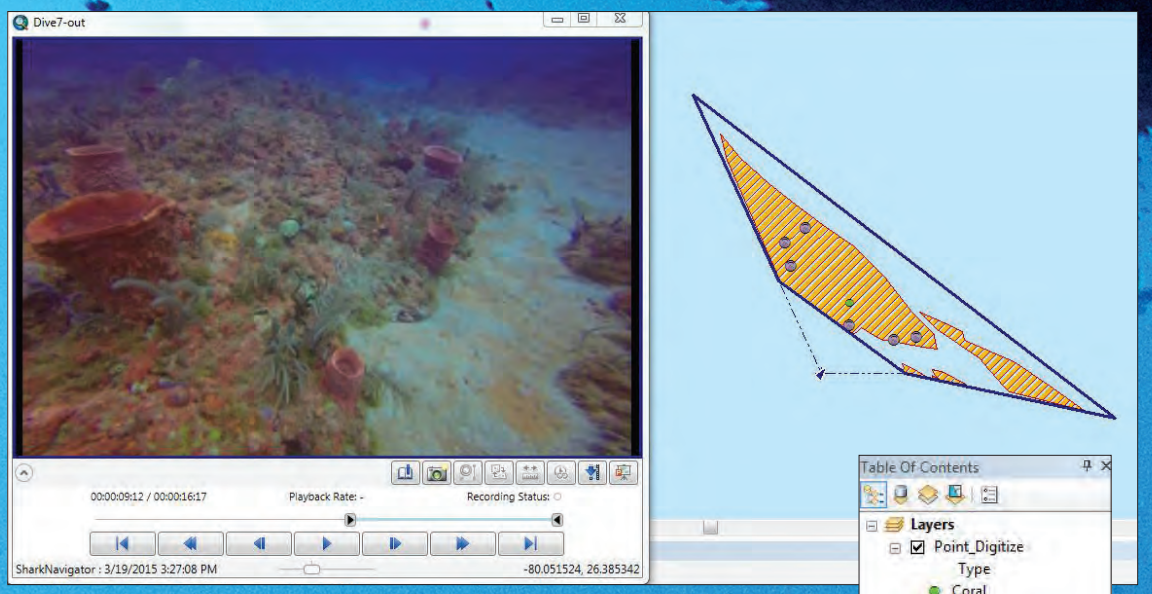
To address this issue, CSA utilizes an upgrade it created for the FMV converter package for ground-projected instantaneous field of view, which provides users with a continuous guide to the scale and orientation of the video image. This is an advanced component of the FMV converter package that can be used with video encoders in the field or during postprocessing in the office. Its custom algorithm calculates the size of the camera's field of view and inserts the result into the navigation file before it is embedded in the video. When the encoded video is played with ArcGIS Full Motion Video, a box is displayed on the image representing the camera's field of view. The box dynamically changes as the camera's angle and location change, so the field of view can be calculated for each video frame. The field of view bounding box can be overlaid onto any ArcMap feature, such as multibeam bathymetry, satellite imagery, survey points, or infrastructure features. Additionally, users can estimate the accuracy of the bounding box by comparing bounding box coordinates to measurements of known physical features in the survey area or an intentionally inserted object whose dimensions are known.

With this understanding of field of view, users can make advanced calculations of survey areas and observed features using ArcGIS for Desktop, Portal for ArcGIS, ArcGIS Online, and other mapping applications. To CSA's scientists, this approach has been useful for evaluating fish density in both shallow and deep-water coral reef habitats, assessing the integrity of underwater pipelines, and classifying different kinds of reefs and types of ocean floor.

The Virtues of Technological Integration

The integration of video technology, GIS, and custom programming provides marine scientists with the opportunity to observe and analyze the benthic environment in ways that were previously impractical. ArcGIS technology—especially the ArcGIS Full Motion Video add-in—provides exciting opportunities for marine scientists to collect, visualize, and efficiently analyze environmental data and reduces the need for postsurvey data entry.

For more information, visit csaocean.com or contact Sarah Franklin, geospatial coordinator at CSA Ocean Sciences Inc., at 772-403-6098 or sfranklin@conshelf.com.



↑ In this full motion video, playing in ArcGIS 10.3.1 for Desktop, the field of view of the camera is shown by the dark blue trapezoid on the right. Users can click inside the video to digitize species and habitat types, which appear as points in the screen on the right.

Harvard Integrates 3D Campus Maps with ArcGIS

Visualizing, Analyzing, and Sharing

By Parvaneh Kossari, Harvard University, and Jan Halatsch, SmarterBetterCities

Harvard University has several campuses in Cambridge, Massachusetts, and the neighboring city of Boston, plus footprints around the state and in multiple international locations. In total, Harvard manages 660 buildings that give its 21,000 students and more than 16,000 faculty and staff access to the university's renowned working environments.

To provide useful visualizations of the campuses, Harvard Planning and Project Management (HPPM) has used 3D for more than 18 years in conjunction with 2D maps. Initially, HPPM modeled buildings individually in great detail, relying on existing 2D computer-aided design (CAD) where it was already available. This was tedious and expensive work. Despite their complexity, these models were used for scenario visualization and decision making but weren't adequate for conducting 3D spatial analysis, which is critical for exploring interdependencies between built structures to conduct energy planning or perform impact analyses of potential new buildings and remodeling projects. Harvard also wanted to make all this generally accessible online.

As Harvard's campuses continue to develop, creating a GIS-generated 3D map was crucial.

Incorporating Geographic Context

While 2D campus maps are typically limited to representing land-use zones, building locations, facilities, and transportation networks, 3D maps connect individual buildings with geographic context. Suddenly, a building or even an individual room can become more than a singular component of a campus inventory.

A constantly updated and evolving 3D campus map can be used for integrated and interdisciplinary planning and management. The metadata in a 3D map allows databases to be viewed in diverse ways: Planners or managers can see recent campus projects and assets, staff and students can easily find campus locations, and the vice president for finance can produce fiscal reports.

Fortunately, over the last three years, many of the technical challenges of making 3D maps have ebbed significantly as GIS software and computer hardware have evolved. 3D content is no longer limited to desktop computers, as smartphones and tablets can display beautiful 3D maps just about anywhere. And converting 3D CAD data into geodatabases has become much less time-consuming.

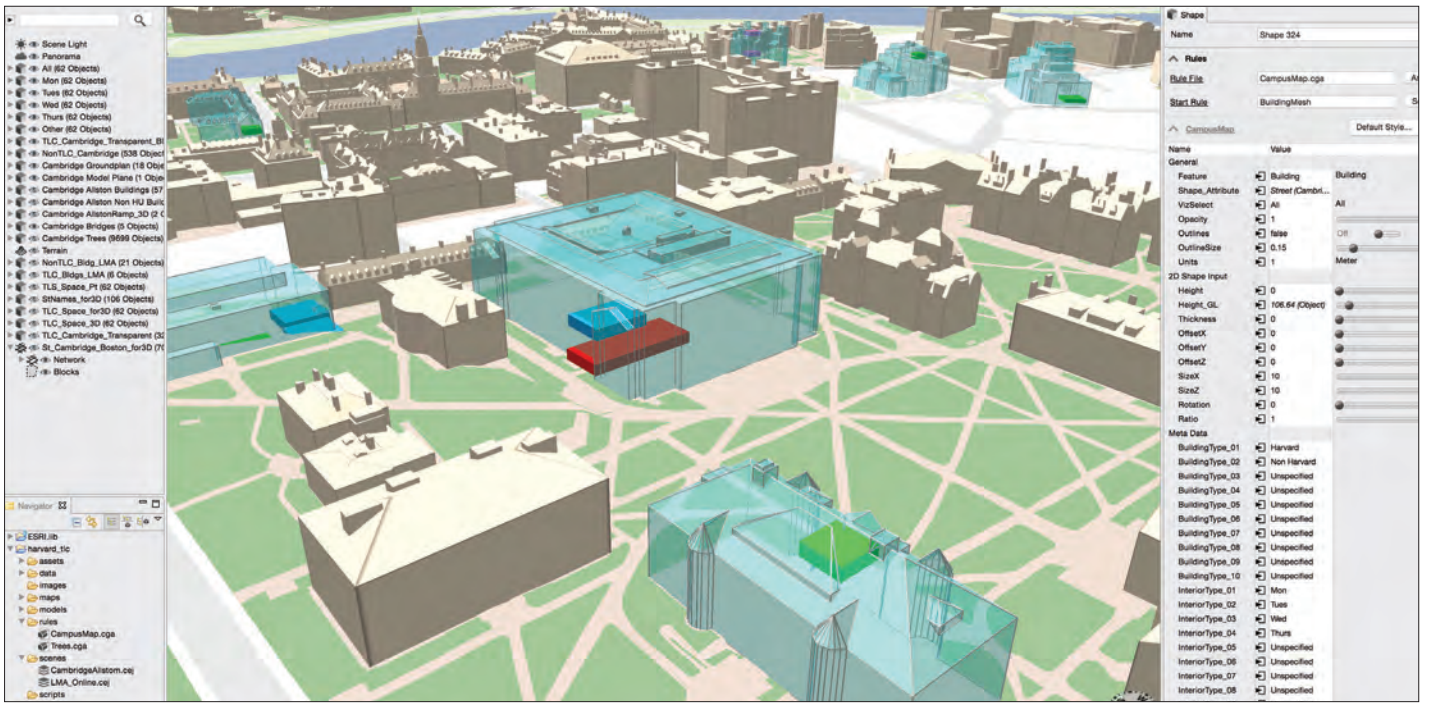
These technological strides make 3D cartography an indispensable tool for carrying out important tasks.

Building a Sustainable Digital Workflow

Given the number of campus buildings at Harvard, HPPM needed to create an integrated workflow.

To reduce the time it took to convert 3D CAD data into geodatabases, the department implemented Esri Silver Tier partner Safe Software's FME data integration solution to convert non-GIS files into the Harvard University 3D GIS database. But the file sizes for detailed converted 3D CAD models can get very large,

↑ Harvard University's 3D campus maps are shared online using CloudCities, an online 3D web sharing service from SmarterBetterCities built on top of ArcGIS technology.



↑ After 3D models from CAD or photogrammetry are prepared, the data is imported and formatted using Esri CityEngine.

which renders it impossible to work with on a campus-wide scale and also makes it infeasible to stream 3D data, meaning that conducting even simple 3D spatial analysis would fail. So Harvard looked for alternatives.

HPPM conducts flyovers of Harvard's campuses every other year to produce high-resolution stereo aerial photography to make it easier to track changes on campus. This type of input data is ideal for building lightweight 3D models, so Harvard worked with Esri Silver Tier partner CyberCity 3D to use this imagery to create the 3D models of Harvard buildings. These new 3D models replaced the detailed models. HPPM then incorporated the 3D buildings into a high-resolution terrain model so that planners and architects could make good use of the map.

To colorize and unify the 3D data, HPPM used Esri CityEngine, which efficiently brings together different data sources and makes it easy to fine-tune the 3D model data.

Some individual building models had to be split according to ownership, building name, and street address to discern which sections of a building are part of Harvard and which aren't, since Harvard shares real estate with Cambridge and Boston. The buildings needed to be aligned with the terrain data as well, which can be time-consuming. Harvard worked with Esri emerging partner SmarterBetterCities to optimize the 3D campus model by giving it a Harvard look and making it even more lightweight. SmarterBetterCities used CityEngine rule packages to provide custom map symbologies, which makes it easy for Harvard to maintain and edit elements of the campus model.

The campus models were exported as a geodatabase. Using ArcScene and ArcGIS Pro, HPPM can easily process 3D data; perform common operations, such as unifying projections; and implement additional attributes from other resources, including Microsoft Excel tables.

At last, Harvard had a lightweight, campus-scale 3D model that could be used for 3D spatial analysis as well as new-use case studies, such as climate change investigations, plotting new development scenarios, designing novel campus lighting projects, visualizing bike routes, and coming up with detailed vegetation plans.

Sharing the 3D Map

Completion of Harvard's 3D campus model gave rise to the next logical step: sharing 3D models with the public via the Internet.

Stepping into the online world required a reliable 3D hosting service to ensure a great user experience, so Harvard used SmarterBetterCities' CloudCities, an online 3D web sharing service for cities that is built on top of ArcGIS technology, including CityEngine. It allows users to easily upload 3D models and embed them into a website. Additionally, ArcGIS Online users can directly access their content on CloudCities and share data on smartphones, tablets, and computers without installing software.

Integrating Interior Details

3D models could become important prototypes for novel workflows that bridge the gap between GIS and computer-aided architectural design (CAAD). They could help launch applications, such as indoor navigation or that manage smart metering devices.

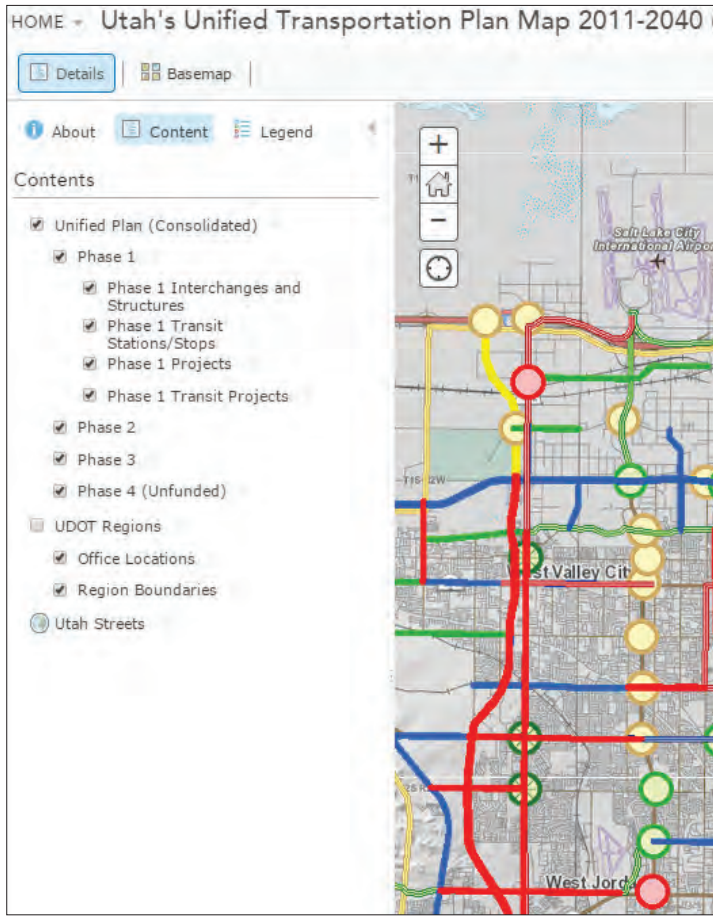
As an early demonstration of this, Harvard and SmarterBetterCities created a room-finding web application for the 3D campus map. More than 60 learning and teaching spaces were plotted on the campus map and made available to the Harvard community as a 3D web application during Harvard's Learning Spaces Week in early June 2015. Even though most event participants were not familiar with GIS, many of them found the application easy to use and valuable.

For the next phase of the 3D campus map, Harvard is working with Esri and SmarterBetterCities to develop a more advanced interior model that includes rooms, stairways, elevators, and building systems.

For more information about 3D campus planning, email Parvaneh Kossari at parvaneh_kossari@harvard.edu. To learn more about Esri-based 3D web GIS solutions, email Jan Halatsch at halatsch@smarterbettercities.com.

Putting Utah's Transportation Data Online

UPLAN Provides Model for US DOTs



→ A web map in UPLAN displays phase-based, long-term plans for Utah's roads and highways.

The Utah Department of Transportation (UDOT) uses ArcGIS Online to power UPLAN, an interactive mapping platform that includes information about the state's unified transportation plan, pavement management, safety and crash analysis, bridge locations, bike lanes, mileposts, and more.

UDOT needed a mapping solution for a long time. The department manages 5,800 miles of roads and highways with goals to reduce crashes, injuries, and fatalities (to zero if possible); preserve transportation infrastructure through proactive investments; and optimize mobility across the state via innovative designs.

This work requires access to extensive amounts of data: traffic volumes, accident statistics, pavement conditions, and much, much more. But for years, data was isolated so that only some UDOT employees could see it.

"We didn't know how to get at it," UDOT planning director John Thomas said.

Spatial data for projects wasn't always on maps either. At meetings, engineers devoted a lot of time to describing spatial information.

"We would spend half the conversation trying to describe a location and issue when a simple map would allow the discussion to address the issues at hand much more effectively," Thomas said.

After several attempts to devise mapping solutions of its own, UDOT turned to Esri and ArcGIS Online to provide exactly what the department needed: a browser-based GIS application that fostered organization-wide access to data-driven map viewers published as web services.

"It was a perfect match," Thomas said. "UDOT had the business need, and Esri had the software."

Transformed by Maps

UDOT had used Esri software before, but ArcGIS Online was transformational. The service enabled UDOT to publish maps, tools, and apps to its internal website. Non-GIS staff across the agency could view and analyze data intuitively on user-friendly maps. Collaboration spread throughout UDOT as employees began embedding maps in websites and putting them on mobile devices. Anyone who needed data could access, query, analyze, and edit it via ArcGIS.

UDOT was also an early adopter of Esri Maps for Office, which let users quickly build maps in Microsoft Excel. Employees published these maps as live web maps, which could also be integrated with other web services. Staff used these in presentations, emails, and Microsoft SharePoint. The web maps were updated every night, so staff knew the information was current.

In a perpetuating cycle, employees began to want more information. With ArcGIS Online, they could access groups of content related to road planning, asset management, and more critical roads and highway information. UDOT also started sharing its visual data with partners, who could use the maps themselves.

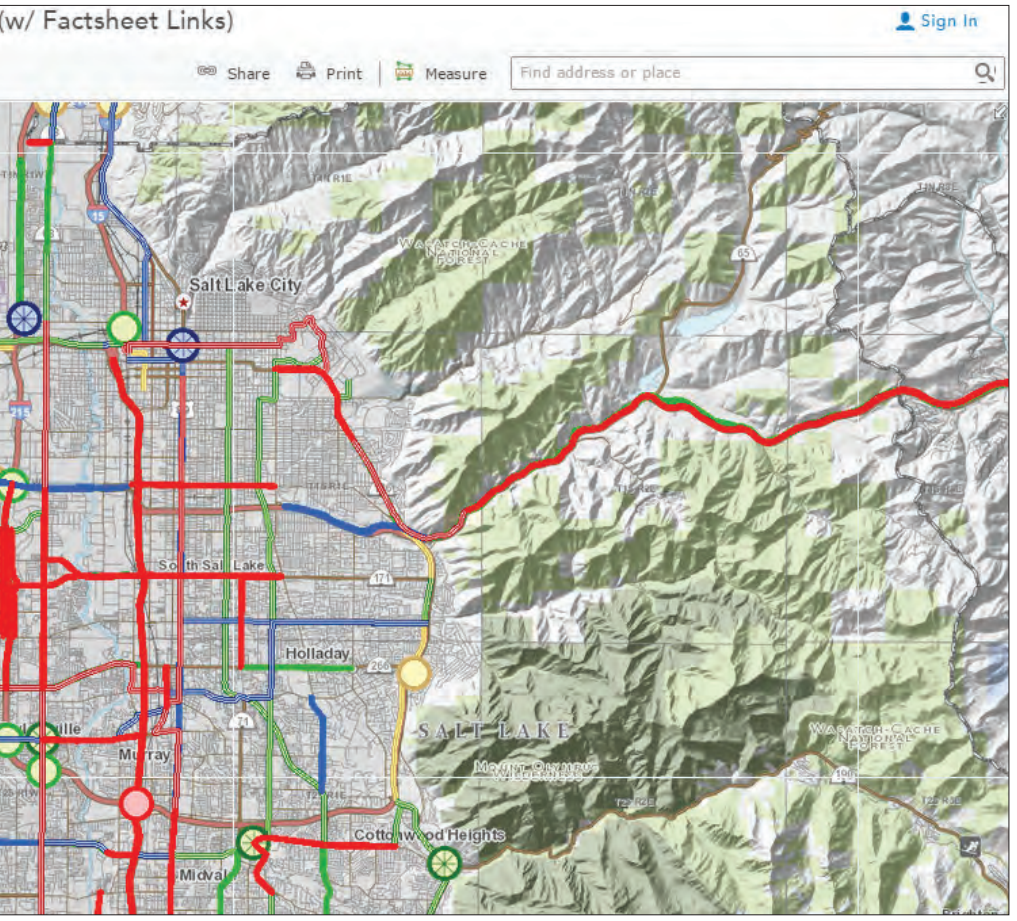
Staff became more productive at meetings, and projects took less time and money. UDOT used ArcGIS Online to identify potential rail-line corridors in a 200-mile-by-200-mile study area in parts of three states. Using ArcGIS Online, the agency developed 26 corridors, totaling more than 4,000 miles. Screening the 26 alternatives for engineering and environmental feasibility took just two months, at a cost of only $400,000.

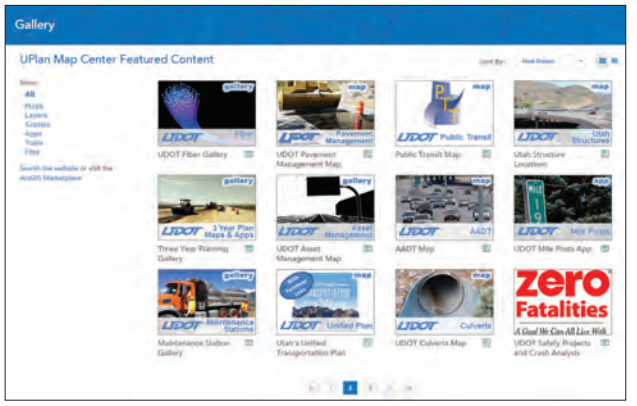
"If UDOT had done that before ArcGIS Online, it would have taken at least three years and several million dollars to do the same work," said Thomas.

By helping UDOT understand where and what assets—such as signs, pavement markings, and rumble strips—are in its system, UPLAN supports decision making at all levels. UDOT managers bookmark UPLAN to access their most-referenced maps. There is seldom a meeting without a live web map, which can be pulled up on any employee's device. Gone are the spreadsheets and poster boards the GIS department used to supply for meetings. Now, everyone expects a web map. UPLAN also uses a single web map to provide access to its phase-based, long-term planning for Utah's roads and highways.

Regulatory agencies and UDOT have started to share more information earlier in the process as well. UDOT can produce environmental impact reports in minutes instead of several weeks or months. UDOT's relationships with federal and state permitting agencies became stronger as information sharing among the agencies created greater transparency during reviews.

Additionally, residents of the state can view some UPLAN maps on the UDOT website. They can find live, mapped access to weather conditions, safety information, and planned road construction projects. The maps foster a greater level of engagement, trust, and involvement between UDOT and the public, as well as regulators.





← The Utah Department of Transportation (UDOT) uses ArcGIS Online to share maps with the public and officials.

← Maps are organized in UPLAN using groups, such as UDOT Asset Management and UDOT Enterprise Content.

One DOT at a Time

Thomas quickly realized that UPLAN was unique, though it shouldn't be.

"Transportation doesn't stop at the border," he said.

The United States has never had a federally supported, collaborative framework to view and interpret its entire national road system, and most state departments of transportation have not been equipped with systems like UPLAN, which shocked some officials. Yet transportation is critical infrastructure. Roads and highways are the pulse of the national economy, and optimizing the transportation system improves quality of life. Departments of transportation often get asked for information related to the federal highway system at congressional hearings—but the data isn't readily available.

So Thomas contacted the American Association of State Highway and Transportation Officials (AASHTO), which circulates technological best practices among departments of transportation through its AASHTO Innovation Initiative. Before long, he started forming a passionate team with goals to share Utah's experiences with other states and learn best practices from those states.

Thomas's main questions were critical: How do we share information within our state? How do states collaborate with each other? Does a tool like UPLAN help with a national view that supports US DOT goals?

With AASHTO's help promoting cutting-edge technology, best practices, and implementation tools, Thomas, Esri's Terry Bills, AASHTO Innovation Initiative consultant Monica Worth, and others, set out to get each state to develop its own ArcGIS Online system. Esri supported the AASHTO Innovation Initiative by providing a one-year free license of ArcGIS Online to participating states.

The team deployed ArcGIS Online at each state's department of transportation, often working long and late hours to get to every state quickly. By the end of 2014, 30 departments of transportation across the United States had begun to launch their own versions of UPLAN.

"There has been a lot of interest by states to implement a tool that helps use their information to learn more about their transportation systems," Thomas said.

The initiative is rolling out state-by-state and, so far, includes Minnesota, North Carolina, and Pennsylvania.

"It's just kind of everybody talking to each other and understanding each other better," Worth said. "That's a demonstration of a really good use of the taxpayers' dollar to bring information to the public."

Integrating Severe Weather Data Helps Manage Snow Removal

By Matthew Balling, AICP, New York State Department of Transportation

Buffalo, New York, gets snow—and lots of it. Last winter, a number of surrounding areas—including parts of Erie, Niagara, Chautauqua, and Cattaraugus counties—were pummeled by lake-effect snowfalls.

During a snowstorm, Region 5 of the New York State Department of Transportation (NYSDOT) is responsible for maintaining 3,675 lane miles (length plus number of lanes) of highway used by commuters, freight haulers, and emergency responders in western New York. To do this, NYSDOT snowplow operators clear the roads on their assigned snow and ice beats while emergency managers use GIS in the background to help predict where the storm is going to make the biggest impact.

With assistance from the National Weather Service, the NYSDOT Emergency Operations Center developed two ArcGIS software-based map applications in January 2015 to help emergency managers better respond to severe snowfall events. To achieve more encompassing situational awareness, practitioners wanted to create reliable snowfall forecast maps that could be analyzed using GIS to predict a storm's impact on the transportation network.

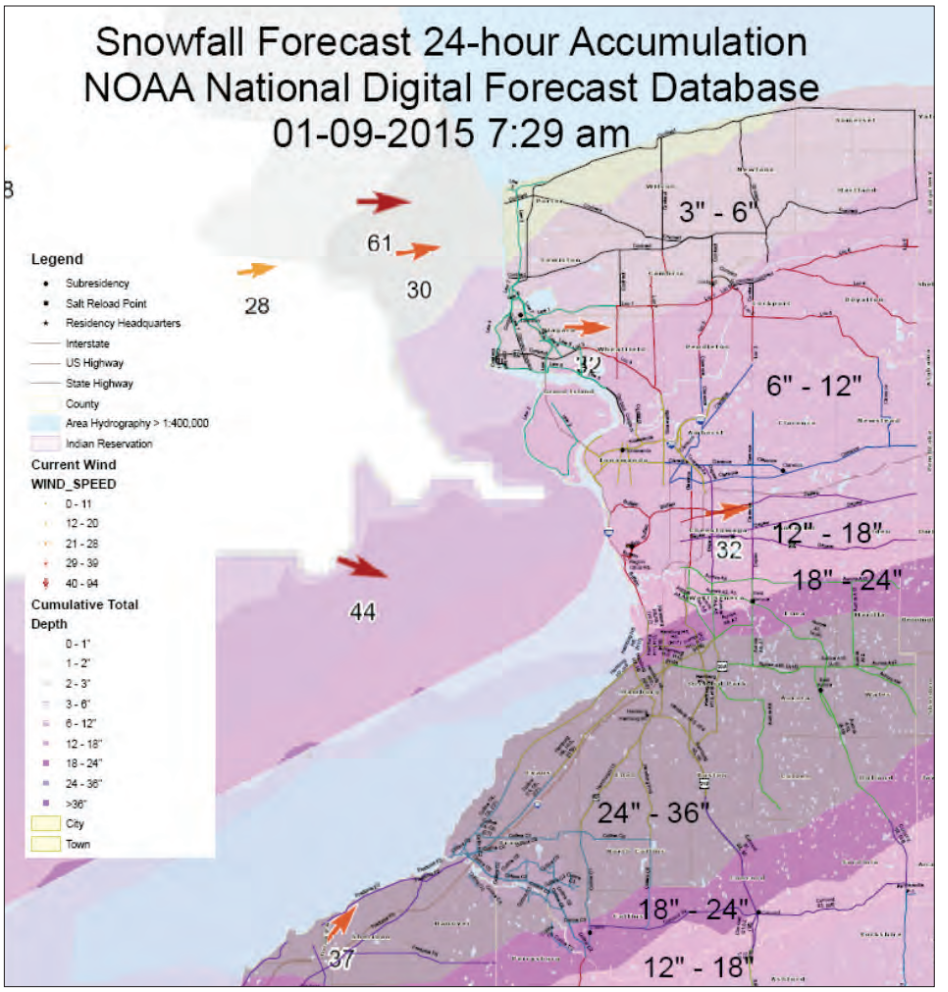
Getting Accurate Snowfall Forecasts

Finding reliable sources of snowfall forecast data was challenging. NYSDOT does not maintain or generate weather forecasting data or mapping, so researchers at the department explored the data and tools available on ArcGIS Online to see what they could find.

The group quickly discovered that users affiliated with Esri generate a number of mapping products available to the ArcGIS Online user community. One of the maps NYSDOT discovered was the Severe Weather Web Map, which contains information from the National Weather Service.

According to federal policy, the National Weather Service is required to provide a diverse suite of products and services derived from its digital forecast databases. To get the most accurate and up-to-date snowfall forecasts, the National Weather Service uses its National Digital Forecast Database (NDFD), which collects weather data 24 hours a day from field stations across North America. The NDFD makes its weather observations, forecasts, and warnings available to the public via databases that can be converted into maps, graphics, and GPS points.

↓ Cumulative snowfall maps show projected cumulative snowfall, wind direction and speed, maintenance areas, and plow routes.



NYSDOT ended up consulting with the National Weather Service's Buffalo field office, which recommended using the Severe Weather Web Map for its mapping applications. The map uses NDFD gridded raster data in KML format to show predicted snowfall, so NYSDOT implemented it as its basemap in ArcMap. A critical step was being able to convert the data from KML into layers using the KML To Layer tool in ArcGIS for Desktop, which allowed NYSDOT to adjust the symbology and further refine the weather data.

Engaging Framework Data

NYSDOT also has GIS framework data that consists of various feature classes for highways, capital assets, community facilities, and natural landforms. The highway network data, symbolized as lines, documents all the highways NYSDOT is responsible for maintaining. DOT storage facilities that house plowing equipment, salt, liquid deicing agents, and fuel are represented as point feature classes. The framework data displays the maintenance boundaries for each NYSDOT office as well, and Region 5 has GIS data that shows the highway routes traversed by specific plow drivers.

The initial purpose of developing this framework data was to create operational maps for snow and ice removal. However, the NYSDOT researchers repurposed it to figure out which DOT facilities and plow routes could be most impacted by a severe snowfall event. Combined with the GIS data for predicted snowfall, NYSDOT could understand the magnitude of expected conditions, as well as the spatial context needed to begin planning snow removal.

Two Advantageous Maps

After the NDFD and NYSDOT GIS framework data was incorporated into ArcGIS Online, the department created two map layouts that the Emergency Operations Center can activate for severe snowfall response. The 72-Hour Cumulative Snowfall Map, which is updated every 12 hours during events to help plan for upcoming operational periods, displays the predicted snow accumulation in the area plus the parts of the transportation network and locations of NYSDOT facilities expected to be most affected. The 6-Hour Snowfall Forecast Map goes a step further, displaying the forecasted snowfall amounts in 6-hour increments. This allows NYSDOT to estimate the predicted rate of snowfall per hour.

Using these maps—which are printed and posted on the walls of the Emergency Operations Center and emailed in PDF form to affected DOT offices—emergency managers can keep emergency responders well informed about potential conditions. Managers can also identify areas where a storm may have the greatest impact on transportation so they can allocate NYSDOT resources there for a specified amount of time.

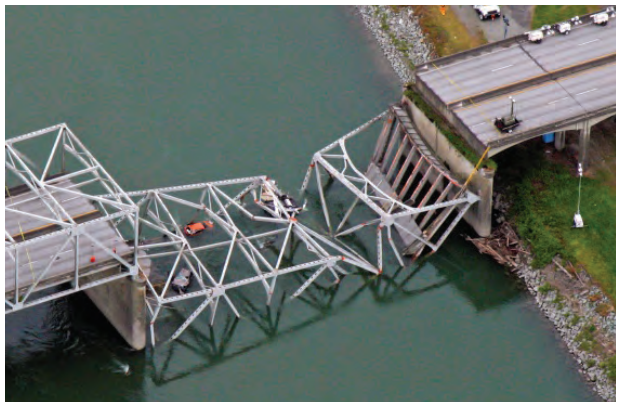
For more information, contact Matthew Balling, NYSDOT Region 5 transportation analyst, at matthew.balling@dot.ny.gov.

Truck Drivers Go Digital

Steering Clear of Low Bridges Using Web Maps

By Dani Huston-Brown, Washington State Department of Transportation

In May 2013, just outside Mt. Vernon, Washington, a semitruck with an overheight load 15 feet, 11 inches tall struck the trusses of the Skagit River Bridge, causing part of the bridge to collapse into the water. The truck was traveling in the bridge's outside lane, which, at the edge, only had a vertical clearance of 15 feet, 6 inches. The inside lane, however, had a clearance of 18 feet.



↑ Part of the Skagit River Bridge collapsed when a tall semitruck, driving in the wrong lane, struck its trusses.

While the strike was not due to lack of signage or erroneous data, the National Transportation Safety Board recommended that the Washington State Department of Transportation (WSDOT) create a way for the public to have better access to its vertical clearance data through GIS. The resultant web map application, called the Bridge Vertical Clearance Trip Planner, gives the trucking community an effective and convenient tool for planning routes in Washington State.

Seeing Route Obstructions Instantaneously

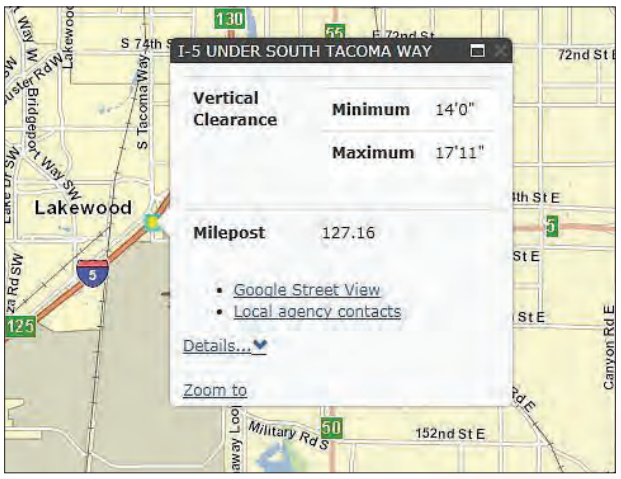
In the state of Washington, truck operators are responsible for checking proposed routes and ensuring safe maneuvers around any obstructions. Before WSDOT's web application went live, truck operators (or those applying for the permits needed to drive oversized loads through Washington) had to use the WSDOT Bridge List, a scrollable PDF, to locate all the crossings—bridges, overpasses, and underpasses—they would encounter on state-owned roads to determine whether they were passable. Operators then had to use their own paper maps to plan their main routes, alternate routes, and detours.

Now, with the Bridge Vertical Clearance Trip Planner application, truck operators can instantaneously see which crossings should be avoided or approached with caution. The map, displayed on the WSDOT website and accessible via ArcGIS Online, uses the department's bridge preservation database, which houses up-to-date information on vertical clearances and crossing locations along state routes.

↑ The Bridge Vertical Clearance Trip Planner allows truck operators to easily see which crossings should be avoided.

In the application, users enter the height of their load and, if they wish, a state route or an interstate number (including state route ramps, spurs, and couplets). Once users press Submit, the map legend shows the total number of vertical restrictions along the route and the map itself displays where those restrictions are located. Bridges and overpasses that are too low are marked with red dots, while cautionary ones that require a lane change for proper clearance are marked in yellow. Users can then zoom in and click on the points to obtain more detailed information about each restriction, including minimum and maximum vertical clearances, mileposts, street-level images, local agency contacts, and permit information.

The Bridge Vertical Clearance Trip Planner is written in HTML5 and uses ArcGIS API for JavaScript to display the interactive map. The vertical clearance data used by the application is stored in a Microsoft SQL database and published as a map service on ArcGIS for Server. The application works with current versions of Internet Explorer, Chrome, and Firefox.



↑ Users can get detailed information about each restriction, including minimum and maximum vertical clearances.

Opportunities to Innovate

Putting the Bridge Vertical Clearance Trip Planner together gave WSDOT several opportunities to be innovative. For example, WSDOT's bridge inventory database supports crossing records—each instance where a state route crosses over or under another road—but not location geometry, which is the actual point of crossing. Additionally, multiple crossing records can exist for the same location, such as when a highway goes under a bridge (that's one crossing record for the bridge going over the highway and two crossing records for the highway going under the bridge in two directions). The vertical clearance measurements for each record are usually similar, but the route information is different. So WSDOT had to develop much of the data needed to support the GIS before adding it to the system. In some cases, one crossing record had to be split into multiple GIS events, while at other times, multiple crossing records were reduced to a single event. A procedure was also created to evaluate and merge duplicate locations onto a single point linked back to the original crossings.

Once WSDOT compiled information for the more than 6,200 vertical clearance points in the state, the agency checked the data to make sure each location was correct and there were no duplicates. The legacy database was updated with additional tables that included the new geometry-to-crossing record relationships. Moreover, to ensure that the trip planner is accurate and up to date, an extract, transform, and load (ETL) process was developed to regularly update the new SQL database that supports the application.

Working within funding constraints, WSDOT continues to expand the trip planner's functionality. A new tool is being developed to help the WSDOT bridge preservation team update bridge location geometry with an easy-to-use web interface that integrates with the department's Bridge Works software, which is used to manage inspection data. This tool may eventually be extended to cities and counties so they can maintain their bridge data.

WSDOT is also looking to display lane-by-lane height, directional information, and city and county bridges in the trip planner. Additionally, the department has made its Bridge Clearances API available to third-party developers so they can use state-generated data to develop more tools to improve highway safety.

Supporting Safer Roadways

By making vertical clearance information easier to access, WSDOT's ultimate goal is to help the trucking community make safer decisions while traveling across the state of Washington.

As for the Skagit River Bridge, WSDOT crews completed repairs by July 2014. They replaced the collapsed span; raised and reinforced the remaining bridge structure, giving it 18-foot vertical clearance across all lanes; and retrofitted several trusses with reinforced steel components to add strength if the bridge is ever struck again.

For more information, contact WSDOT's GIS and Roadway Data Branch manager, Alan Smith, at smitha@wsdot.wa.gov or 360-596-8925.

↓ The Washington State Department of Transportation repaired the bridge, giving it 18-foot vertical clearance in all lanes.

GIS Data Standards in Oregon

A Program That Works

By Cy Smith and Bob DenOuden, State of Oregon

As geospatial technologies continue their march into the mainstream, GIS professionals no longer face a dearth of available data. Instead, they often find themselves swimming in a sea of undocumented and often redundant data. This makes it difficult and time consuming to find authoritative sources of GIS data.

That is why building and maintaining a core set of basic framework GIS data is becoming more important. To do this, it is essential to have a robust data standards process, developed collaboratively, that makes sound data available in a centralized catalog.

For almost 15 years, the State of Oregon has employed a unique method for creating such geospatial data standards. Dubbed the Oregon GIS Framework Program, it is a process of generating and maintaining GIS data that evolves with technology and can be molded to the needs of various government agencies and private organizations. Additionally, because it is voluntary and rooted in consensus, the program breaks down the barriers that typically divide government organizations and encourages different levels of government to engage with one another in meaningful ways.

Using National Standards as a Springboard

In 1994, the US federal government initiated a nationwide program to improve how people and organizations develop, find, and share geospatial data. Coordinated by the Federal Geographic Data Committee, state and local governments defined seven geospatial datasets that encompassed a framework of themes such as cadastral, transportation, elevation, and administrative boundaries. But the State of Oregon did not stop there. It expanded its framework to include eight more themes—including land cover and use, climate, hazards, and utilities—and has identified a more detailed set of over 250 data elements that form the foundation of the state's GIS utility, navigatOR.

The framework themes are the organizational construct for Oregon's GIS Framework Program, which is guided by the Oregon Geographic Information Council (OGIC). The program has 15 Framework Implementation Teams (FITs), one for each theme. More than 450 volunteers from Oregon's GIS community—working in local and state government, federal agencies, the private sector, and tribal organizations—comprise the FITs. Smaller workgroups of two to six people from these FITs are typically assigned to start the data standards development process. Those workgroups draw up the data content and data exchange standards that are reviewed by the larger GIS community and then, ideally, endorsed by OGIC.

Developing Standards from the Ground Up

The Oregon GIS Framework Program uses a 12-step process for standards development. This method, which separates the technical aspects from policy and management considerations, involves different levels of GIS staff and management while incorporating the various perspectives of participating organizations.

In the drafting phase, once a workgroup starts composing a new standard, the framework coordinator sends a notice of intent about it to the GIS community to inform others who might be interested and avoid redundant efforts. The workgroup then owns the standard throughout the drafting phase and incorporates any changes.

When a first draft of the standard, called a proto-standard, is ready, the workgroup emails it to the relevant FIT for feedback. If no changes need to be made, the workgroup presents the proto-standard to the GIS community for review at a standards forum and by posting it online. Once all feedback is incorporated, the proto-standard becomes a draft standard.

The workgroup then sends the draft standard for formal review to one of three advisory groups, depending on the subject: the natural resources group; the administrative, cadastral, and transportation group; or the preparedness, hazards, and utilities group. These advisory groups are formed as needed and consist of program volunteers who have a stake in the proposed standard. Once all feedback is integrated, the draft standard becomes a preliminary final draft standard.

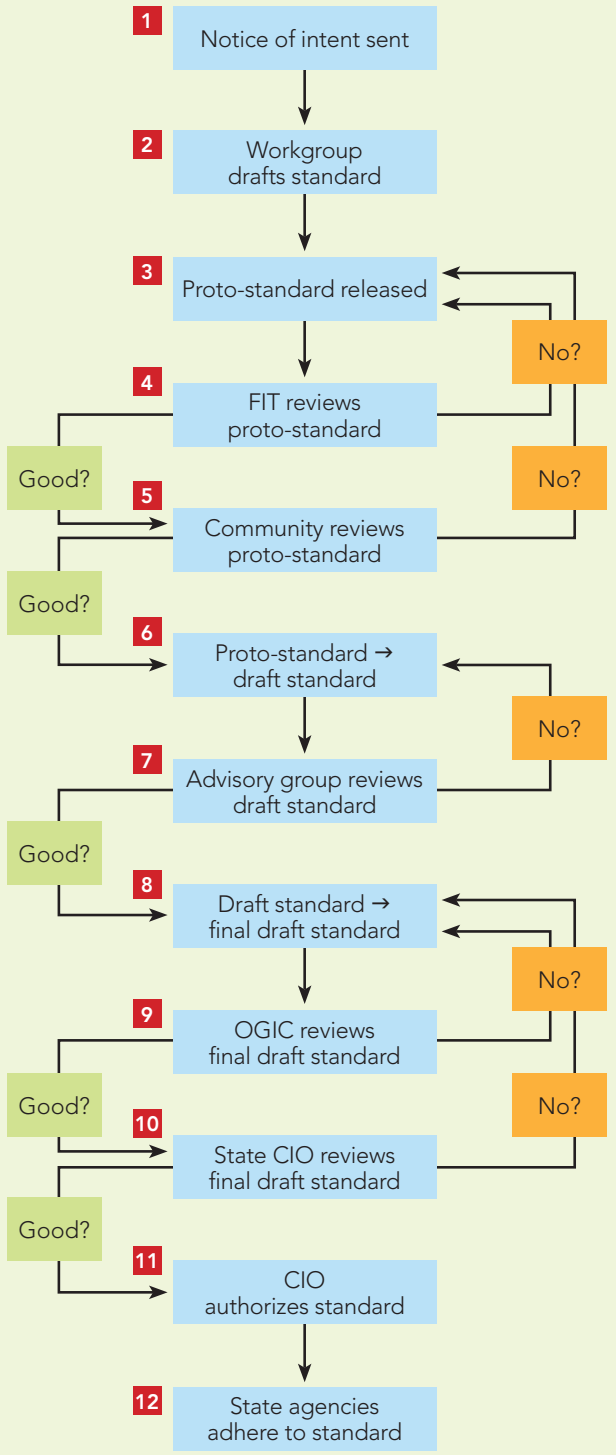
To begin the official endorsement process, the workgroup presents the preliminary final draft standard to a second standards forum to obtain consensus from the GIS community. If the standards forum identifies a problem, it returns the document to the workgroup for revision. However, if feedback can be incorporated without major restructuring, the workgroup does so and the preliminary final draft standard becomes a final draft standard.

Oregon's geospatial information officer then presents the final draft standard to OGIC for endorsement. If there are no major problems, the final draft standard is passed to the state's chief information officer (CIO) with a recommendation for authorization.

If the CIO authorizes the standard, all state agencies must adhere to it. Although authorized standards do not apply beyond Oregon's state government, local, tribal, and regional governments find value in adopting the standards because they participate in the standards development process and, through their endorsement, agree with the need to adopt them.

To date, the FIT has developed 28 endorsed framework data standards. Many of them have been amended over the years as well, to ensure their continued utility.

State of Oregon
Standards Development Process



Keeping Geospatial Data Up to Standard

In addition to authoring data standards, framework groups also develop data for their individual data themes and elements. A data manager at the Oregon Geospatial Enterprise Office (GEO) receives the data and stores the majority of it in a central location at the State Data Center, where it can be accessed through the Oregon Spatial Data Library. The public can access most framework data, plus a host of nonframework geospatial data, via this web-based portal.

The framework coordinator at GEO also conducts a framework forum twice a year to introduce new data standards or amendments, educate the GIS community about upcoming standards and ongoing data development efforts, and gain the community's endorsement for proposed standards.

What Makes This Process Unique

No governing body in Oregon has the authority to mandate geospatial data standards for all organizations. Rather, the whole process is rooted in cooperation.

One of the most important aspects of the Oregon GIS Framework Program is that members of the geospatial community come to a consensus on endorsing and adopting data standards. Because multiple organizations in Oregon create data, the best way to ensure that data development is coordinated and efficient is to have all organizations agree to the standards.

This consensus within the geospatial community also inspires willing organizations to act as data stewards by taking responsibility for datasets for which they have the strongest business needs. Those organizations ensure that the data under their charge remains current, accurate, and well documented and that data contributors adhere to the adopted standards.

Reaping the Benefits

Having data standards and an active GIS community that supports them has been invaluable to the State of Oregon. The Transportation FIT ensured that data from more than 300 road authorities is now integrated into a set of statewide road centerline data. Through the Geoscience FIT, land management, geology, and agricultural agencies worked together to develop a statewide soils dataset. The Administrative Boundaries FIT also brought together multiple state agencies and local governments to create a standardized, statewide dataset for zoning, saving the Oregon Department of Transportation $150,000 to develop it itself. And those are just a few examples.

Oregon's standards development effort is key to the state's comprehensive program for foundational, or framework, dataset development. It also supports government business processes at every level.

When geospatial data standards are well crafted, they enhance the efficiency and cost effectiveness of any GIS investment.

Partner Offerings

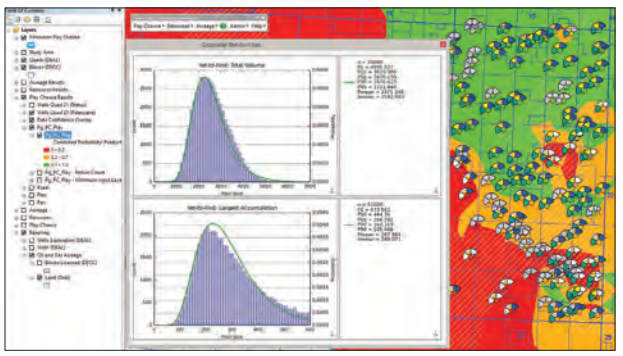
Tapping into their own technological and sector expertise, Esri partners around the globe deploy software, services, and applications that enable users to become more efficient and effective. With these GIS solutions, people at all levels of an organization—from policy makers and executives to knowledge workers and GIS analysts—can apply geography to every decision they make.

Making Public Safety Decisions More Quickly

Location is key to meeting the stringent and demanding requirements of mission-critical emergency response GIS. To address this need, **Geo-Comm** uses the ArcGIS platform to power its GeoLynx family of software and services for end-to-end public safety GIS needs, which range from 9-1-1 GIS data management and mobile responder mapping to tactically connecting Public Safety Answering Points in real time. By employing accurate, authoritative data and maps, policy makers and public safety and law enforcement agencies can work together to make sound decisions in a hurry. Learn more at geo-comm.com.

Improving Natural Resources Production

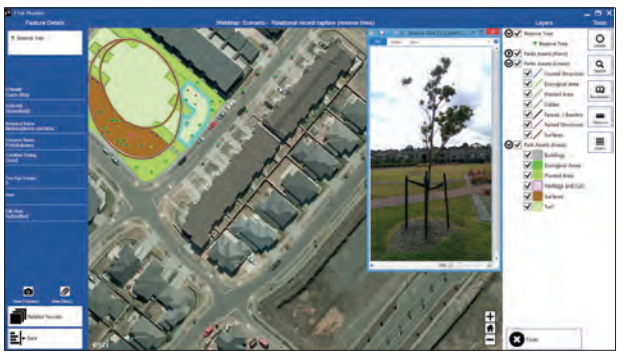
Drawing on a unique blend of geoscience and GIS expertise, **Exprodat** helps oil and gas companies improve their exploration and production processes by applying spatial analysis. Exprodat's Exploration Analyst extension for ArcGIS simplifies assessments of potential petroleum systems, basins, and plays using play-based exploration tools in conjunction with in-house, vendor, and public domain data. This allows executives and geoscientists in oil and gas exploration to have more immediate access to results, analysis, and statistics, enabling them to stay on top of performance metrics. Learn more at exprodat.com.



↑ Exprodat's Exploration Analyst extension for ArcGIS simplifies petroleum exploration.

Enabling Enterprise-Wide GIS

Working in a broad range of sectors, **Geographic Business Solutions (GBS)** helps users embrace and expand enterprise-wide GIS. GBS's 2 Fat Thumbs solution lets knowledge workers tap into field-based data viewing, editing, and collection. Using Windows tablets or laptops, users can take data offline and into the field, make updates, and sync back to ArcGIS Online or Portal for ArcGIS when collection is complete. They can view, edit, and create related tables and records and also attach photos and files, download basemaps, and provision devices with prebuilt basemaps—all leading to more informed conclusions. Learn more at gbs.co.nz.



↑ Geographic Business Solutions' 2 Fat Thumbs solution allows knowledge workers to take data offline and into the field.

Esri's more than 2,000 global partners provide customer-focused, geoenabled solutions that span Esri's core sectors and industries. Products and services range from configured apps and custom-built solutions to complete ArcGIS system implementations and content. To search and discover partners, solutions, and services that meet your needs, visit esri.com/partners.

Esri's Startup Program Is Helping Users Stimulate Geoinnovation

The Esri Startup Program helps emerging businesses add location analytics to their services and solutions. Companies founded less than three years ago that build software or platform-as-a-service products and currently generate less than $1 million annually may be eligible to participate in the Esri Startup Program. This three-year program provides qualified businesses with free ArcGIS platform technology to integrate spatial functionality into their products.

Members receive software, tools, support, and opportunities that help their businesses succeed. Key benefits include access to an ArcGIS Online organizational subscription, an ArcGIS for Server license, and the Esri Developer Network package plus training, support, and maintenance. Startup Program participants also have opportunities to attend and exhibit at Esri conferences and comarket with Esri business teams.

Taking advantage of this support, these startups build revolutionary technologies for many industries, including utilities. Learn more and sign up at developers.arcgis.com/startups.

Getting the Power Back On with Social Media

Social media is fast-tracking business communications. People now use social media to contact their utilities—even to report outages. And progressive power companies reportedly recognize social media as a reliable resource for outage information.

Esri emerging partner DataCapable helps energy companies put social media data to work for customer service, outage management, and storm impact prediction. The company's UtiliSocial solution mines, maps, and analyzes social media in real time so utilities can interpret customer engagement and satisfaction and even get a dependable, upgradable operational view of the grid.

In just one year, DataCapable captured more than one million outage-related social messages, many of which included photos and videos that can help dispatchers get the right truck to an emergency, faster, for example. By combining diverse sets of outage data with social media commentary and on-the-ground images from customers, operational staff can also better understand events in real time, aiding predictive storm modeling.

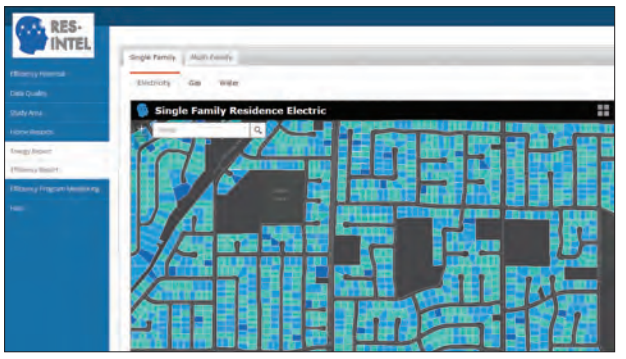
↑ DataCapable's social media map displays real-time feeds about power outages across the United States.

Helping Homeowners Reduce Energy Costs

Using GIS, startup company Residential Energy and Water Intelligence (Res-Intel) helps homeowners and utilities build realistic energy and water efficiency strategies.

For homeowners, Res-Intel uses utility company data to determine how much energy houses in a given area consume, plus what each residence pays. Property owners can then compare their consumption to their neighbors' and see what efficiency investments people around them are making.

For utilities, Res-Intel profiles individual properties to determine their energy and water consumption, enabling companies to make energy efficiency suggestions relevant to each property. Res-Intel also uses ArcGIS Online to map housing types (single-family homes or apartments, for example), demographics, and wealth data to help utilities figure out who makes energy conversion decisions and which properties can afford up-front costs. Companies can also see where energy intensity scores are high and use community-based outreach to target efficiency investments.



↑ Res-Intel maps out houses' energy efficiency scores. The ones in blue need energy upgrades.

On the Fringes of Possibility

GIS Hero

↑ Mark Sorensen

He's been shipwrecked on a desert island; he once climbed two of Southern California's tallest mountains in a day; and there was that time he got evacuated from Baghdad in an armored vehicle—and it got hit by an improvised explosive device. But aside from his sense of adventure, what really distinguishes Mark Sorensen, founder and CEO of the Geographic Planning Collaborative (GPC) Group, is his drive to extend and expand the use of GIS—especially in the developing world.

"He works at the outer fringe of possibility," said Esri senior consultant Mike Larrance, who has done projects with Sorensen around the world. "He does these jobs that probably not a lot of people would do. The fact that he just pushes through, regardless of circumstance, is a testimony to his passion about GIS technology."

Sorensen—who currently splits his time between Abu Dhabi in the United Arab Emirates and San Diego, California—is a land planner at heart and sees incredible value in using GIS for urban and regional development.

"I was very interested in visualization—the ability to look at landscapes in a three-dimensional view and envision how you'll be able to intervene with those landscapes," he said, adding that what drew him to the technology was "being able to put information into a computer and then consider multiple variables and their interdependencies in the land-planning decision-making process."

Examining manifold perspectives and figuring out how they affect and rely on one another is the methodology that has defined Sorensen's career from the beginning. As a young construction worker, he got ahold of Scottish landscape architect Ian McHarg's *Design with Nature*, a seminal book that champions understanding the existing natural landscape to better integrate man-made design.

"That made complete sense—to know more about the environmental forces you are dealing with in a space and then think about the human systems you interject into those spaces," said Sorensen.

This rational, systematic process inspired him to study landscape architecture. At age 21—after he had already been married for four years and had two kids—Sorensen enrolled in the landscape architecture program at California State Polytechnic University, Pomona. While working with plants there, he also developed an interest in computers. Thus, when he was encouraged to go to graduate school, he chose to attend Harvard University's Graduate School of Design to pursue a master's degree in landscape architecture and regional planning, since he would be working not only with landscape architects but also with people who were doing research with computers.

One of the classes that really stuck with Sorensen was one Carl Steinitz taught on methods of landscape planning. Steinitz led students through a range of design perspectives, including Chinese Feng Shui and how Native Americans used to organize themselves into landscapes. Sorensen recalled how "mind-bending" it was to think about all the different cultural contexts and how, to really understand an environment, he would have to use all the methods and tools available to him and essentially do geodesign.

After graduating from Harvard, Sorensen really began to hone his design and planning philosophies by applying them to practical experiences. He worked at Esri for more than a decade, where he wore many hats, including special exhibit designer, GIS project manager, and head of the landscape planning group. His projects varied widely: One week he would be in Honolulu working on sewer systems; the next month he would be doing a project in Kenya on elephant poaching. He did extensive community planning throughout Japan and helped devise GIS support for municipal projects in Baghdad.

His primary goal was—and still is—to gain as much perspective about a place and a situation as he could to provide the best solutions possible. He would talk to community members, local city officials, different sectors, and an array of other stakeholders to find out what everyone needed. Then he would analyze the data over and over to come up with a plan—often taking the time to figure out both how the stakeholders wanted it done and how he and his team would prefer to carry out the project.

"He's constantly exploring and innovating and thinking," said Dan Bucko, an urban planner and landscape architect at Hart Howerton, who has worked with Sorensen on a number of projects throughout the years.

Eventually, Sorensen developed a niche expertise in the emerging field of spatial data infrastructure (SDI) development.

"When you go through a couple hundred projects like that, you get exposed to how these different sectors think about these issues," he said. "You really become a translator in what otherwise was a Tower of Babel."

With this knowledge, Sorensen founded GPC Group (an Esri Silver Tier partner), where he consolidated his learning and experience into an overarching SDI philosophy. He came to understand how interdependent many sectors were yet how they often work with blinders on. He also figured out how to build structural integrity at a governance level.

Early on, GPC Group worked with the government of Lebanon to conduct one of the first SDI studies. The company also received a contract to help the Libyan government develop an SDI, which was a pivotal project. In addition to focusing on the data, Sorensen realized that, by really digging deeply into sectoral issues, he and his colleagues could pinpoint fundamental problems that affected governments at the experiential level. This helped GPC Group expand and refine its basic methodology and begin looking at the ecology of the whole governance framework.

"It's not just about streamlining operations," said Sorensen. "It's also about looking at what, why, and how we do things in fundamentally new ways."

↑ The GPC team in Libya, pictured here, completed the main SDI project for the Libyan government, but political turmoil curtailed full implementation.

That is how Sorensen approached more recent projects with the government in Abu Dhabi. First tasked with evaluating the Abu Dhabi Global Environmental Data Initiative (which was part of the United Arab Emirates' commitment to closing the environmental data gap between developed and developing countries), Sorensen and his team were then asked to take a look at plans to develop a GIS that would connect government departments across the country. The consultancy's recommendation that the government integrate its GIS program with what was then a nascent e-government program prompted Abu Dhabi to hire GPC Group for both projects. Today, more than 80 organizations in Abu Dhabi share close to 800 layers of information—a feat that won Abu Dhabi the inaugural Smart Government Award at the 2015 Esri User Conference.

Sorensen's work doesn't stop there, though. His company now focuses heavily on GeoSmart Solutions That Matter, an initiative that strives to use location information to solve interesting problems that will have transformative impacts. With this, Sorensen wants the developed and developing worlds to better coordinate how they implement projects.

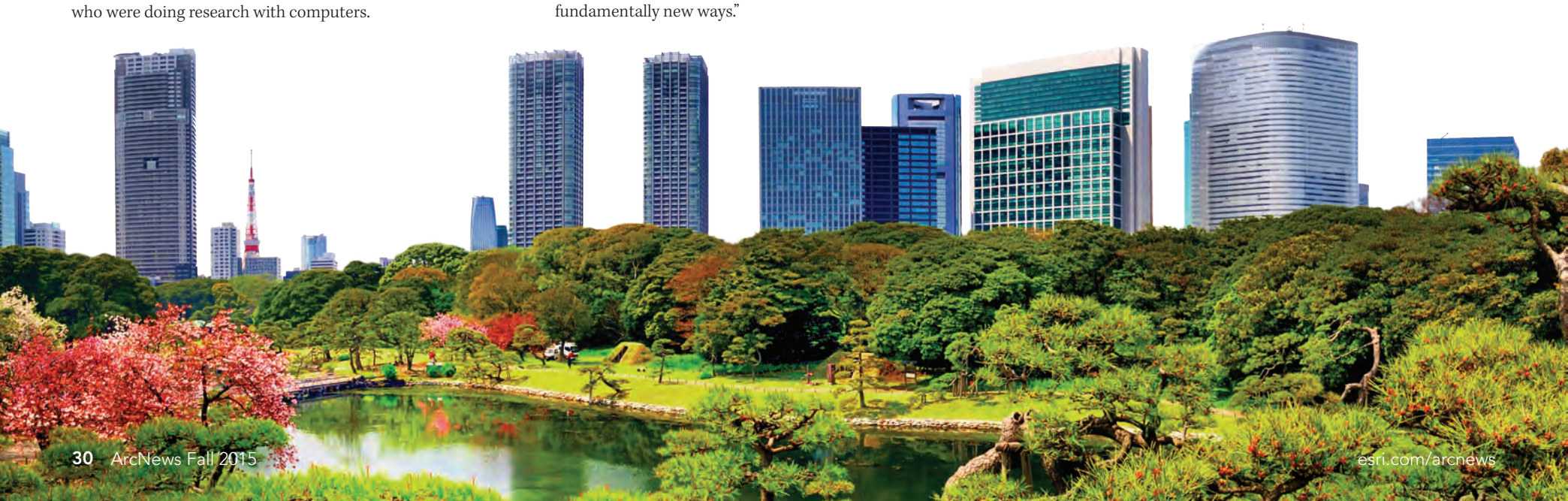
"We realized that a lot of the SDI work we're doing in developing countries is largely a top-down perspective," said Sorensen. Rather than perpetuate that structure, he wants to implement these projects in a more integrated way.

"The classical approach to SDI that's been applied in the developed world really has to be repositioned and retooled to address issues in the developing world," he said. That is why, for projects in developing countries, Sorensen has recoined *SDI* to stand for *spatial development infrastructure*, which he believes fosters a more ground-up approach to spatial data development.

For someone who said decades ago—before he got into Harvard—that he wanted to bring the principles of environmental design to the developing world, he sure has succeeded, though not without support.

"After being married for 43 years, I have to give some credit to my wife for having put up with all this vagabondism for all these years."

Sorensen and his wife, Kathy—a professor of anthropology at Ashford University—have three children and four grandchildren, all of whom live in California.



MASTER'S DEGREE in GIS

Gabriel Borroni, a UMBC alum and Geospatial Analyst for **WSP | Parsons Brinckerhoff**, credits UMBC's Master's Program for expertise and tailored coursework in GIS. As a geospatial analyst, Borroni focuses on systems, spatial analysis and application development, and has been able to deploy the skills learned at UMBC to high-profile projects within the workplace.

Through work performed on a local highway project, Borroni was able to assist in database design, application development and web design which resulted in an invitation to present his project at the **National ESRI AEC Summit, July 2015**.

When asked what prepared him for success in his career, Borroni recognizes **UMBC's faculty**. "Their tailored approach and expertise in project management, leadership, communications and the technical aspects of database design and application made the difference."

"The program gave me the confidence I needed to think outside the box and take on new responsibilities. Rather than relying fully on tried and true methods, I learned to be as creative and innovative as possible."

— Gabriel Borroni

UMBC

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umbc.edu/gis

Crossing Borders

A column by Doug Richardson
Executive Director, Association of American Geographers

Teaching History with GIS

Esri's gift of free GIS software for all K–12 schools in the United States opens up new horizons for teaching not only geography but also history to American students.

Geographers and national leaders have long been concerned that geography is not being taught enough or very well in K–12 classrooms, as I outlined in my winter 2011/2012 column for *ArcNews*. Over the past few decades, changes in school curricula have often substituted a mushy blend of "social studies" for rigorous, stand-alone courses in geography and history, as well as other core subjects. These blended social studies classes are often taught by teachers who have some undergraduate background in history but who frequently have little knowledge of geography or GIS.

Esri's ConnectED donation of ArcGIS Online to all US classrooms is now turning out to be a boon for history teachers as well. Most of them can benefit by integrating GIS into both their history classes and the geography components of their social studies courses.

↑ History teachers can integrate ArcGIS Online into their history and social studies courses.

This synergistic development should come as no surprise, as geography has traditionally had its longest and deepest interactions with history. Geographers have practiced historical geography with distinction for centuries, as illustrated by D. W. Meinig in his book, *The Shaping of America: A Geographical Perspective on 500 Years of History*, to name just one example. And many historians, such as Fernand Braudel, have contributed geographically grounded historical accounts that have become classics in the study of geography.

During the past few years, significant new forms of interaction between geographers and historians have also begun to emerge. In higher education, geographers and historians are integrating historical and geographic research agendas using spatial analysis and new geographic technologies—and the potentially transformative implications of this work for both history and geography are clear and exciting. These areas of intellectual, educational, and technological collaboration—often referred to in shorthand as historical GIS—are now sparking fundamental reevaluations of historical research methods and interpretation. They are also revealing new possibilities for education and a better understanding of our world in both history and geography.

Historians and history teachers are starting to understand key aspects of GIS, such as its ability to integrate, analyze, and visualize large amounts of spatial and temporal data from multiple disciplines and sources. They are also beginning to comprehend the technology's ability to move across multiple scales, both spatially and temporally, or geographically and historically. This capacity to combine space and time in one integrated system has profound implications for research and education in history and geography.

Many history teachers are beginning to grasp the significance of incorporating a spatial dimension across multiple scales into historical research and education, despite the barriers of vested interests and outmoded curricula in many of their schools. Daniel J. Bodenhamer, a prominent historian, has argued, for example, that "of all modern information technologies, GIS may have the most potential for breaching the wall of tradition in history," noting that "its ability to integrate disparate information drawn from the same place at the same time allows scholars to simulate the complexity of history."

Just as the microscope and DNA sequencing, for example, have revolutionized research and education in biology, making the work of Carl Linnaeus and Charles Darwin ever more important to modern biology and medical applications, so too do new geographic technologies, such as GIS and real-time interactive GPS/GIS technology, have the potential to extend rather than displace traditional research and teaching in geography and history.

Recent advances in GIS can help historians tackle the issue of explaining the historical construction of space, says Stanford University historian Richard White in the forward for *Placing History: How Maps, Spatial Data, and GIS Are Changing Historical Scholarship*.

"GIS creates the possibility of extending spatial analysis beyond the local scale," writes White. "We can tell more complex stories more clearly and coherently."

He also points out that spatial history not only fosters collaboration within the discipline but essentially requires it. Thus, the number of major international historical GIS projects—often coupled with traditional methods of historical and geographic analysis—continues to expand. Examples of such projects include the China Historical GIS, the Great Britain Historical GIS, the Tibetan and Himalayan digital libraries, the Hawai'i Island Digital Collaboratory for Humanities and Science, the US National Historical Geographic Information System, and the Holocaust Historical GIS Project, among many others. (These historical GIS projects are discussed in more detail in my article "Geohistories" in the book *GeoHumanities* [Routledge, 2011], from which portions of this column were adapted.)

Begin Using GIS for Education

Any school in the United States can sign up for a free ArcGIS organizational account by visiting Esri's ConnectED home page at connected.esri.com. Scroll down, click "Request a free school account," and complete a brief online form to get started.

The AAG-Esri GeoMentors program can help with technical support and educational resources as well. Sign up online at geomentors.net/participate to seek GeoMentor assistance (or to serve as a GeoMentor), and then program staff will provide information on how to integrate GIS into the classroom or extra-curricular student activities. The GeoMentors website, geomentors.net, also has details about available training and curriculum materials, as well as information on how to connect with GeoMentors, teachers, and school collaborators. Additionally, join and follow several GeoMentors online communities, including those on social media, at geomentors.net/communicate to get program announcements, discover helpful new resources, and meet fellow members of the GeoMentors community.

Among the many educational materials available to K–12 history and geography teachers are the Esri GeoInquiries for US History, which can be found at edcommunity.esri.com/Resources/Collections. They are designed to be fast and easy-to-use instructional resources that incorporate advanced web mapping technology. With no installation, fees, or logins necessary, instructors present the 15-minute activities in each collection from a single computer or projector. The Esri GeoInquiries collection includes a range of subjects, such as history, geography, and earth science, and is meant to supplement the lessons and topics already being covered in the classroom. Each GeoInquiry even describes the specific textbooks and chapters with which it aligns so the activities adhere to current curricula.

Many other educational resources for teaching and learning GIS are also available. The My Community, Our Earth: Geographic Learning for Sustainable Development (MyCOE) program, for example, works with students in the United States and around the world on GIS and geography projects within their own communities, and some assignments include historical GIS components. Access the program, which is supported by a number of US federal agencies and international organizations, at aag.org/mycoe or contact Candice Luebbering at cluebbering@aag.org for more information.

Synergistic Opportunities

Historical GIS is destined to be common ground for the disciplines of geography and history for decades to come. We now have new synergistic opportunities for history and geography teachers to collaborate to benefit our K–12 students, thanks to Esri's remarkable gift of GIS software to these schools.

At the Association of American Geographers, we seek creative and productive new ways to enable interaction between geography and history, these two old friends that have coexisted and been in conversation for millennia. As we embark on revitalizing and reenergizing American educational agendas, these time-honored disciplines of study and research are fresh with promise and laden with enormous new potential for understanding not only our past but also each other.

Contact Doug Richardson at drichardson@aag.org.

The Relevance of Cartography

A Cartographer's Perspective

A column by Menno-Jan Kraak
President of the International Cartographic Association

The Magic of the Map

Maps are magic. I am enchanted by maps.

It might sound strange for an academic, generally deemed more rational than quixotic, to be so mesmerized by maps. But think about it: Maps raise all kinds of interesting thoughts and questions.

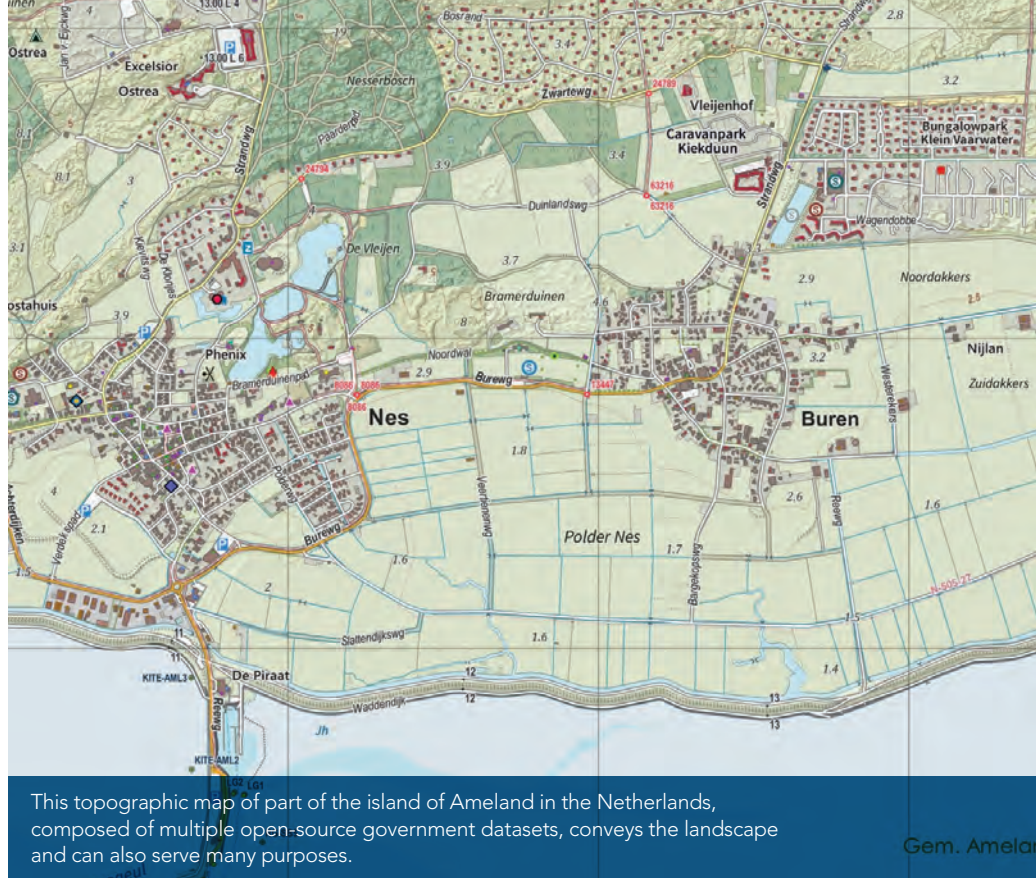
This year, during International Map Year (mapyear.org), global attention is being paid to the unique role maps play in our world. At such a moment, it is good to wonder what makes a map special—what is the magic of the map—because, somehow, maps enchant everyone.

Ask around if people like maps. I guarantee that a clear majority will say yes. But then I wonder, what do they like about maps?

Do maps signify beauty, when their colors match the wall or a historical map looks sophisticated? Or do they represent an escape, since they can give people a view into an unknown world, show locations visited, or offer dreams of new places to go? Maybe maps are just handy because they help us avoid getting lost? Or is it all about information, given that maps reveal spatiotemporal patterns and trends about both tangible and nontangible phenomena in the world?

Some maps can play all these roles at the same time. Think about a topographic map. Isn't that wonderful? Even if we limit ourselves to the informative role of the topographic map, we can witness many different kinds of uses. A geologist will concentrate on the contour lines and be able to point to fault lines. A geomorphologist will observe the different parcel sizes and land uses and will be able to tell something about the origin of the landscape. A trail runner will plan an attractive route. And a soldier will look for a spot to hide or a point from which the surroundings can be observed.

There are many more examples of special uses. But be reminded that topographic maps were designed to give a generic representation of the landscape. Isn't it magic, then, that a topographic map can do all these things at once? It might seem so, but we can rationally explain that the content of the topographic map is being enhanced with specific knowledge from each map reader—the geologist, the geomorphologist, the trail runner, and the soldier.



This topographic map of part of the island of Ameland in the Netherlands, composed of multiple open-source government datasets, conveys the landscape and can also serve many purposes.

Not all maps have these expanding characteristics. Some thematic maps, such as a dot map showing all the Starbucks in Manhattan, have been designed with very specific and limited goals in mind.

Isn't it extraordinary, then, that, despite there being a scientific approach to map design, 10 different professional cartographers working with the same data can come up with 10 different solutions—all of which can be qualified as good? And most users have no problem with this.

It can be explained if we look at the definition of cartography: the art, science, and technology of making and using maps. Happily, creativity still does play an important role in map design. In the past, the tools used to create maps would have limited this; but today, software allows for automated creativity. Going back to our topographic map, even though some of its content, such as the scale, is standardized, creativity is visible if we put the maps of different countries next to each other. Despite all kinds of conventions and international agreements, such as making water blue and forests green, each country reveals its own style. One may use the color red to depict main highways, while another uses black. This might be a bit bothersome when crossing a border, but magically, it works.

For today's youth, traveling from point A to point B with just a paper map is a kind of magic. There is no GPS telling you where you are and where to go, so how is it possible? In the same vein, it might be difficult for us to understand how explorers in the sixteenth century could have navigated the world's seas with their faulty maps. Was it a miracle? Yes and no, if we follow this line of thought: Today we can easily navigate the subways of London, Paris, or Tokyo with very schematic maps just by sticking to colored lines—both on the maps and on the platforms. And what about cartograms in news articles about, for instance, the US presidential elections, where each state is just a blue or red square of some size? We understand all of this because well-designed maps are powerful and our minds are flexible enough to cope with different graphic representations and link them to tangible (subway lines) and nontangible (election results) reality.

The cartographic community observes all this map magic. In their scientific research, cartographers try to unmask the magic and look for rational explanations for how to make even better maps. In the case of topographic maps, cartographers try to understand the relationship between the map and the viewer's perception of the map content *and* reality based on how he or she plans to use the map.

This, undoubtedly, will still keep the next generation of cartographers busy.

About the Author

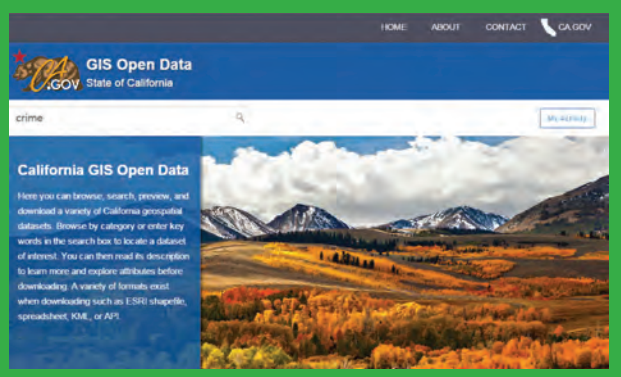
Menno-Jan Kraak is professor of geovisual analytics and cartography at the University of Twente in the Netherlands, where he has been teaching since 1996. He has a degree in cartography from the Faculty of Geographical Sciences at Utrecht University and received his PhD in cartography from Delft Technical University. Kraak has written extensively on cartography and GIS. His book *Cartography: Visualization of Spatial Data*, written with Ferjan Ormeling, has been translated into five languages. He also wrote *Mapping Time: Illustrated by Minard's Map of Napoleon's Russian Campaign of 1812*, published by Esri Press in 2014. Kraak is a member of the editorial boards of several cartography journals, including the *International Journal of Cartography*. He currently serves as president of the International Cartographic Association.

Thousands of Organizations Share Their Data Using ArcGIS

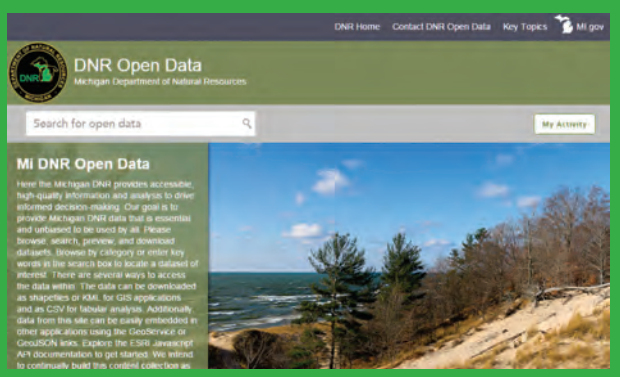
ArcGIS Open Data is helping organizations around the world share their authoritative data in multiple open formats. The solution, hosted and managed by Esri, comes free with ArcGIS Online. It enables users to set up public-facing websites where members of the community can search and download open data.

Recent examples include the following:

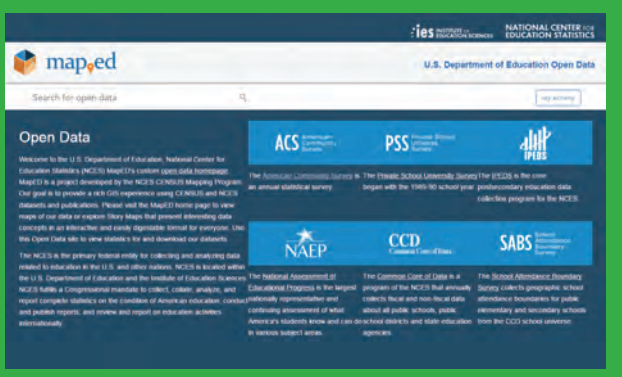
California GIS Open Data
data.california.opendata.arcgis.com
The State of California uses ArcGIS Open Data to make available a wide variety of geospatial datasets, including many with information about demographics, the environment, transportation, and health. Data can be downloaded as a shapefile, spreadsheet, or KML, as well as accessed via an API.



Michigan Department of Natural Resources Open Data
gis.midnr.opendata.arcgis.com
ArcGIS Open Data can be used to create open data sites around a particular area of interest. The Michigan Department of Natural Resources uses its open data site to provide high-quality, unbiased information about natural resources. The website includes data on hunting, fishing, mineral resources, trails, and forestry.



MapED, US Department of Education
data.deptofed.opendata.arcgis.com
MapED is an open data site from the US Department of Education, National Center for Education Statistics. It fulfills a congressional mandate to collect, manage, and analyze statistics on the state of American education and evaluate international education activities. Users can access an array of data on test scores, demographics, and higher education.



To view other websites powered by ArcGIS Open Data or to create your own, visit **esri.com/opendata**.

Open Data Made Easy

How Ireland's Roscommon County Council Publishes Open Data

Open data is quickly becoming an imperative for all government bodies in the Republic of Ireland. Indeed, it is a requirement for the Open Government Partnership (OGP), a global program launched in 2011 to promote government transparency around the world. To that end, in May 2014 the Irish government published its National Action Plan, which lays the foundation for how government organizations intend to share more information about their activities, increase civic participation, fight corruption, and use new technology to strengthen governance.

The plan helped Ireland become a full OGP member in July 2014. Now, all central government departments, public sector bodies, and local authorities are under even greater pressure to make more of their data open. In practice, this means giving any person or organization free access to vast quantities of public information, unconstrained by licensing agreements and available in standard formats used in a range of IT applications.

There are inevitable challenges to doing this—especially during a recession with staff, budgets, and time in short supply.

Roscommon County Council, the primary body of local government in Ireland's ninth-largest county, serving 64,000 people, turned to GIS to surmount these challenges. In 2013, Roscommon purchased a license for the ArcGIS platform and discovered a ready-to-use template for publishing open data: ArcGIS Open Data.


Roscommon County, Ireland.

The council's GIS officer, Barry Doyle, used this ArcGIS Online template to develop a brand-new channel for delivering open data. As a subscription-based cloud service, ArcGIS Online requires no hardware infrastructure, no on-site data storage, and no system maintenance. So it was quick and inexpensive for Doyle to launch the new approach.

In less than two years, Roscommon County Council has published more than 50 datasets on its Open Data Portal that range from recycling facility locations and fishing sites to development plans and local election results.

Doyle is very impressed by how simple it is to publish datasets.

"ArcGIS Online makes it very easy for councils to create and maintain an Open Data portal," he said. "You don't have to be a programmer; you don't have to export data in multiple formats; all the hard work is done for you."

The Open Data Portal is an integrated part of the ArcGIS platform and, as such, draws on the same source of geospatial data as the public-facing interactive mapping applications the council has on its website.

"I only have to maintain and publish our data once," said Doyle, "and it is presented to the public in two different ways."

With ArcGIS Online, Roscommon County Council now has a simple means of publishing data in numerous standard formats, such as Microsoft Excel spreadsheets or Esri shapefiles, or via APIs—making it easy for anyone to access. This allows an array of organizations and individuals to support local businesses, sustain community groups, and stimulate the local economy using the council's open data. What's more, the council achieved its open data objectives cost-effectively, using minimal internal resources.

"If I hadn't had ArcGIS Online," explained Doyle, "I would have had to *[engage]* a web developer to build a separate website specifically for serving up open data. I would then have had to export all our data to the open formats, maintain it, and host it. That would have taken a lot of time and money."

The Open Data Portal also saves Roscommon County Council time in retrieving and responding to requests for information. People can now go to the council's Open Data Portal directly to find the information they need. Doyle estimates that he and his coworkers reclaim a week or two per year now that they don't have to respond to so many information requests.

"I like to think that the benefits of open data will increase over time as more people catch on to the fact that all this data is available," Doyle added. "As I publish more datasets, the more the value of our Open Data Portal will grow."

As Esri Ireland's Michael Byrne, a founding member of the Irish chapter of Open Knowledge (openknowledge.ie), commented, "The achievements of Roscommon County Council clearly demonstrate Ireland's readiness and ability to deliver on the open data agenda right now."

For more information, email Roscommon County Council's GIS manager, Barry Doyle, at bdoyle@roscommoncoco.ie.

↑ Roscommon County Council Open Data Portal, powered by ArcGIS Online, helps people and organizations support local businesses and sustain community groups.

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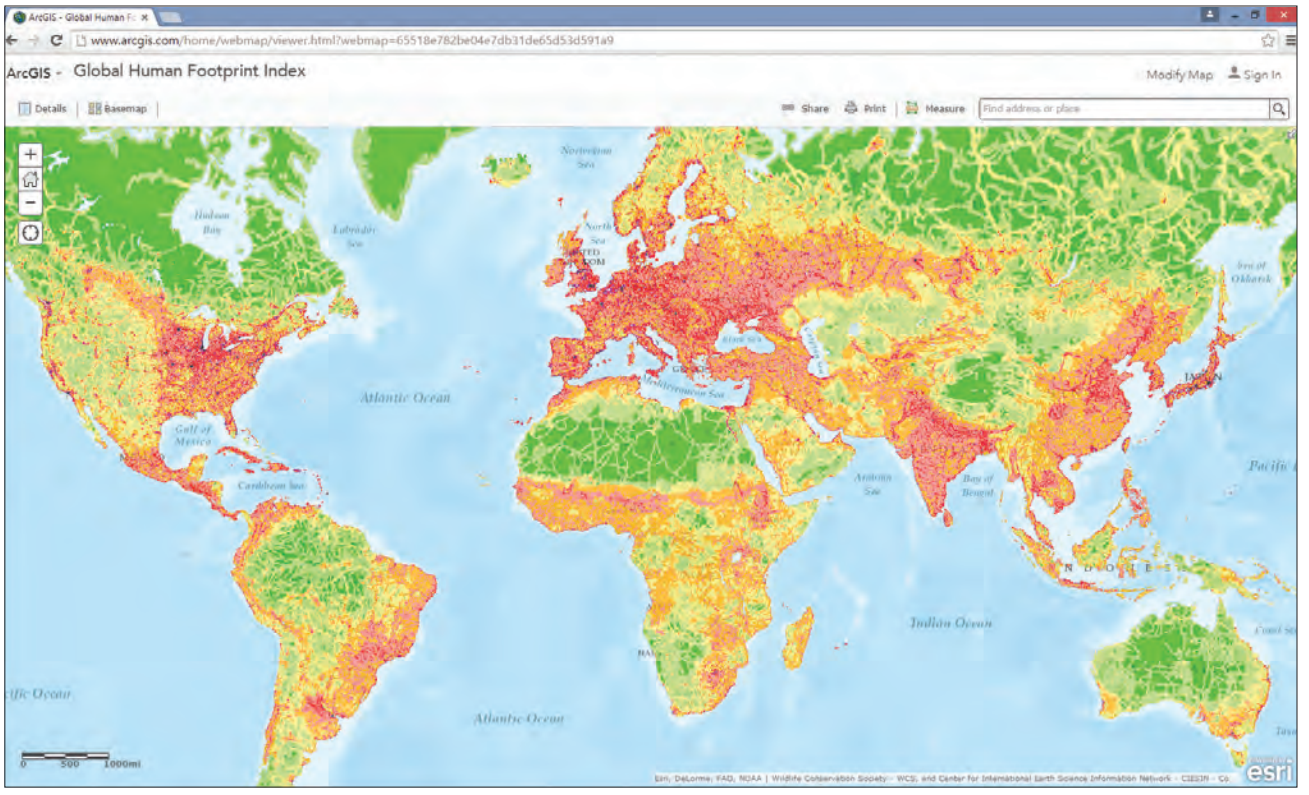
CIESIN Map Services Now in ArcGIS Online

The Center for International Earth Science Information Network (CIESIN), part of the Earth Institute at Columbia University, released a series of mapping services in the Landscape for Contributors group on ArcGIS Online. These services—related to conservation, health, demography, and transportation—are available at no charge to ArcGIS Online users.

While these datasets can be downloaded in GIS formats on the Socioeconomic Data and Applications Center (SEDAC) website (sedac.ciesin.columbia.edu), CIESIN published these mapping services via ArcGIS Online so they can reach a wider audience.

Available global layers include the Last of the Wild, the Global Human Footprint Index, population density, atmospheric particulate matter, and roads. CIESIN has also compiled and published a layer of selected hazardous waste site polygons for US National Priorities List Superfund sites, which were originally created by the Agency for Toxic Substances and Diseases Registry. This is the first time that polygon data for Superfund sites has been made available to the public in a single spatial layer.

These services and data products are provided by CIESIN with funding from the National Aeronautics and Space Administration for the Socioeconomic Data and Applications Distributed Active Archive Center and the National Institute of Environmental Health Sciences Superfund Research Program.



↑ The Global Human Footprint Index from CIESIN is now available in ArcGIS Online and incorporates data on human population pressure, human land use and infrastructure, and human access to spaces such as roads and navigable rivers.

Well-Traveled Esri T-shirts, Magazines

Dr. Lemuel Patterson, a STEM education instructional systems specialist for the South Carolina/Fort Stewart/DoDDS Cuba school district, poses at the welcome sign to Guantanamo Bay, Cuba, where students at the US Department of Defense Education Activity's W.T. Sampson School conduct geocache activities on the island.

Gretchen Brown, CAD/GIS specialist for the City of Bainbridge Island in Washington State, dons an Esri cycling jersey while mountain biking on the Lower Big Quilcene Trail in the Olympic National Forest.

Annabelle Henderson, daughter of FBI geospatial analyst Parrish Henderson, kicks back to read the latest issue of *ArcUser* at the family's home in Miami, Florida. "Apparently, now we have two geogeeks in the house," said Henderson's wife.

New Training and Certification Offerings

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The Esri Training Pass allows customers to purchase training days in advance at a fixed price and then access instructor-led classes and e-learning courses as needed. The Training Pass is available for single-year and multiyear terms and is included on the Esri Federal GSA Schedule. Learn more at esri.com/trainingpass.

Maintaining Geodata

Data is the engine that powers maps, apps, and all the decisions made using them. Ensuring data accuracy and reliability is much easier when organizations implement efficient workflows founded in best practices. The courses below are designed for database administrators and GIS professionals who create, manage, and maintain their organizations' authoritative geographic data.

- Building Geodatabases
- Deploying and Maintaining a Multiuser Geodatabase
- Distributing Data Using Geodatabase Replication
- Editing Data with ArcGIS for Desktop
- Editing and Maintaining Parcels Using ArcGIS
- Implementing Versioned Workflows in a Multiuser Geodatabase
- Working with CAD Data in ArcGIS for Desktop

Have a Free Hour? Watch a Free Seminar!

Each month, Esri Training Services streams at least one live training seminar to desktops and tablets around the world. In these hour-long courses, Esri experts teach ArcGIS best practices and tips, as well as the software's latest capabilities. All seminars are recorded and available online shortly after the live event. View the schedule for upcoming live seminars, plus the archive, at esri.com/lts.

Certification

The new ArcGIS Desktop Entry certification exam is now open for registration. This certification is designed for those with less than two years of experience using ArcGIS for Desktop to complete basic GIS tasks related to mapping, geodata, and analysis. Recent college graduates, GIS certificate recipients, and others, will benefit from this certification. Learn more about the exam at esri.com/certification.

Visit esri.com/training for more information. Find courses at esri.com/coursecatalog. Keep up with Esri training news by subscribing to the newsletter (esri.com/trainingnews), visiting the *Esri Training Matters* blog (esri.com/trainingblog), and following @EsriTraining on Twitter.

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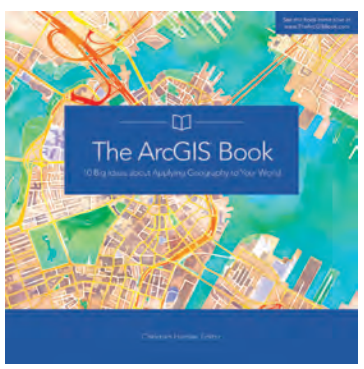
The ArcGIS Book: 10 Big Ideas about Applying Geography to Your World

Edited by Christian Harder

Intended for the professional mapping community and GIS novices alike, *The ArcGIS Book: 10 Big Ideas about Applying Geography to Your World* helps readers understand and use web GIS, which is transforming the way geographic information is applied and shared. The book explores 10 "big ideas" that show how the Internet has helped digital mapmaking become mainstream. Rooted in the ArcGIS platform, this hands-on book empowers readers to do new things and accomplish familiar tasks more quickly by working with *The ArcGIS Book* as much as they read it. Using "Learn ArcGIS" lessons, readers make a story map, conduct geographic analysis, edit geographic data, work in a 3D web scene, build a 3D model of Venice, and more. July 2015, 152 pp. Paperback ISBN: 9781589483453 and e-book ISBN: 9781589484313.



Esri Map Book, Volume 30

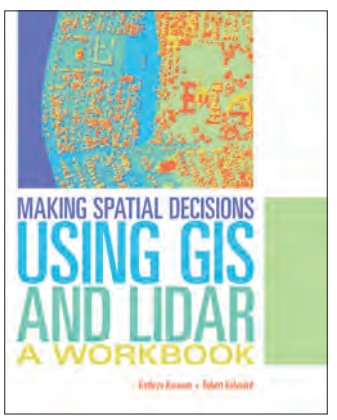
By Esri

Every year, works from mapmakers around the world are selected for the *Esri Map Book* to demonstrate how GIS helps governments, businesses, and citizens. *Esri Map Book*, Volume 30, preserves this tradition by showcasing maps and applications that use ArcGIS to make sense of extensive and often diverse sets of data in efforts to evaluate resource sustainability, determine efficient transportation routes, mitigate the effects of natural disasters, come up with more streamlined business practices, and much more. This year's *Esri Map Book*—which contains descriptions of each map or application's purpose and how it was produced—is an invaluable compilation for GIS users, cartographers, collectors, and map libraries. July 2015, 160 pp. Paperback ISBN: 9781589484252.

Making Spatial Decisions Using GIS and Lidar

By Kathryn Keranen and Robert Kolvoord

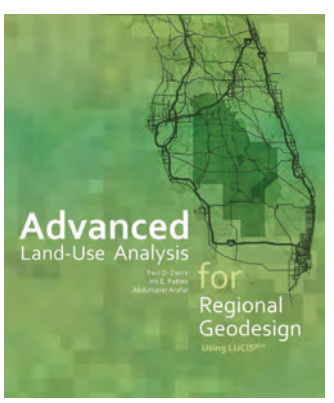
Making Spatial Decisions Using GIS and Lidar, the third workbook in Esri's Making Spatial Decisions series, focuses on scenario-based problem solving using an integrated workflow in ArcGIS 10.2 for Desktop and above. Authors Kathryn Keranen and Robert Kolvoord employ lidar—a powerful and increasingly popular data source used to create highly accurate elevation and terrain models—as the primary data source, enabling students and self-learners to develop their GIS and lidar-related analysis skills. Downloadable data and access to a 180-day free trial of ArcGIS are available on the Esri Press book resources page at esripress.esri.com/bookresources. To obtain instructor resources, email esripress@esri.com. October 2015, 264 pp. Paperback ISBN: 9781589484290.



Advanced Land-Use Analysis for Regional Geodesign: Using LUCISplus

By Paul D. Zwick, Iris E. Patten, and Abdulnaser Arafat

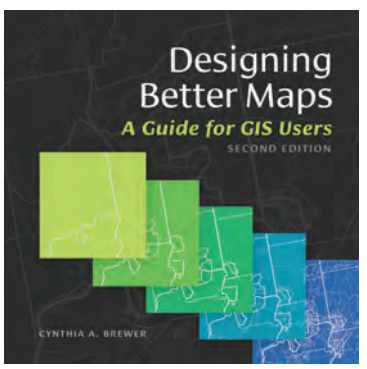
Land-use planning has evolved recently—not least because of the 2008 recession. In *Advanced Land-Use Analysis for Regional Geodesign: Using LUCISplus*, Paul Zwick, Iris Patten, and Abdulnaser Arafat expand on the Land-Use Conflict Identification Strategy (LUCIS) model put forth by Zwick and Margaret Carr in their 2007 book, *Smart Land-Use Analysis: The LUCIS Model*. For *Using LUCISplus*, the authors upgrade the LUCIS model—which uses GIS to formulate land-use conflict identification strategies—to address common issues, including the interplay between transportation and land use, the identification of urban mixed-use opportunities, and the land-use implications of natural disasters. The book also addresses scalable geodesign in regional, urban, and environmental contexts. October 2015, 530 pp. Paperback ISBN: 9781589483897 and e-book ISBN: 9781589484337.



Designing Better Maps: A Guide for GIS Users

By Cynthia Brewer

Expanded and with updated illustrations, *Designing Better Maps: A Guide for GIS Users*, Second Edition, is a comprehensive reference guide that breaks down the myriad decisions mapmakers must make about color, font, and symbology to create maps that effectively communicate the intended message. Author and renowned cartographer Cynthia Brewer demystifies the basics of good cartography by walking readers through layout design, scales, north arrows, projections, color selection, font choices, symbol placement, and various export options—all of which lead to the creation of publication-worthy maps. The book also includes an appendix that describes the author's popular online color selection tool, the ColorBrewer application. October 2015, 260 pp. Paperback ISBN: 9781589484405 and e-book ISBN: 9781589484375.



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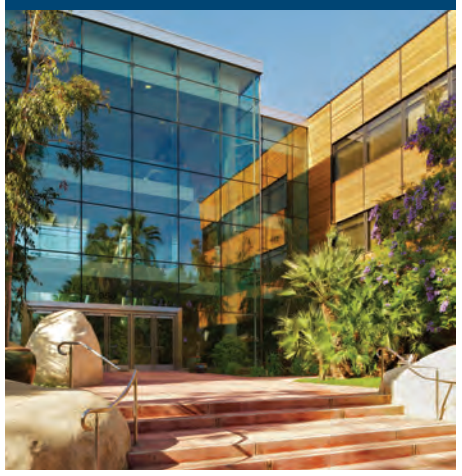

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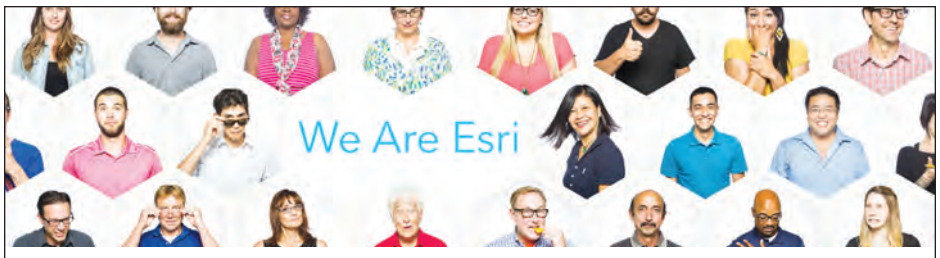

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