ArcNews

Esri | Winter 2016 | Vol. 38, No. 1

Briefly Noted

Big Data Analysis Made Easier
In a release scheduled for this year, Esri will support ArcGIS using SAP HANA. By feeding big data into HANA, an in-memory computing platform that does not require back-and-forth data transfers, ArcGIS users will have their data available for instant access at all times, making data processing much faster and fueling critical business decisions in real time. Learn more about this ongoing partnership at esri.com/saphana.

Watching Cities Evolve in Real Time
Local governments can now see their cities evolve in real time. Esri startup partner Mapillary, which crowdsources street-level imagery and makes it available instantaneously, is now integrated with the ArcGIS platform, enabling departments of public works, transportation, and utilities, among others, to benefit from near real-time 3D landscape views. Learn more at mapillary.com/arcgis.

IoT Spatial Analytics
To help organizations consume large data streams in real time coming from the Internet of Things (IoT), Esri and Microsoft are integrating location services and spatial analytics into the Microsoft Azure IoT Suite. Using preconfigured solutions, governments and businesses can employ IoT data to improve safety, reduce air pollution, and mitigate traffic congestion.

ArcGIS Is a System of Engagement... and a System of Record

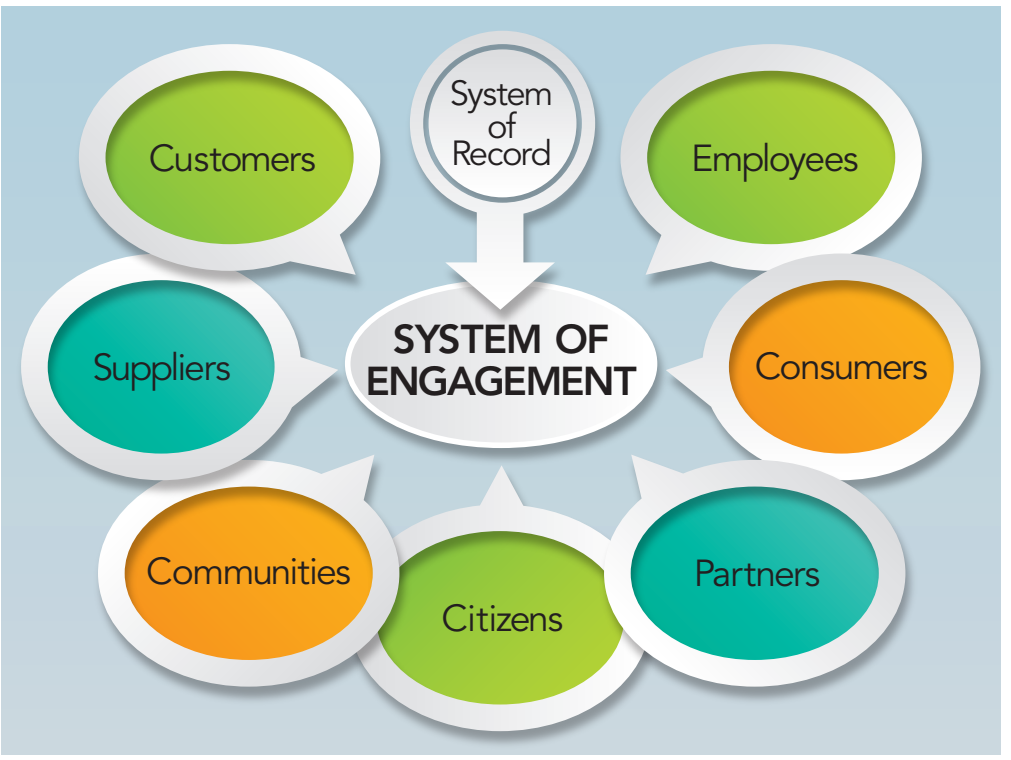
Applying the Benefits of Geography Everywhere

For decades, users have employed ArcGIS as a system of record for geospatial information and assets. In today's world, however, that is not enough. To make a system of record more valuable, the information it holds must be shared with a broader audience in a collaborative way. In other words, a system of record needs a system of engagement.

The ArcGIS platform is in a unique position: It is both a system of record and a system of engagement.

Most GIS professionals are already experts at using ArcGIS as a system of record. They use it to collect, manage, and compile geospatial information in maps, which represent reality in a lucid way and allow for better analysis and more sound decision making. The power of geography is that nearly anyone can look at a map and quickly grasp complex information. Whether simply trying to see where a company's customers are located or modeling the impacts of climate change on different ecosystems to better understand Earth's evolution, maps make it easier to gather insights on trends and spatial relationships.

A system of engagement allows more people to share and understand complex data and ideas. And that is exactly what ArcGIS does.



↑ A system of engagement leverages a system of record and impacts more people within and across organizations.

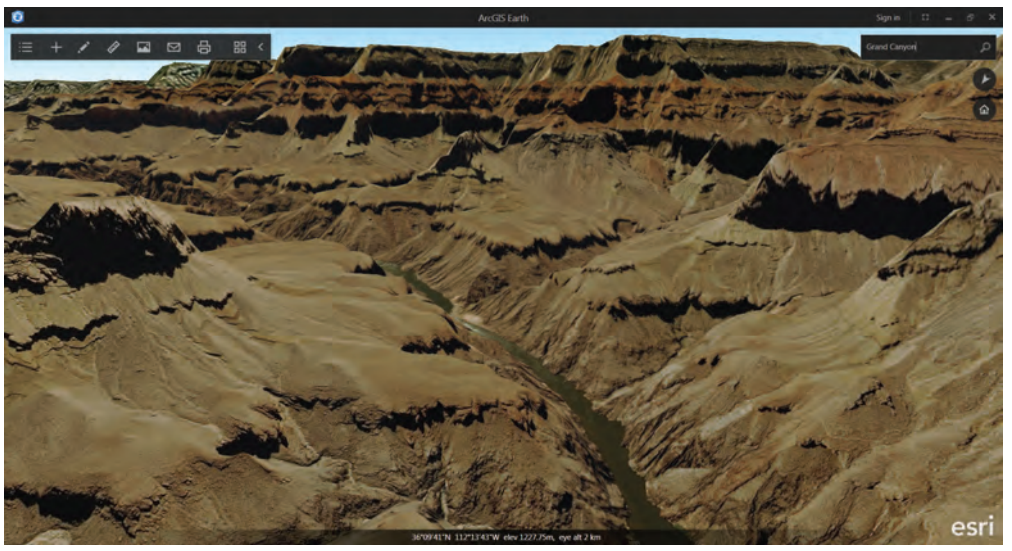
The Power of Geography

Esri president Jack Dangermond talks about awakening the world to the power of geography. Geography, he says, is an integrative science that can help create a better future—one in which people have the right information to make smarter decisions, communicate more effectively, and work in ways that are healthier for the planet as a whole.

continued on page 4

ArcGIS Earth: Now Released

Esri Provides Free App for Visualization of GIS and KML Data



↑ 3D terrain views, like this one of the Grand Canyon, are available by default in ArcGIS Earth.

ArcGIS Earth, an interactive globe that allows users to explore any part of the world and work with 3D and 2D data, is now available from Esri.

Fully integrated with the ArcGIS platform, the program works with Esri and open standard data formats, including shapefiles and KMLs. Users who want to quickly view spatial information can use ArcGIS Earth, at no cost, to access map data that has been shared with them as a file or link. They can also work with data stored behind a firewall in ArcGIS for Server or ArcGIS Online, as well as securely access, share, and publish their enterprise maps and data.

Extending Esri's 3D Offerings

The ArcGIS platform's 3D capabilities span a number of products that are built to meet diverse needs. At one end of the spectrum, the 3D Scene Viewer allows anyone with a web browser to easily view, create, and share location information in 3D. At the other end, ArcGIS Pro enables users to do advanced 2D and 3D

continued on page 3

ArcNews

Esri | Winter 2016 | Vol. 38, No. 1

The nonliterate Mbendjele tribe in the Congo Basin used an icon-driven app to map sacred and medicinal trees to save them from being cut down.

Table of Contents

Executive Editor
Monica Pratt

Editor
Citabria Stevens

Graphic Designer
Takeshi Kanemura

Illustrators
Doug Huibregtse
David Lauruhn

Manage Your *ArcNews* Subscription

To subscribe, unsubscribe, or make changes to your Esri publications, please go to **esri.com/updates**.

Outside the United States, please contact your international distributor to subscribe, unsubscribe, or change your address. For a directory of distributors, visit **esri.com/distributors**.

Article Submission Guidelines

Before writing an article, read and follow the publication guidelines at **esri.com/ansubmission**.

ArcNews
Esri
380 New York Street
Redlands, CA 92373-8100 USA
arcnews_editor@esri.com
Tel.: 909-793-2853, ext. 1-2730
Website: esri.com/arcnews

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.

ArcGIS Earth: Now Released

continued from cover

visualization, editing, analysis, and publishing. ArcGIS Earth extends these 3D capacities.

Here's what users can do with this new, visually compelling 3D experience:

Go around the world. Start with a view of the globe and zoom in to the rooftop of a house. Or, explore different terrains, oceans, and mountains anywhere in the world. Tilt and rotate the high-performance, interactive globe to unearth new details about a multitude of locations using 3D views and satellite imagery. The user interface is immersive.

Take in the full picture. Instantly open familiar data formats—such as KML files, KMZ files, shapefiles, imagery, and web services—to view them in 3D and see details that might not be prominent in 2D. Continue with already established workflows and access publicly shared feature, scene, map, and image services via a URL or by browsing services in Portal for ArcGIS or ArcGIS Online. Users who log in with named user accounts can access secure organizational and group data.

Add context to maps. Incorporate publicly shared basemaps from ArcGIS Online, including global imagery, topographic maps, world ocean maps, and OpenStreetMap. ArcGIS Earth supports content from the Living Atlas of the World as well, including demographic, landscape, terrain, and transportation data.

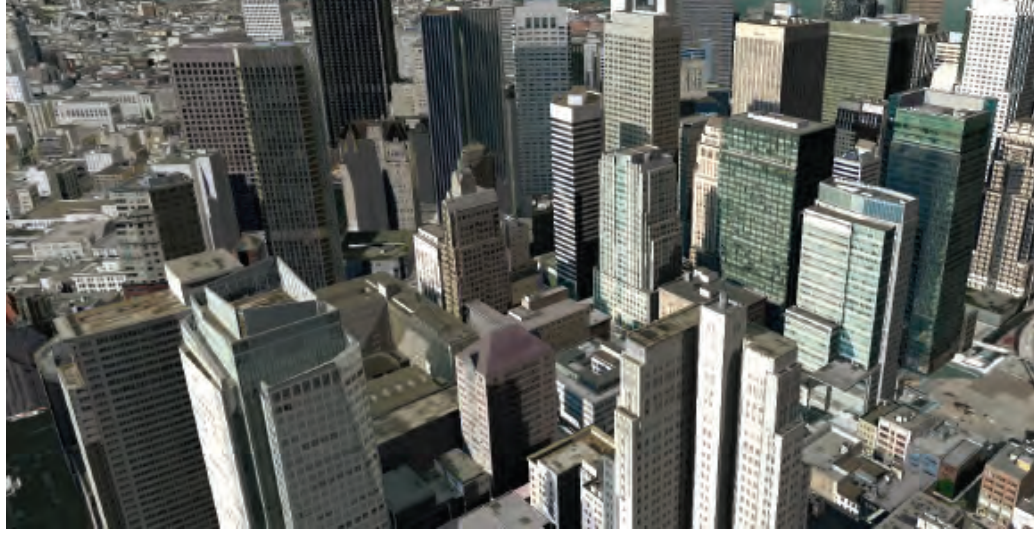
Sketch and measure. ArcGIS Earth supports basic linear and segmented distance measurements. So interpret elevation; calculate distance and area; and draw point, line, or polygon place marks.

Communicate progress more effectively. Report the status of a project and present work to stakeholders or clients in a compelling and interactive 3D format. Supplement maps with sketches and annotations to help others see the situation comprehensively. With one click, ArcGIS Earth users can email a 3D map view to others or save it as an image to share later.

Enable secure access. Like the rest of the platform, ArcGIS Earth allows users to share data securely through enterprise IT compliance and private groups and services. Outside an enterprise firewall, access information in ArcGIS Online, including basemaps, terrain, and data shared publicly by other users. Inside the firewall, create basemaps and services using Portal in ArcGIS for Server.

A New Option for Google Earth Enterprise Clients

ArcGIS Earth is part of Esri's offer for Google customers and partners looking to transition to Esri software. Along with the other capabilities of the ArcGIS platform, ArcGIS Earth provides an alternative to the Google Earth Enterprise Client. Additionally, those with a Google Apps API key can implement Google Street View inside ArcGIS Earth. Using a web service, they can call Google Street Views in KML, point ArcGIS Earth to the service, and display Google Street Views in ArcGIS Earth.



↑ This 3D view of buildings in San Francisco, which is a web service, makes it easier to see details that might not be prominent on a 2D map.

↑ ArcGIS Earth allows users to instantly open familiar data formats, such as this KML file of air quality data, and view them in 3D on the globe.

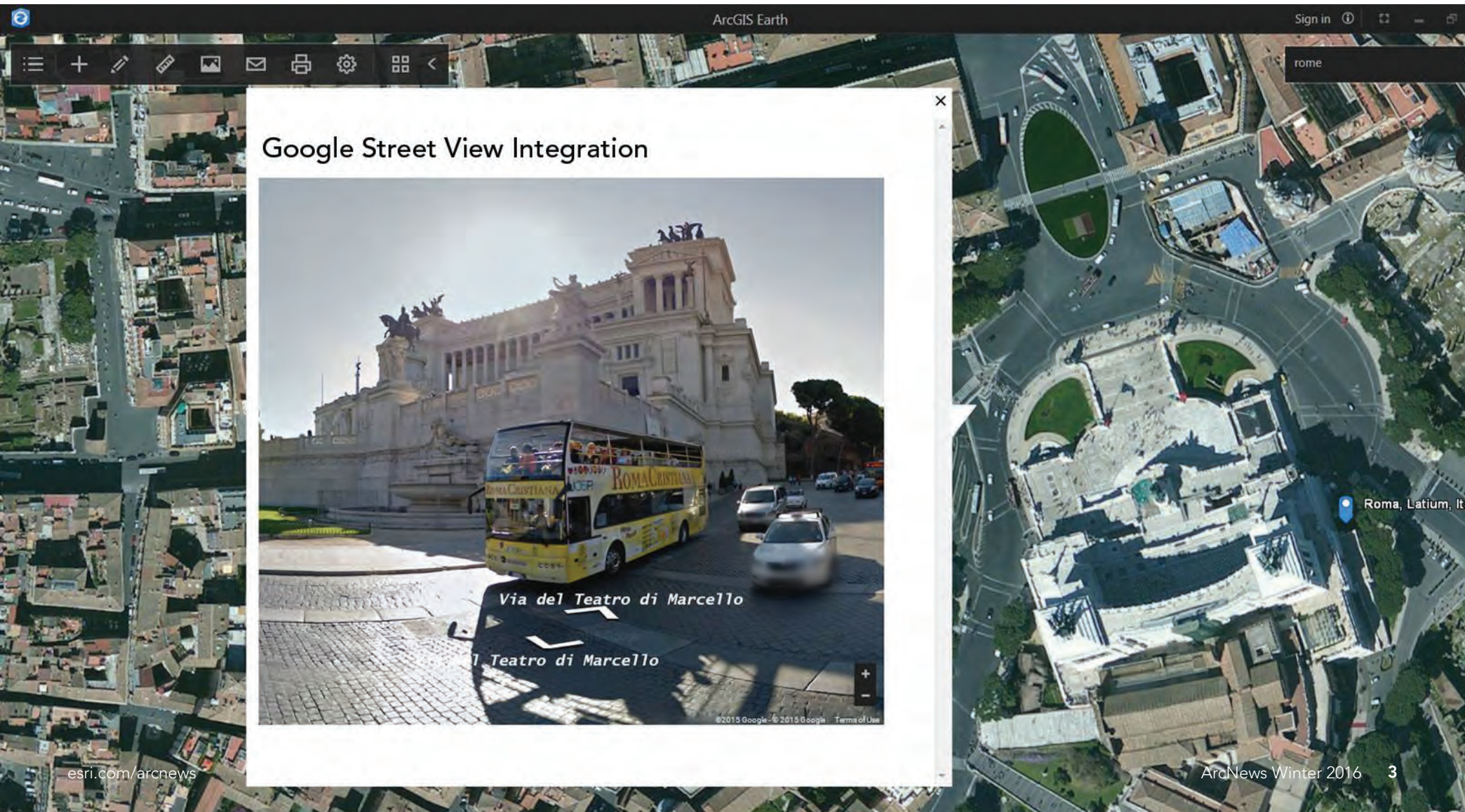
More to Come

Now that ArcGIS Earth has been released, Esri is focusing on adding new features and enhancements. Support for web map services, time sliders, map tours, and offline use are on the road map and will be released in future versions.

Get Started

ArcGIS Earth is free, so anyone can install it and begin using it—without impacting the budget. Download ArcGIS Earth at esri.com/earth.

↓ With a Google Apps API key, Google Street View can be integrated inside ArcGIS Earth to give users an on-the-ground look at places such as the National Museum of Italian Emigration in Rome, Italy.



ArcGIS Is a System of Engagement and a System of Record

continued from cover

As geography's emissary, GIS can bring about this awakening by fulfilling its potential as a system of engagement.

GIS as a system of engagement applies the benefits of geography—of maps—everywhere, across organizations and communities, in a way that invites participation from everyone: employees, customers, partners, and citizens.

To realize this vision, the ArcGIS platform has been expanded to include ready-to-use apps, content, capabilities, and GIS infrastructure so everyone can visualize, analyze, and collaborate using maps—anytime, anywhere, and on any device.

Records Versus Engagement

Geoffrey Moore, author of *Crossing the Chasm* and other books on technical innovation, spurred much of the record versus engagement discussion when he introduced the concept of systems of engagement as the future of IT. Moore said that systems of engagement are decentralized and encourage peer-to-peer interactions. He also said that the systems usually leverage cloud and mobile technologies to enable interaction in a scalable and cost-effective way.

Thus, it is not just about collecting and having information; it is about empowering everyone in an organization (and in that organization's community) to access and understand it.

This is exactly what maps do. They free up access to powerful information that would otherwise be locked away in systems of record. Maps—and GIS—turn a system of record into a system of engagement. But it is not an either-or situation. ArcGIS is a system of record *and* a system of engagement because it is essential to have both and integrate them in meaningful ways.

ArcGIS for Connection and Collaboration

Graduating to the next level, where ArcGIS is easily and naturally the go-to system of engagement, requires connection and collaboration.

A system of engagement starts with communication, with connecting people in real time using smart and geographically aware devices. It is a move to enable and empower more people—employees, customers, consumers, citizens, and suppliers—with the information they need.

Using apps on mobile devices, field crews become more productive and effective by getting and providing near real-time information as they work. By visualizing and analyzing business data on a map, office employees discover new patterns and insights. Citizens can now more easily find information about their city, county, or country on open data portals and provide direct feedback to their governments using crowdsourcing apps that they can simply install on their smartphones. Executives and officials get a deeper and more encompassing look at their businesses or common operating pictures, allowing for better situational awareness.

The keyword in all this is, of course, engagement. That is achieved by sharing information via collaborative tools that make it easy for everyone to get involved. While GIS professionals feed the system of record that powers the system of engagement (by building, maintaining, and analyzing geospatial information), they—along with cartographers—are no longer the only ones who can make, use, and share maps. Now, everyone everywhere can collaborate with maps that are hosted on web browsers and apps on desktop computers, laptops, tablets, and smartphones.

Location as the Integrator

Location-aware systems and devices are unique enablers of a system of engagement because of their ability to integrate many disparate data sources across different systems of record.

GIS professionals have long known that almost every piece of information in virtually any system of record—including GIS, enterprise resource planning (ERP), and customer relationship management (CRM)—already includes some location information. Once the information is integrated based on location and visualized on a map, they can more easily discover unique patterns. This works with tabular, vector, imagery, and even big data.

In a system of engagement, all this visual information is easily shared, fostering increased collaboration and resulting in new insights. The ArcGIS platform does this.

> GIS as a system of engagement applies the benefits of geography everywhere in a way that invites participation from everyone.

Different Types of Systems of Engagement

This approach can be applied to various scenarios using different types of engagement.

Governments offer the most obvious application for using a mapping platform as a system of engagement. All levels of government must connect with their constituents and communities. Using ArcGIS as a system of engagement, a government organization can work closely with businesses and citizens to build smarter and more resilient communities.

Cities, for example, can include citizens in urban development and planning projects to solicit feedback before making major investments. One way to do this is to create the city Hub. A Hub uses cutting-edge, ArcGIS software-based technology to engage with key members of the community, including businesses, startups, nongovernmental organizations, academic institutions, and citizens. These disparate groups collaborate using community data, maps, and apps to solve problems—such as how to better conserve water or how to more usefully connect public transportation to points of interest—to build smarter communities.

This approach, which supplies all the necessary data in easy-to-locate places, is applicable to all levels of government. It empowers citizens to provide feedback to their government organizations easily via apps and websites, and it encourages businesses to innovate with the goal of solving community issues.

Systems of engagement are not limited to governments, though. Companies across a number of industries increasingly use them to foster direct interaction between field crews, office staff, and executives. Doing this leads to better decision making, reduces costs, and increases timeliness and accuracy.

What It Takes

ArcGIS users already have access to a platform that is easily configured to be a system of engagement.

With ArcGIS Open Data, organizations can communicate directly with citizens. Using a suite of apps for data collection, routing, and optimizing workflows—including Collector for ArcGIS, Navigator for ArcGIS, and Workforce for ArcGIS—companies can engage with field crews in real time. And with apps for the office, business intelligence, and business analysis, such as Esri Maps for Office and the Esri Business Analyst suite, organizations can easily enable knowledge workers and business analysts to make more informed decisions.

Maps continue to power systems of record, even while they have become the language of systems of engagement. Having both a system of record and a system of engagement is optimal. And both are already possible with ArcGIS.

ESRI'S COMMITMENT TO OPEN

ArcGIS is fundamentally an open platform. We take this seriously, as it ensures our users' data and systems are interoperable with other technologies. Embracing this approach can be challenging because different organizations have different approaches, philosophies, and preferences for implementing interoperability. At Esri, we are working to support multiple pathways to ensure that our system is open. Here's how:

Open Standards

We support open standards and are active in many organizations, including the Open Geospatial Consortium, Inc. (OGC), and the International Organization for Standardization (ISO), to help drive and develop new standards.

Open Data Formats

We support open data formats so different technologies can work well together. This enables one commercial off-the-shelf product to talk directly to another. It is the most efficient way to achieve interoperability because the two products simply work together using common data formats. We implemented ArcGIS Open Data so you can openly share your data in multiple formats.

Open System

We make sure our system is open. This means open APIs. We have open-source tool libraries and bring open-source packages into our environment. We participate in GitHub, with more than 300 open-source projects. Our extendible architecture allows you to add to it, and you can embed our technology into other integrated solutions.

Our approach—multiple pathways to interoperability—is successful, as evidenced by the thousands of systems our customers have implemented. These systems are complex and heterogeneous, and they work.

To get involved or learn more about our approach to building ArcGIS as an open platform, please visit esri.com/software/open-site.

Sincerely,

GIS Helps Rid the World of Land Mines

The Geneva International Centre for Humanitarian Demining (GICHD) and Esri have joined forces to modernize the software that plays a central role in clearing land mines and unexploded ordnance (UXO) in more than 40 countries around the world.

Esri is working with GICHD to develop new mobile data collection apps and spatial analysis and reporting tools for the Centre's Information Management System for Mine Action (IMSMA), the software that makes mine action (the broad efforts to remove land mines and UXO) safer and more efficient.

"Mine action is inherently geographic," said GICHD ambassador and director Stefano Toscano. "It relies on identifying the location and spatial extent of explosive hazards and analyzing their proximity to vulnerable communities and assets. GIS is ideally suited to support this work."

GICHD is an international organization dedicated to helping nations find and dispose of land mines, cluster munitions, and other explosives. Although casualty numbers are decreasing, more than 3,600 people were killed or maimed by land mines and other UXO in 2014, according to *Landmine Monitor 2015*, a publication from the International Campaign to Ban Landmines. These hidden hazards affect the daily lives and socioeconomic development of communities long after armed conflicts have ended. GICHD provides expert guidance to government and nongovernmental agencies in the mine action sector to observe standards, apply effective and cost-efficient tools, and improve survey and clearance methods.

GICHD and Esri signed a memorandum of understanding in October to strengthen their 17-year partnership to rid the world of land mines and other explosive remnants of war. In 1998, GICHD enlisted the help of Esri and a team of GIS programmers to create IMSMA, a single database application for all mine action projects that could be tailored to each country's cleanup efforts.

Free access to IMSMA helps mine action officials in each country identify, develop, and improve demining activities. National authorities, mine action centers, and partner organizations use IMSMA to securely collect, aggregate, and share data via interactive maps.

With Esri's ArcGIS technology, IMSMA grew to serve a critical purpose in the mine action process: understanding exactly where mines are located prior to conducting clearance. And the system has since evolved. What began as a tool for mine action partners to organize, qualify, and share data has developed into a system of tools that delivers actionable intelligence.

"IMSMA has grown to become arguably the most advanced and widespread information management tool in the humanitarian sector," Toscano said.

When IMSMA was first deployed in 1999 in Kosovo after the conflict there, the Mine Action Coordination Center (MACC) processed vast amounts of raw data about suspected land minds for inclusion in the database. The information was then distributed to field-workers in near real time, helping personnel verify true minefields over rumored ones. GICHD then amplified IMSMA with other tools, including its Mine Action Intelligence Tool (MINT). Today, MACC and organizations around the world use MINT to create and schedule reports, analyze demining data stored in IMSMA and other systems, track indicators, and design dashboards. Available on mobile devices, MINT helps demining personnel get the most out of their data so they can make evidence-based decisions.

GICHD's next version of IMSMA will further harness Esri's latest GIS software and deliver a set of increasingly interconnected tools and processes that can be configured for each country's needs. With the current version of IMSMA offering limited GIS analysis capabilities, GICHD will work with Esri to develop future IMSMA components that enhance existing information management offerings. The organization plans to integrate existing Esri solutions into IMSMA to offer the mine action community the latest GIS technology for mobile data collection, spatial analysis, and reporting.

Several of these components are already in progress, with functions available in beta to the mine action community.

For example, GICHD's multicriteria prioritization tool (PriSMA), powered by Esri technology, will let decision makers use spatial data to determine where to dispatch resources. Built on an interface that requires minimal training, stakeholders will be able to interact with data and weigh various factors to identify the hazards and areas that are most important. Users will be able to gauge which hazards pose the highest risk to regions based on population, access to hospitals, proximity to schools and roads, and more. By scaling these indicators according to their level of importance, the tool will run a priority analysis and produce a map that shows the areas that are most impacted and the hazards that are the most dangerous.

GICHD's objective is to work with Esri and other partners to enable the use of GIS throughout the mine action community within the next three years.

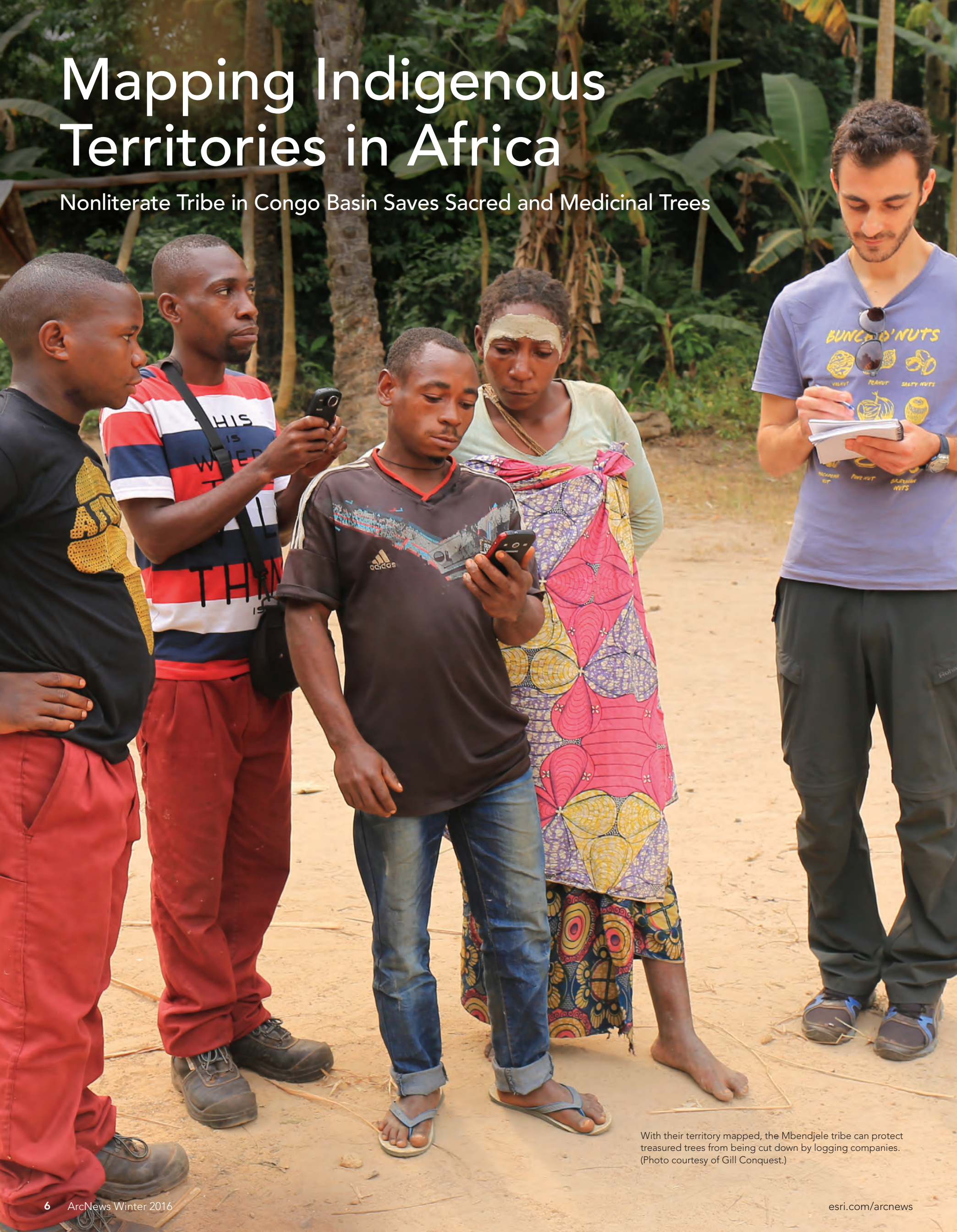
"The Centre's work is profoundly important and deeply geographically oriented," said Esri president Jack Dangermond. "Saving and enhancing people's lives across the world depends on GICHD's success, and the Centre's success depends on accurate, up-to-date GIS solutions and information. We at Esri are proud to provide our technology and expertise to help drive GICHD's mission."

For more information, visit gichd.org.

↓ Images from a GICHD story map show how, in Maputo, Mozambique, the removal of land mines (from the red areas) stimulated development in the surrounding community.

Mapping Indigenous Territories in Africa

Nonliterate Tribe in Congo Basin Saves Sacred and Medicinal Trees



With their territory mapped, the Mbendjele tribe can protect treasured trees from being cut down by logging companies. (Photo courtesy of Gill Conquest.)

← Although few tribal members had seen a cell phone, the ExCiteS team ensured that local populations could easily use the application. (Photo courtesy of Jerome Lewis.)

↓ Using the intuitive app, the Mbendjele mapped their tribal lands and highlighted trees that were important to them. (Photo courtesy of Jerome Lewis.)

While the world's indigenous people are estimated at only around 370 million, or about 5 percent of the global population, they reportedly speak 95 percent of the world's languages. Yet they remain virtually unrepresented both politically and economically. Often, their lives and livelihoods are under threat from the competing economic needs of others living within their countries. But with increased attention from the United Nations, nonprofit organizations, and volunteer groups, greater awareness and understanding of the rights of indigenous people have emerged at the international level, providing them with some legal standing.

Recognizing the ability of GIS technology to underpin citizen-based initiatives, Muki Haklay, professor of geographical information science at University College London (UCL), and Jerome Lewis, a lecturer of anthropology at UCL, formed the Extreme Citizen Science (ExCiteS) research group. ExCiteS is an interdisciplinary team composed of researchers, artists, and information and communication technology specialists that work with local people to better engage them in the process of citizen science through participation.

"Extreme Citizen Science is a bottom-up practice that takes into consideration local needs, practices, and cultures," said ExCiteS research associate Patrick Rickles. "We work with residents to understand their needs and problems and help them develop solutions and transform their communities using innovative GIS applications. Results are shared with the community and interested parties, based on the sensitivity of the data and consent from participants, so that the project can develop as they see fit."

Challenges to Mapping Indigenous Territories

Since 1994, Lewis has worked as an anthropologist with the Mbendjele, a nonliterate group of indigenous hunting and gathering people living in the Republic of the Congo.

"Logging has been imposed over the lands of indigenous people across the region," said Lewis. "The legal system hardly recognizes the rights of local people."

One of the local logging companies, Congolaise Industrielle des Bois, chose in 2006 to become Forest Stewardship Council certified, which identifies the company as environmentally and socially sustainable in its forestry operations. Part of the certification requires that the company respect the rights and resources of indigenous and local forest people.

But when Congolaise Industrielle des Bois asked the Mbendjele to indicate their territories on a map so the logging company could avoid interfering with resources that were critical to the community's livelihood, literacy issues and cultural differences became considerable obstacles.

Because the Mbendjele do not have a written language, members of the tribe were unable to interpret the map. Furthermore, the Mbendjele have an ideological aversion to land ownership, rejecting the concept altogether. They see their forestland as an extension of themselves.

"An Mbendjele loves the forest as he loves his own body," said Lewis.

An Intuitive Mapping Application

To help clear up these communication issues, Lewis developed an icon-driven mapping application that the Mbendjele could use to map their key resources and protect them from logging-induced damage. While this application worked for several years, by 2013 the software and hardware were outdated. So Lewis and Haklay founded the ExCiteS team to create more durable mapping solutions for the Mbendjele and other indigenous peoples.

With support from Esri, team members Matthias Stevens, Michalis Vitos, Julia Altenbuchner, Gill Conquest, and Carolina Comandulli began to develop Sapelli, a cell phone-based mobile data collection platform. Named after the mahogany-like Sapelli tree that grows in the Congolese rainforest (one of the main points of conflict between local communities and logging companies, as it is valued by both), Sapelli is an open-source Android app driven by pictogram decision trees.

Although few tribal members had seen a cell phone before the ExCiteS team introduced the technology to the project, the researchers ensured that local populations could easily understand how to use the application. After designing the initial pictograms, the ExCiteS researchers sought feedback from the Mbendjele and other users in the area. The team then altered the designs accordingly.

Using the now-intuitive application, the Mbendjele mapped their tribal lands and highlighted trees that were important to them, usually for medicinal reasons or religious significance. Congolaise Industrielle des Bois then verified the trees that the tribe documented as valuable and removed them from its cutting schedule. The tribe also documented illegal logging and poaching activities.

Because cell phone signal coverage is limited in Mbendjele tribal lands, the Sapelli app is programmed to transfer and reassemble very small packets of information at a time whenever possible. It uses compressed text messages to transfer key data, such as time stamps and selected points on the decision tree, back to the ExCiteS group.

Since the Mbendjele have no electricity and solar power can be unreliable under the canopy where they live, members of the tribe charge the phones using Hatsuden-Nabe cook pots from Japanese company TES New Energy Corporation. As the pots heat up over an open fire—while cooking dinner, for example—the heat is transformed into electricity that, conducted via a USB connector, powers the phone batteries.

Better Connecting Citizen Data

In general, members of ExCiteS use Esri software to do development and analyze data that helps inform their research. But the team is working on connecting the citizen data more comprehensively to Esri technology.

To do this, ExCiteS developer Oliver Roick engineered GeoKey, an open-source web API used to save and access geospatial information in a format compliant with the Open Geospatial Consortium, Inc. It lets the various ExCiteS projects store data collected by Sapelli or other geospatial technologies, as well as translate remote sources of data, so they can be consumed by a number of GIS programs and applications.

Currently, to import data into GeoKey from Sapelli, users must compress files exported from Sapelli and use an extension in GeoKey to import the ZIP files. Once the data is in GeoKey, users can visualize it in a web browser or a desktop GIS platform that can consume KML, GeoJSON, and CSV data, such as ArcGIS Online. In the future, however, transferring data will be done seamlessly from Sapelli, and additional data format outputs will be available in GeoKey. Moreover, as the platform's functionality increases, ExCiteS projects will be able to send GeoKey data directly to ArcGIS Online.

"This will allow citizen data collected through our open-source platforms to be shared with those using Esri technologies, such as government departments and *[nongovernmental organizations]*, for more informed decision making," said Rickles.

Expanding Sapelli to Other Populations

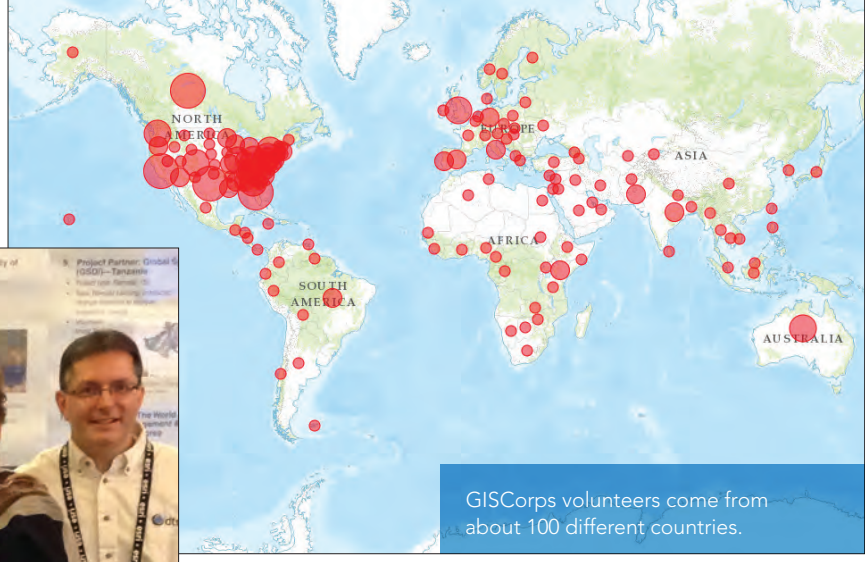
While ExCiteS initially developed Sapelli for use by the Mbendjele, the team has begun making the technology available to other populations as well.

"The pictogram decision trees in the application can be swapped out for other pictograms to facilitate its use by completely different communities," said Rickles. "It is currently being used by tribes in the Amazon by another ExCiteS researcher, Carolina Comandulli."

Comandulli is working with an Ashaninka group living in Acre State, Brazil. Unlike the Mbendjele, the Ashaninka have a designated area of indigenous land that they manage, and they are using Sapelli to collect evidence of illegal intrusions onto that land. Because the Ashaninka have a strong tradition of drawing, they designed many of their own icons.

The ExCiteS team is also working on other Sapelli projects in the Congo Basin that are currently in various stages of completion. In all cases, the platform plays a central role in the ExCiteS mission, which is to develop theories, tools, and methodologies to enable any community, anywhere, to engage in citizen science.

Using GIS for a Greater Good



GISCorps volunteers come from about 100 different countries.

GIS Hero

Passionate, *wonderful*, *energetic*, and *caring* are just a few of the exclusively favorable adjectives people use to describe Shoreh Elhami, the founder of GISCorps.

The organization, a program of the Urban and Regional Information Systems Association (URISA), connects volunteer GIS practitioners with nonprofits and emergency relief programs all over the world when they need help with mapping. Since its establishment in 2003, GISCorps has launched more than 175 missions, attracted more than 4,000 prospective volunteers from about 100 countries, and deployed around 950 volunteers for both on-site and remote projects.

"The idea was to go out and teach people about the technology in different parts of the world," said Elhami about the founding of the organization. She envisioned having volunteers go to places where either the GIS skillset was completely lacking or people couldn't afford to learn the technology.

"The main objective was to help others with what you know and what you're capable of," she added.

← Shoreh Elhami (center) with GISCorps Core Committee members (from left to right) Carole Kraemer, Mark Salling, Dianne Haley, and Allen Ibaugh.

Doing Ever More with GIS

Elhami was bitten by the GIS bug when she was a master's student in city and regional planning at Ohio State University. As a research assistant, she used the technology and realized early on that it was a much faster way to do the mapping and analytics work she had done by hand as an urban planner and architect in Iran.

"From then on, I was on a quest to see what more I could do with this," said Elhami.

That purpose has guided her career. As a GIS coordinator for the Delaware County Regional Planning Commission, she and her team created one of the first county-comprehensive plans that used GIS for analytical purposes. When she was recruited to be the GIS director for the Delaware County Auditor, she led the effort to build the organization's GIS division from scratch. As an adjunct professor at Ohio State, she stayed connected to her urban planning background while devising forward-thinking GIS curriculum for her nighttime classes. And, currently, as the GIS manager for the City of Columbus, Ohio, she and her team find new, fantastic uses for GIS every week that help people get their jobs done better and more quickly.

"The impact and the use and the benefits of GIS are now so much more widespread than ever before," said Elhami. "In many cases, until it's put in front of *[people]*, they don't know what they're missing."

Making GIS More Far-Reaching

Elhami's goal with GISCorps is to make the technology even more far-reaching than it already is.

She and the organization's other six Core Committee members volunteer their nights and weekends to run GISCorps. They sift through project requests, track down qualified candidates from the organization's extensive database, write up and send out job descriptions, review applications, interview prospective volunteers, and handle logistics for green-lit assignments.

Elhami estimates that she has spent part of 90 percent of every weeknight working on GISCorps.

"It's what I do and love," she said. "Nothing makes me happier than helping someone whom I feel my expertise can help."

The Real GIS Heroes

This same sense of wanting to give back permeates the organization. That is why Elhami believes that the GISCorps volunteers are the real GIS Heroes.

"There's nothing like meeting people who are like-minded, like-hearted," said Elhami about the volunteers.

David Litke, another Core Committee member, echoed this when talking about a recent project—an urgent call at the end of 2014 to help the World Health Organization (WHO) map its Ebola response activities in West Africa.

"We had 50 or 60 people that were willing to travel at a moment's notice over the holidays to a place where the Ebola epidemic was going on," said Litke. "Being made aware of having such great volunteers that were willing to do that impressed me a lot."

Mapping WHO's Ebola Response

GISCorps deployed four volunteers to help with the effort: Leslie Zolman, who went to Ghana; Charleen Gavette, who worked in Liberia; Jeff Pires, who traveled to WHO's headquarters in Geneva, Switzerland; and Emmanuel Lansana, who worked in Sierra Leone, where he also lived.

"I really loved being there," said Zolman, a GIS coordinator with the Montana Office of Tourism and Business Development and the Montana Department of Commerce. She spent just over five weeks in Ghana, where the United Nations (UN) had set up headquarters for the UN Mission for Ebola Emergency Response (UNMEER).

Initially deployed to coordinate with the affected countries to get their data in ArcGIS Online, Zolman and her GISCorps colleagues ended up doing much more basic—and badly needed—data collection and cleansing.

"It became evident that the administrative boundaries that people were using weren't really correct," said Zolman. "They didn't really nest with each other."

There were more than 300 cases of Ebola that couldn't be pinpointed anywhere because of data problems. So Zolman worked with the affected countries to get their data, clean it up, and put it into maps.

Gavette's work fed into this too. When she arrived in Liberia, she found out that no field data was being collected.

"No mapping of facilities or patients or anything," she said. "There was a high demand—from clinicians, epidemiologists, the trainers—for maps," but "there was no central GIS; there was no data repository; there was no data anywhere to even start to make a map."

Gavette, a GIS coordinator for the National Marine Fisheries Service in California, contacted people who had location information so she could start compiling data for towns, hospitals, and Ebola treatment centers. Although she and her team discovered large amounts of data inaccuracies, they made maps with the caveat that not all the information was correct. The maps still allowed aid workers to visualize large amounts of information quickly.

The data inaccuracies inspired Gavette to implement a data collection strategy as well.

"What we set in place was that, as the WHO staff visited facilities or went to any of their checkups…they were to begin collecting GPS coordinates from their cell phones so that we could actually start correcting the database and come back with accurate information," she said.

At WHO headquarters in Geneva, Pires consolidated all the information that Zolman, Gavette, Lansana, and their teams on the ground were compiling.

"What I ended up doing was normalizing and bringing together all this Ebola information…and then consolidating that and making it easily available for really the worldwide response community," said Pires, a lead analyst with National Grid in Massachusetts.

He and his team made an Esri Story Map Journal app to present the public with easily digestible Ebola situation reports. They also set up an ArcGIS Open Data site to enhance public awareness about the outbreak's evolution.

All three volunteers regard making and consolidating authoritative datasets a big success.

"Hopefully this will leave the countries with better infrastructure data than they had before," said Zolman.

"It would definitely help a future outbreak," echoed Gavette.

Assistance Now, to Help in the Future

Setting up sound GIS networks for future use is a recurring theme for GISCorps projects.

The organization recently completed its seventh mission to Afghanistan, where two GIS professionals went to Kabul Polytechnic University to teach the faculty advanced GIS. John Van Hoesen, a professor of geology in Vermont, and Gary Hunter, a GIS consultant from Australia, continued a multiyear professional development initiative to help the university establish an undergraduate course in GIS—a first for Afghanistan.

And remote projects, where volunteers work from home, are becoming ever more useful for establishing good data for current and future use. Brian Baldwin, the lead technical specialist for the utilities team at Esri, completed a GISCorps project after the earthquake in Nepal in which he helped map vulnerable areas throughout the country to let aid agencies know where they should focus their resources.

The Future for GISCorps

With crowdsourced projects becoming more the norm, now that GISCorps has set up partnerships with organizations such as Humanitarian OpenStreetMap and the Digital Humanitarian Network, the organization's impact is growing exponentially.

"We have been launching about 20 to 25 projects per year, starting in 2011," said Elhami. "That's huge."

With thousands of extraordinarily dedicated volunteers who are just "thrilled to be able to contribute to the greater good," according to URISA executive director Wendy Nelson, GISCorps will undoubtedly keep demonstrating the benefits of GIS to communities in need around the world. And, given the limitless energy that Elhami, the Core Committee, and other volunteers put into the organization, GISCorps doesn't look like it will slow down anytime soon.

For more information about GISCorps, visit giscorps.org.

The hen harrier could soon become extinct in Ireland if nothing is done to protect and restore upland landscapes.

Protecting Ireland's Endangered Birds of Prey

GIS Identifies Appropriate Land for Conservation Efforts

The hen harrier is one of Ireland's most iconic upland bird species. Yet this slim, long-tailed hawk has been driven almost to extinction by sustained habitat loss and mistreatment. It is in grave danger of becoming extinct in Ireland in the next 30 years if nothing is done to protect and restore upland landscapes.

To save this precious bird of prey, the Golden Eagle Trust is spearheading an urgent conservation initiative on behalf of the National Parks and Wildlife Service, and GIS is playing a critical role in conservation measures.

Establishing Accurate Habitat Knowledge

The Golden Eagle Trust, a nonprofit dedicated to safeguarding and restoring Ireland's native birds and their habitats, was appointed in June 2013 to help identify the pressures and threats on hen harriers and gain a better understanding of why the population is declining. The organization is carrying out its research in six special protection areas (SPAs) that have been designated hen harrier breeding zones. From 2005 to 2010, these SPAs—which cover more than 167,000 hectares across the country—saw a severe 18 percent decrease in the number of hen harrier territorial pairs (mates that defend their territories against similar birds and potential predators).

To fulfill its mission, the Golden Eagle Trust urgently needed to establish accurate knowledge of hen harriers' habitats, as well as various land uses within their breeding areas. To do this, the trust acquired ArcGIS for Desktop from Esri Ireland and began using it to create a comprehensive, species-specific habitat and land-cover map for all six SPAs. The organization amalgamated existing data and aerial photography from a range of partners, including Ordnance Survey Ireland, the National Parks and Wildlife Service, the Forest Service, natural resource management company Coillte, Irish agriculture and food development authority Teagasc, the All-Island Research Observatory, and Esri Ireland. It then imported GPS data from three previous national hen harrier breeding surveys that showed the locations of territorial pairs to identify the birds' important areas for nesting and foraging.

Thus, the Golden Eagle Trust created a single source of authoritative habitat data. The organization then used the powerful analytical capabilities of ArcGIS to analyze land cover, which yielded insights into how suitable (or unsuitable) different habitats within the SPAs are for hen harriers. This resulted in better comprehension of the challenges these birds face.

Indisputable Evidence, Thanks to ArcGIS

ArcGIS has given the Golden Eagle Trust unequivocal evidence as to why the hen harrier is struggling to survive in Ireland. It shows, for instance, that just 20.2 percent of the SPAs are actually the birds' favored open heath and grassland areas, while 80 percent of the forest in the network is unsuitable for these hawks due to dense canopies and high numbers of predators.

"ArcGIS confirmed that the increasing extent of mature forest in upland breeding areas is a significant driver of decline in the hen harrier population in Ireland," said lead project ecologist Ryan Wilson-Parr.

Implementing Targeted Land Management

The Golden Eagle Trust now uses the insights garnered using ArcGIS to assist the Irish government in implementing targeted, cost-effective approaches to land management for the benefit of the hen harrier.

"Analysis in ArcGIS can provide optimum conservation scenarios for the hen harrier in SPAs, identifying the most demographically and economically advantageous options for forest removal whilst providing the greatest benefit in terms of habitat restoration for the hen harrier," said Wilson-Parr. "ArcGIS also provides insight into how landscapes will change over time and, crucially, how the hen harrier population will likely respond in the long term."

The trust also depends on ArcGIS to help it consider the environmental impacts of changing land-use patterns for agricultural land, as well as renewable energy development in SPAs.

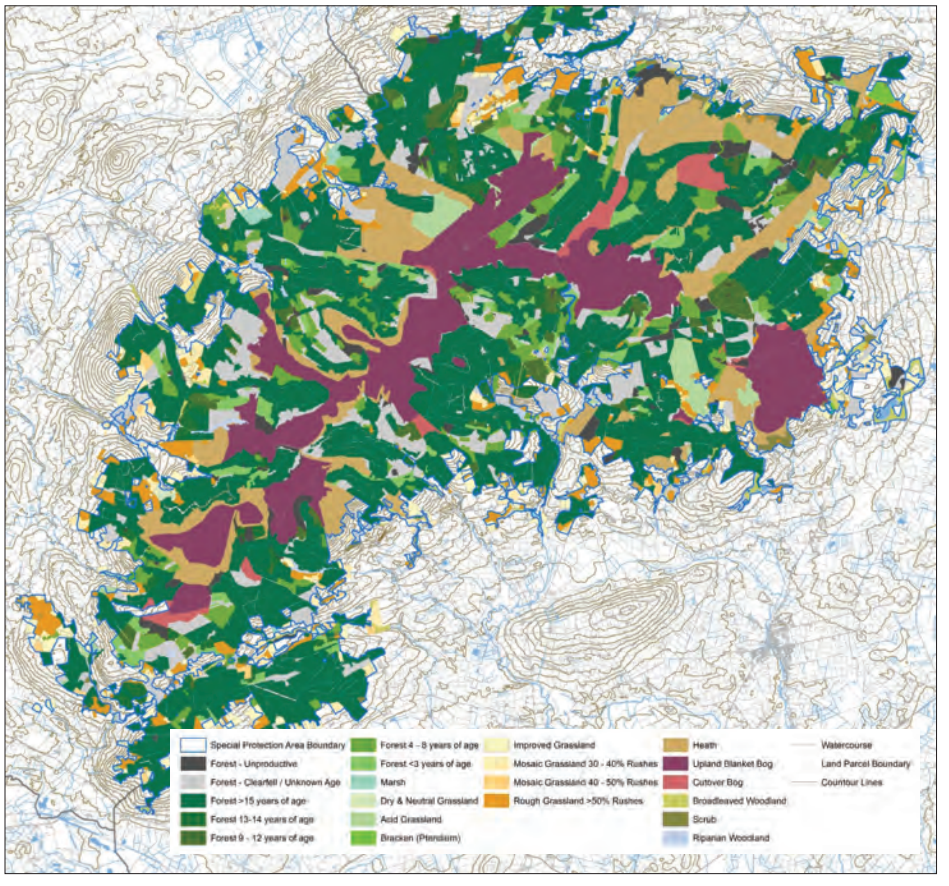
"The GIS habitat map will allow a really accurate and evidence-based assessment of new development schemes," said Wilson-Parr. "It will help us to understand how new projects, in combination with other existing developments and land use, can impact the hen harrier population. It will also show how we can promote sustainable forestry and expand renewables while protecting the hen harrier and the habitats on which it depends."

Wilson-Parr is realistic about future obstacles, though.

"Hard decisions will need to be made about how to balance the needs of local landowners, rural communities, and developers while meeting the government's legal obligations to protect the hen harrier," he said. "Having this GIS-based habitat map gives us the evidence government agencies need to justify the substantial conservation effort and important land-use changes required to save this species while being sensitive to other social and economic pressures."

For the Golden Eagle Trust, GIS has been the foundation of evidence-based decision making and effective land management during this project.

"ArcGIS holds the key to helping us halt the decline in hen harriers," said Wilson-Parr. "It gives us hope that we can safeguard this iconic bird for future generations."



↑ ArcGIS helped the Golden Eagle Trust see that 80 percent of the forest in Ireland's special protection areas is unsuitable habitat for hen harriers.

Real-Time GIS Improves Incident Management at LAX

One of World's Busiest Airports Gets a System of Engagement

More than 70 million people pass through Los Angeles International Airport (LAX) in a year. Maintaining situational awareness to manage safety, security, and operations is complex.

At LAX, this responsibility falls to the Airport Response Coordination Center (ARCC), LAX's command and control facility. ARCC oversees field personnel who work shifts 24 hours a day, seven days a week, both airside (past security checkpoints) and landside (public facing).

To manage airfield, terminal, and landside incidents and security, the ARCC staff have used situation and video management software from Qognify (formerly NICE Security) since 2011. The Qognify Situator allows LAX to integrate security and operational intelligence—including video surveillance and closed-circuit television (CCTV)—and generate automated adaptive response plans. The Qognify NiceVision Video Management System (VMS) provides ARCC and field staff with remote access to and pan-tilt-zoom control of all security cameras throughout the airport.

Until recently, however, much of the collaboration between ARCC staff and LAX field personnel was done manually. Control room staff and fieldworkers communicated information and status updates via phone calls and two-way radios. Field personnel would call or radio in incidents, and an ARCC operations superintendent would then assign technicians via more phone calls or radio communications. All information was conveyed verbally, without maps.

↑ Accessing the eGIS Web Viewer on iPads, field staff can initiate incidents by marking them on an up-to-date map.

In 2012, however, airport officials decided to speed up communication. They envisioned having a common ARCC operating picture that control room staff and field personnel could all access, no matter where they were located.

To get this, LAX worked with Qognify and technical and management support consultant AECOM (an Esri partner) to develop a solution that extended its common operating picture. The idea was to leverage LAX's existing incident management system by implementing ArcGIS for Server, which would allow maps and geographic information to be accessed anywhere, anytime, on any device.

Linking Incidents with Infrastructure

After two years of design, in which various stakeholders' needs had to be taken into consideration, the team created an enterprise GIS program called the Qognify Situator eGIS Web Application. A two-part solution, the eGIS Web Application gives LAX's prior iteration of the Situator both spatial and web capabilities.

The program uses layers that include airport buildings, property, infrastructure, and security sensors. In addition to integrating mission-critical information, the system also works with Esri partner IBM and its Maximo software to manage work orders and AirIT's PROPworks to handle lease and property management. This gives users a complete picture of any situation.

"You can't separate operational events and incidents from the infrastructure you're trying to protect or enhance," said Dom Nessi, deputy executive director and chief information officer at Los Angeles World Airports.

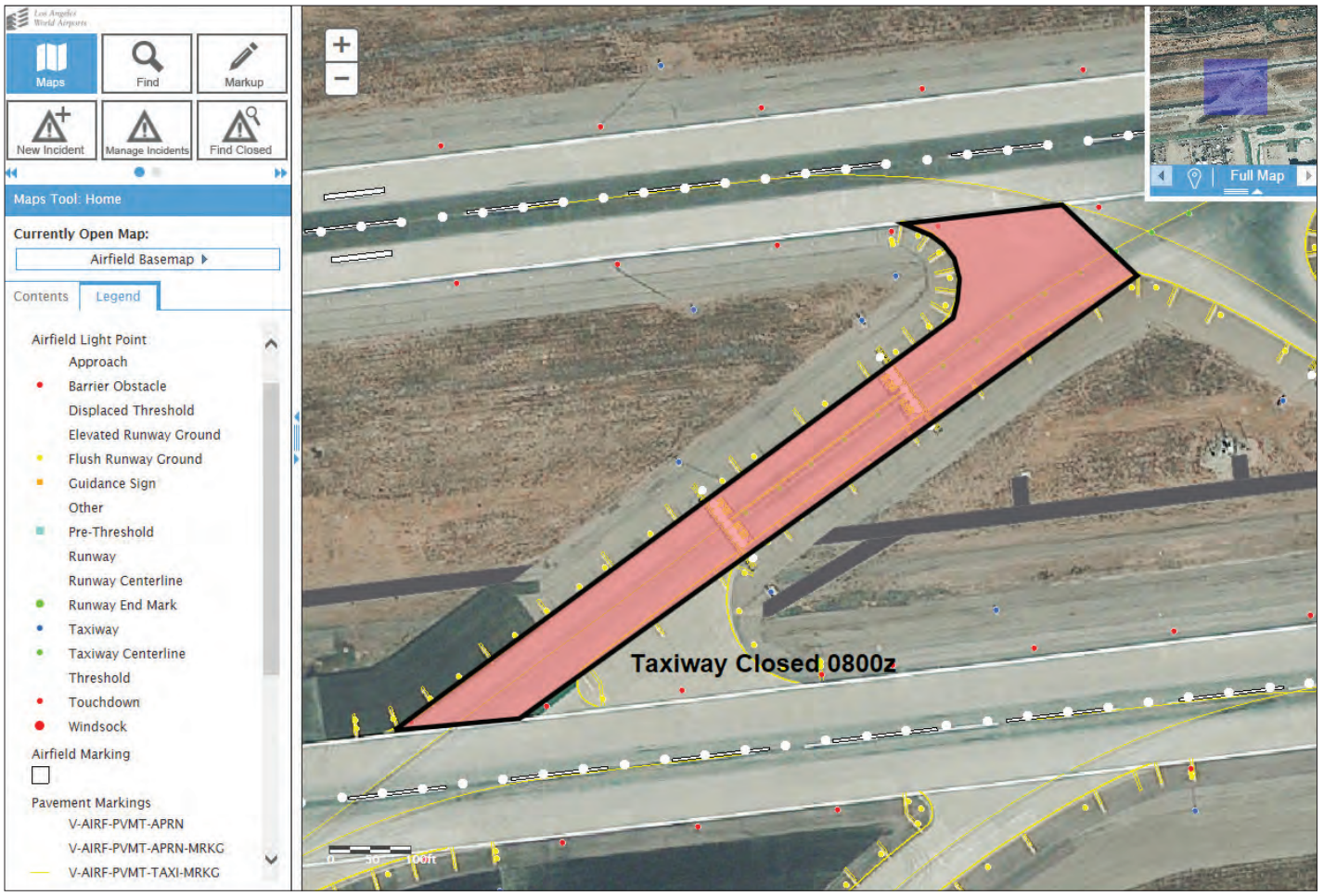
Extending the Control Room into the Field

ARCC staff access the data through both the Situator (a desktop map program) and the eGIS Web Application, which display highly visual geographic information in real time. Control room staff use the Situator to manage incidents. Then they extend the control room into the field with the eGIS Web Application.

Using the eGIS Web Viewer on iPads, field staff can initiate incidents—a slip and fall, a fuel spill at a gate, a leaky toilet, or a pothole on the taxiway—by marking them on a map in the application. They can then add associated information, such as photos and an incident type.

Back in the control room, a collapsible panel next to the map tracks annotations from the field so that, as incidents unfold, ARCC staff can gain insight and engage in spatially smart dialog with field crews. Comments are time-stamped to provide an audit trail of each event.

With both applications, ARCC staff can visualize where they need to send field personnel during an incident. If a situation involves travelers, staff can see how to evacuate them or at least get them out of impact zones. To make this work, control room staff share their own real-time map annotations with field crews.



← ARCC staff access data through the Situator and the eGIS Web Application, which both display visual geographic information in real time.

The eGIS Web Viewer also integrates all predefined workflows from the Situator so users can pull up specific, preplanned procedures for event response. For an incident in a terminal, for example, field crews can see where to set up command posts; query nearby assets, such as the closest surveillance camera or an underground hydrant fueling line; draw routes; spatially scope accidents (such as fuel spills); and add notes. They can access lease information to view tenants in impact zones, their store hours, and contact information. As fieldworkers move through the steps to mitigate the occurrence, they can use the program to check off each component of the appropriate incident management procedure.

"Pulling that information out of the GIS and putting it into the hands of those who need it in real time was a big step," Nessi said. "You can say there is water leaking in Terminal 1, but until you have an exact picture of where the water is, you can't do anything. Now *[fieldworkers]* can not only report it, but they can take a photo of it and attach it to the work order so that people in the ARCC see exactly what they're seeing in the field."

Faster Response, Positive Feedback

Currently, more than 200 airport staff have access to the eGIS Web Viewer across security, operations, property management, information technology, and airport development groups.

All airfield operations staff—who received iPad training if they weren't familiar with the technology—have welcomed the move away from radio communication and phone calls.

"They have everything they need to respond to a field event at their hands," said Kevin Carlson, vice president of national aviation technology at AECOM.

The app brings daily operations into the airport's enterprise GIS. This includes normal activities like examining pavement markings or safety areas, as well as emergency situations like wildlife strikes or malfunctioning baggage carts.

By using the eGIS Web Application and mobile app, LAX has saved time and money. The airport has enhanced compliance by better documenting event response. And having historical data records has enabled staff to spot trends, such as recurring electrical issues, which helps them implement longer-term solutions.

But LAX's enterprise GIS is no longer just an archive of engineering data. Rather, it conveys critical, real-time information spatially, from the control center to the field and back.

"Through its deployment of the…eGIS Web Viewer, LAX has really raised the bar in terms of empowering its personnel in their daily management of airport safety, security, and operations," said Qognify president Moti Shabtai. "People outside the control room can be part of *[an]* incident management process by initiating incidents from the field when they see something happening. They can get real-time geospatial information and receive adaptive response plans as well. All of these capabilities enable LAX to contain incidents faster."

With enterprise GIS optimizing daily operations across the airport, allowing everyone from the airport director to the airside fieldworker to stay abreast of operational status, LAX is a leading example of how up-to-date location information can empower rapid response.

What's New in ArcGIS Online

The November update to ArcGIS Online includes new features and apps, enhancements to the user interface, and improvements to administering and managing accounts.

Here are the highlights from this update.

To get more details and links to helpful resources, head to links.esri.com/agolhelp/whatsnew.

To receive ArcGIS Online news directly in your inbox, sign up at go.esri.com/preferences.

Visualization

Vector Tile Layers

The latest release of ArcGIS Online introduces initial support for vector tile layers as layers in web maps. A vector tile layer references a set of web-accessible vector tiles and their corresponding styles. Similar to image tiles, vector tiles store data as vector representations.

Users will be able to customize vector tile layers to fit the purpose of the map, driving dynamic and interactive cartography. The tiles will also adapt to any display resolution, which often varies across devices. Users can access beta versions of Esri vector basemaps—available as vector tile layers and as maps for display in the Map Viewer—and use them in custom basemap galleries.

↑ Esri vector basemaps, in beta, are available as vector tile layers and maps for display in the Map Viewer and custom basemap galleries.

Map Viewer

Mapmakers now have more control over authoring and editing maps. They can reorder bookmarks and add a halo outline to labels and map notes text. When browsing layers from the Living Atlas of the World, they can find layers based on their current map extent. Using imagery layers has gotten easier too, with improved query capabilities for pixel values and an updated multidimensional slider.

Additionally, the Map Viewer now honors time interval and time interval units configured on time-aware layers. And Directions includes additional options for finding destinations. For example, if an organization has configured custom geocoders, or if the map includes searchable layers, users can select one of those options to search for destinations for their route.

Scene Viewer

The Scene Viewer now allows users to create and view local scenes that present content in any projected coordinate system. Local scenes are great for displaying data in a small or local extent; they also allow for easy visualization and navigation underground.

Users can add outlines to the point symbol options for color, width, and transparency. They can collaborate on scenes within their organizations, too, through shared ownership groups. And, finally, users can now experience the starry night sky and watch the sun rise and set in their scenes.

Smart Mapping

New map styles that illuminate multiple data attributes have been added to ArcGIS Online. These styles do the following necessary calculations behind the scenes:

- Color & Size, which maps the relationship between two numerical attributes, such as the poverty rate and the number of single-parent households in a given area
- Unique Symbols & Size, which maps a count attribute, such as the number of people who have bachelor's degrees, but uses a unique color for each value found in another field (like county name)
- Compare A to B, which maps the ratio between two numbers—for example, the percentage of people with college degrees out of the total population—and expresses that relationship as percentages or simple ratios

↓ Smart mapping's new map styles illuminate multiple data attributes.

Additionally, users now have better control over the slider controls on the smart mapping histogram, and it is more evident that values can be set manually for numbers seen near the histogram. New color ramps also provide a modern feel that works well under reduced transparency.

Hosted Web Layers

Hosted feature layers now have a new edit tracking option that allows editors to view, update, and delete only the features they add. This gives layer owners increased control when managing features created by multiple editors.

ArcGIS Content

World Imagery, *World Street Map*, and *World Topographic Map* can support the display of large-scale data in or on basemaps thanks to additional levels of detail in the tiling scheme. Demographic maps for more than 20 countries, including Canada, now contain more current data.

ArcGIS Apps

Workforce for ArcGIS

Slated for release in beta in January, Workforce for ArcGIS helps field crews work like a team. Users in the field can use the app—and just one device—to easily get work assignments and communicate status updates back to the office. Supported on the iOS platform, Workforce seamlessly integrates with all mobile ArcGIS apps, including Navigator for ArcGIS, Collector for ArcGIS, and Survey123 for ArcGIS. When combined with Operations Dashboard for ArcGIS, the suite of ArcGIS apps provides a robust solution for optimizing fieldwork.

AppStudio for ArcGIS

AppStudio for ArcGIS is now out of beta and is included with ArcGIS Online subscriptions. AppStudio Basic lets users turn maps into beautiful, consumer-friendly mobile apps that run on all devices. No developer skills are needed, and apps can be published to all app stores. The AppStudio Standard upgrade allows users to distribute apps within the enterprise and add more functionality and features to apps built using AppStudio's configurable templates. The standard version also allows developers to create custom apps. For more information, visit esri.com/appstudio.

Survey123 for ArcGIS

Survey123 for ArcGIS, which allows users to incorporate smart forms into field data collection, is now in beta. Available in the Apple, Google Play, and Windows app stores, this easy-to-use mobile app lets fieldworkers capture data on- and offline. And as a solution for form-centric data collection workflows, Survey123 is an excellent companion to Collector. To learn more and get the app, visit survey123.esri.com.

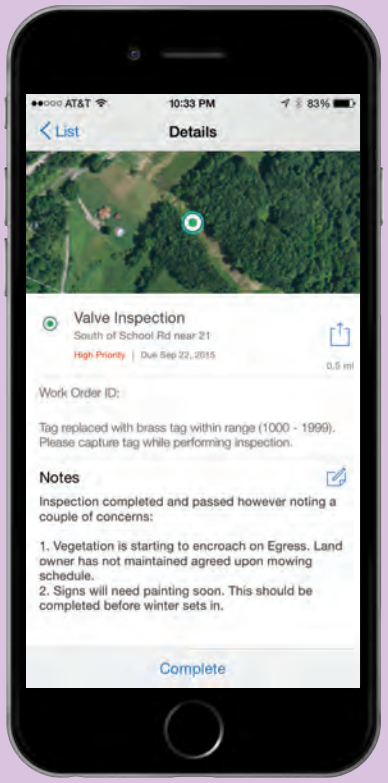
Web AppBuilder for ArcGIS

Web AppBuilder for ArcGIS has four new widgets. The Batch Attribute Editor widget allows users to simultaneously edit multiple attributes. The Reviewer Dashboard widget displays data quality result statistics as infographics, such as pie and bar charts. The Feature Report widget collects and manages data quality feedback from users. And the Image Measurement widget performs measurements on image services that have mensuration capabilities.

The app now includes support for six new URL parameters as well. It automatically saves the app state, including map extent and layer visibility, when users close their browsers. Other enhancements include more print, search, editing, and attribute-related improvements.

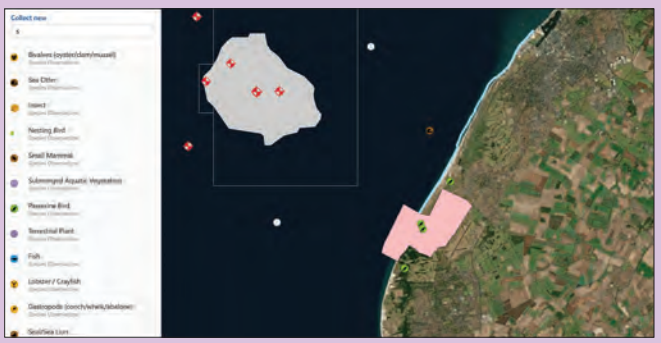
Collector for ArcGIS

ArcGIS Online has a new set of data collection templates for creating hosted feature layers that can be used with Collector. A user could create a map based on the Crop Scouting template, for example, to assess pest pressure and crop performance by evaluating the risk of pest infestations and disease.



↑ Field crews can use Workforce for ArcGIS to get work assignments and communicate status updates back to the office.

↑ With Survey123 for ArcGIS, smartphones can easily capture form-centric data.



↑ The new set of collection templates includes the Environmental Sensitivity Impact template, which identifies, ranks, and classifies sensitive areas and at-risk resources during an oil spill.

Configurable Apps

Story Maps

Building and updating story maps just got easier. In the Esri Story Map Journal and the Story Map Series, users can now create and modify maps and identify and troubleshoot issues in builder mode. In Story Map Basic, users can search, share subscriber content publicly, add a logo to the header, and configure color themes. (This update does not apply to existing Story Map Basic apps. To take advantage of the new features, users must share their maps again using the updated app.)

App Gallery

The redesigned app gallery makes it easier to choose configurable apps. Users can filter their search based on the app's purpose and refine the set of apps that is available.

Minimalist

This new, simple map viewer app has a minimalist user interface. It presents a map with just a scale bar and a zoom slider, but it can be configured to show a content panel with a legend, map details, or pop-up information.

Other Configurable Apps and Templates

- Crowdsource Polling has been enhanced and is now available in the Esri Featured Apps section of the gallery.
- A new version of Elevation Profile is available.
- Basic Viewer has been improved so that people with disabilities can access and use it more easily. This is part of Esri's ongoing effort to design and implement accessible GIS products and technologies that align with the objectives of section 508 of the Rehabilitation Act.
- GeoForm and Crowdsource Reporter have been enhanced.
- Legend has been retired. Use Simple Viewer instead.
- Twitter has been retired. Use Public Information instead.

Administering ArcGIS Online

Managing Service Credits

To help manage expenses, administrators can assign a flexible amount of service credits to some or all users in their ArcGIS Online organization. This tool manages service credit expenditures for the most common services, including batch geocoding, network analysis, geoenrichment, demographics, and tile generation. This service credit budgeting does not apply to organizational credits used to store features, files, and tiles or app proxy usage. Rather, it focuses on services that can be individually consumed but that organizations might want to exert additional control over.

Monitoring Usage

Credit usage statistics can now be downloaded to a CSV file. A new series of apps reports is available too. These reports include aggregate and drill-down details on apps published by the organization; which app creation tools are used; and details on member sign-in activity, including frequency and usage patterns. The apps reports also show the organization's most popular published apps and how many service credits are used for apps that employ the premium content app proxy capability.

Managing Users

Administrators can now assign roles to existing ArcGIS Online users in bulk. Manage Licenses now supports AppStudio for ArcGIS Standard as well.

To improve communication, organizations can configure the administrative contacts listed as points of contact. The ArcGIS Online administrators are now listed in automatic email notifications that are sent to users when they request password resets, user name assistance, service credit allocations, or modifications to their account so that users know whom to contact directly if they need more assistance.

Security

ArcGIS Online now supports encrypted Security Assertion Markup Language (SAML) 2.0. This significantly improves security compliance for enterprise logins.

Portal for ArcGIS Powers Smart Homes in Norway

By Sigve Hamran and Kristin Støle Kalgraff, Lyse

As a purveyor of smart homes, location awareness is crucial for Lyse, a Norwegian industrial group that distributes power and gas, district-wide heating, fiber-to-the-home Internet and television services, and more. To control smart amenities such as lighting, heating, and burglar and fire alarms—as well as provide welfare technologies that assist people in their everyday needs—efficient asset management of its utility network is fundamental.

Employees both in the field and in the office need to be able to locate cables, pipes, cabinets, and stations, which requires seeing them on a map. But getting employees to be able to quickly and easily retrieve map information, independent of their work location, has been challenging. For a long time, field crews had to either print maps in the office before heading out on a job or call the office to have someone print and send the map. And fieldworkers typically have to perform several tasks at various locations during a workday, meaning that they spent a lot of time just waiting.

Lyse had to establish a user-friendly mapping program for field crews that also had a simplified user interface for office employees. Given that Norwegian authorities have classified the company's energy and telecommunications infrastructure as sensitive information and critical infrastructure, the solution had to be highly secure. That is why Lyse chose to implement Esri Portal for ArcGIS.

A Versatile Solution

Lyse needed a flexible and generic product that worked for different users throughout the company. The solution needed to map out all asset information and make this available in an easy-to-use interface on all devices—those used both in the field and in the office. It also had to allow fieldworkers to collect and record information—with pictures, when possible—while they were out on a job. Management needed to have an operational overview as well, and the solution had to be configurable so it could be integrated with another system. Most importantly, it needed to meet corporate data and information security policies, meaning that the company had to be able to control permissions and access to user- and group-specific map information.

The solution Lyse came up with is grounded in Portal for ArcGIS, which contains web services that are assembled in different maps and adapted to various users' needs. These maps are made available both on the web and on mobile devices via Collector for ArcGIS.

Since sensitive information is involved, the product makes data and information security a high priority. Portal is directly linked to Lyse's private app store, which ensures that only authorized users can access the various datasets and makes administration of groups and users easy. Additionally, the Collector app is encapsulated in a mobile device management (MDM) solution, where access to apps and information is governed. Mobile devices and tablets are also enrolled in MDM, and a part of the device storage is isolated and encrypted, making all communications secure. Thus, Lyse retains full control of company information on the devices without affecting employees' private apps and photos. And if someone leaves the company or loses the device, an IT administrator immediately removes the company's data from it.

Maps Provide an Operational Overview

The solution is simple and intuitive. With the app available in Lyse's app store, Android and iOS users of all IT skills can easily access, download, and begin using it without prior training.

Now, field crews can connect to Portal and access web maps on their mobile devices, and employees in the office can access easy-to-use web maps on their computers. With these maps—which accurately locate all the energy and telecommunications assets in Lyse's network—fieldworkers can immediately identify and start any investigations without having to wait for a coworker to send them the information they need.

The maps also contain data on planned projects, ongoing digging activity, work orders, customers, and even parcels and land usage, providing an operational overview of all activities at Lyse. Building on this, the various business units in the company have set up their own maps to ensure that they receive the information they require for their projects.

"The map has become an even more important surface for information sharing at Lyse," said Lyse Group chief information officer Geir Arve Vika. "Access on all types of devices has especially given our field crews an important tool. And it is, of course, pleasing to see the efficiency gain the fieldworkers get from the solution."

Using the app at Lyse is voluntary, which has had the positive effect of inducing users to take ownership of it. They decide for which purposes they want to use the solution and determine the information they would like to see.

Today, more than half of the company's 1,300 employees use Lyse's Portal, with more than 150 technicians accessing the app on a daily basis.

Positive Feedback All Around

Lyse's asset management processes have progressed significantly.

Field technicians really like how the maps center on their GPS coordinates and only make relevant map layers visible. This happens just a few seconds after the app starts up, so it reduces clutter right away and allows users to focus on the task at hand. Lyse technicians also find it helpful to use the app to identify asset characteristics, such as part and model numbers, install dates, and manufacturers. Being able to search for assets by the name of the operation under which their project falls has also proven advantageous.

Overall, Lyse field crews view the app and the online maps as tools that help them do a better job. Fieldworkers report that they save up to 30 minutes per day using the Portal software-based solution, mostly because they don't have to spend as much time retrieving needed information or troubleshooting.

Several business units at Lyse have also made Portal central to their operations. Since almost all the company's activities have a geographic component, the maps ensure that employees in the office interact with crews in the field. They also facilitate information flow between various teams, such as project development and asset maintenance or operations and customer care.

Additional Development

Seeing further potential in the solution, Lyse continues to extend the Portal capabilities and usage. The application supports data collection, and Lyse has opened it up to user feedback on GIS documentation (which was previously reported via paper).

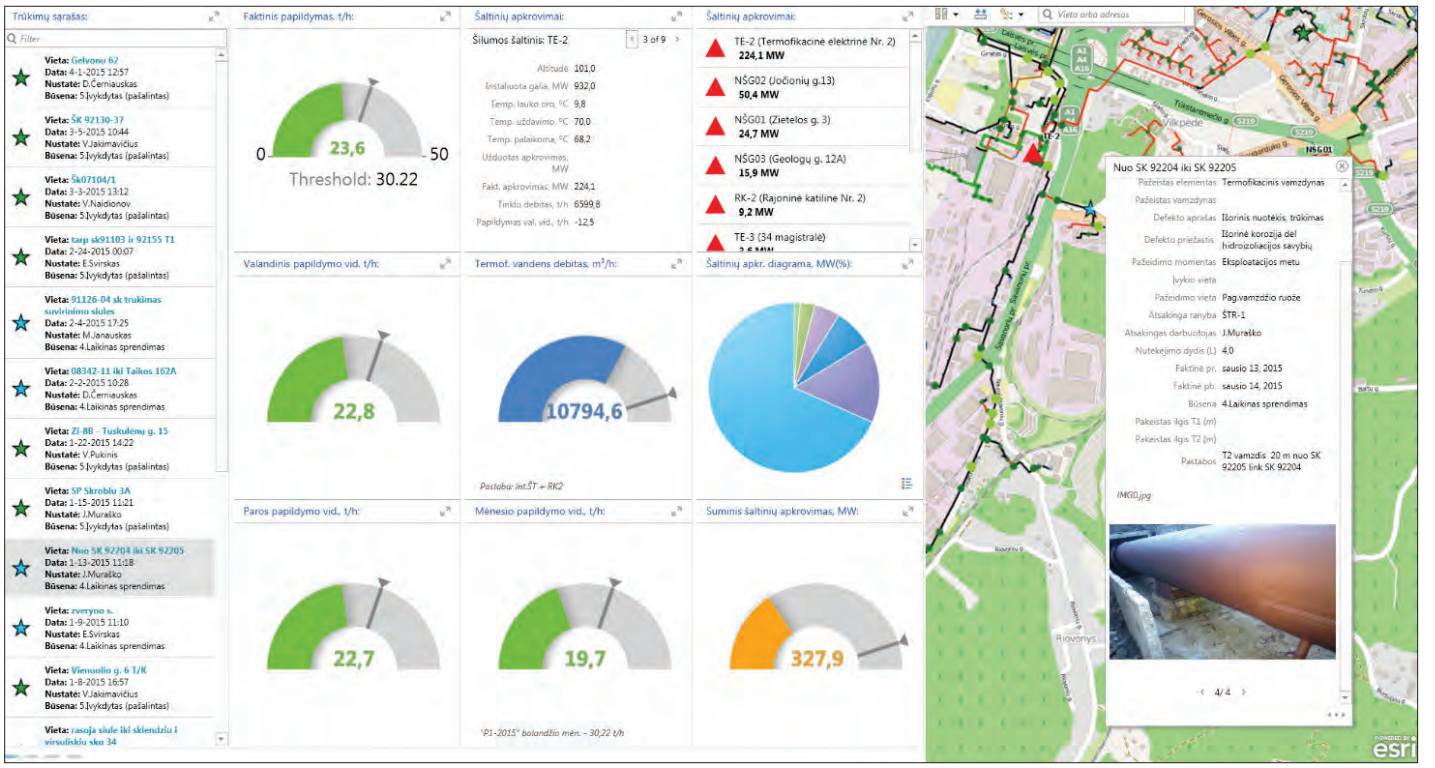
Across the company, having faster access to maps has improved how Lyse delivers power, Internet, and television services to smart homes and other customers. And with sustained development of its Portal software-based solution, Lyse will persist in breaking new ground.

↑ More than 650 employees at Lyse use Portal, and more than 150 technicians access the mobile app on a daily basis.

Mobile GIS Keeps the Heat On in Lithuania

Vilnius Energy provides centralized heating to more than 195,000 apartments, companies, and organizations in the capital of Lithuania. The utility, known in Lithuanian as *Vilniaus energija*, aims to give all customers in its 430-mile (700-kilometer) network uninterrupted heat and hot water while minimizing costs and keeping pace with changing environmental factors.

To accomplish this, the company needed a central view of its heating network. That required real-time geospatial information, which is why the utility implemented the ArcGIS platform with a focus on mobile GIS.



↑ With Collector for ArcGIS, crews at Vilnius Energy report information from the field into the company's dashboard faster and more accurately.

Dealing with Scattered Data

After having used ArcGIS for Desktop for more than a decade, the GIS team implemented the full Esri platform—including ArcGIS for Server and ArcGIS Online—between 2010 and 2012.

At the time, the utility had a big database of technical information, but the data was kept in different places and displayed in various formats. There was no aggregate view of the network.

The GIS team transferred its existing map of documented heat chamber defects into a digital map, which allowed Vilnius Energy to audit critical points in the network and see where to focus its resources. But the data itself had been compiled over the course of a year, so there was no real-time vision of network needs.

Speeding Up Data Collection

When Esri released Collector for ArcGIS and Operations Dashboard for ArcGIS, Vilnius Energy chose to use these to build its real-time heat supply view.

To allow crews to quickly access, edit, and gather defect data in the field, the utility's GIS team configured mobile GIS first. This relieved fieldworkers from having to spend substantial amounts of time completing paper reports; it also curbed redundant data entry and cut down on mistakes. During a mobile GIS test period, fieldworkers reported increased efficiency when it came to filling out service orders, making repairs, and fixing breakages.

Acting on Real-Time Information

With data coming in faster and more accurately from the field, the challenge was no longer getting the data; it was capturing and acting on that information in real time.

The GIS team configured Operations Dashboard to show data in a way that made decision making easy—with the latest information displayed ahead of historical records.

"Before, the data had accumulated as history, mainly," said Vilnius Energy network development and operations division manager Valdas Namajuska. "Now, problems show up on the dashboard in a few minutes. Seeing these issues that *[quickly]* not only saves time but also enables us to record the status of field work orders, track workflows, and access pictures that help us see and control the quality of work completed."

Decision makers at Vilnius Energy use the Collector and Operations Dashboard apps-based system to prioritize short- and long-term maintenance orders. They plan with greater purpose, targeting their workforce's efforts to spots that need the most attention.

"*[Operations]* Dashboard changed our prevention strategy," said transmission network department director Dalius Simaitis. "It changed our understanding of how we can best maintain infrastructure and even our technology."

Integrating Tools for Everyday Use

Vilnius Energy integrated Operations Dashboard with a supervisory control and data acquisition (SCADA) system, which lets managers determine the company's efficiency by tracking and controlling network operations.

Initially, the utility planned for only top-level managers to access Operations Dashboard. But that changed.

"Now we can see that standard requests come from different levels of supervisors and foremen," Namajuska said. "So *[Operations]* Dashboard became an everyday tool, not only to track situations but also to control critical junctures of the whole network and *[make]* our investments based on the real-time picture."

The GIS team integrated Operations Dashboard with Wonderware, a SCADA system that lets Vilnius Energy track and control electricity consumption in pump house heaters. It is also currently working on incorporating the ArcGIS program with two more systems: TERMIS, an energy network simulation system that makes it easier to analyze and manage heat loss, and CRM, a system to help the utility evaluate customer needs and expand to new clients.

Workforce Management for Improved Customer Service

Implementing this mobile GIS along with Operations Dashboard has enabled Vilnius Energy to plan work according to its relative importance, fulfilling the most important work orders first. Thus, using its workforce more efficiently allows the company to provide continuous heating services to its customers.

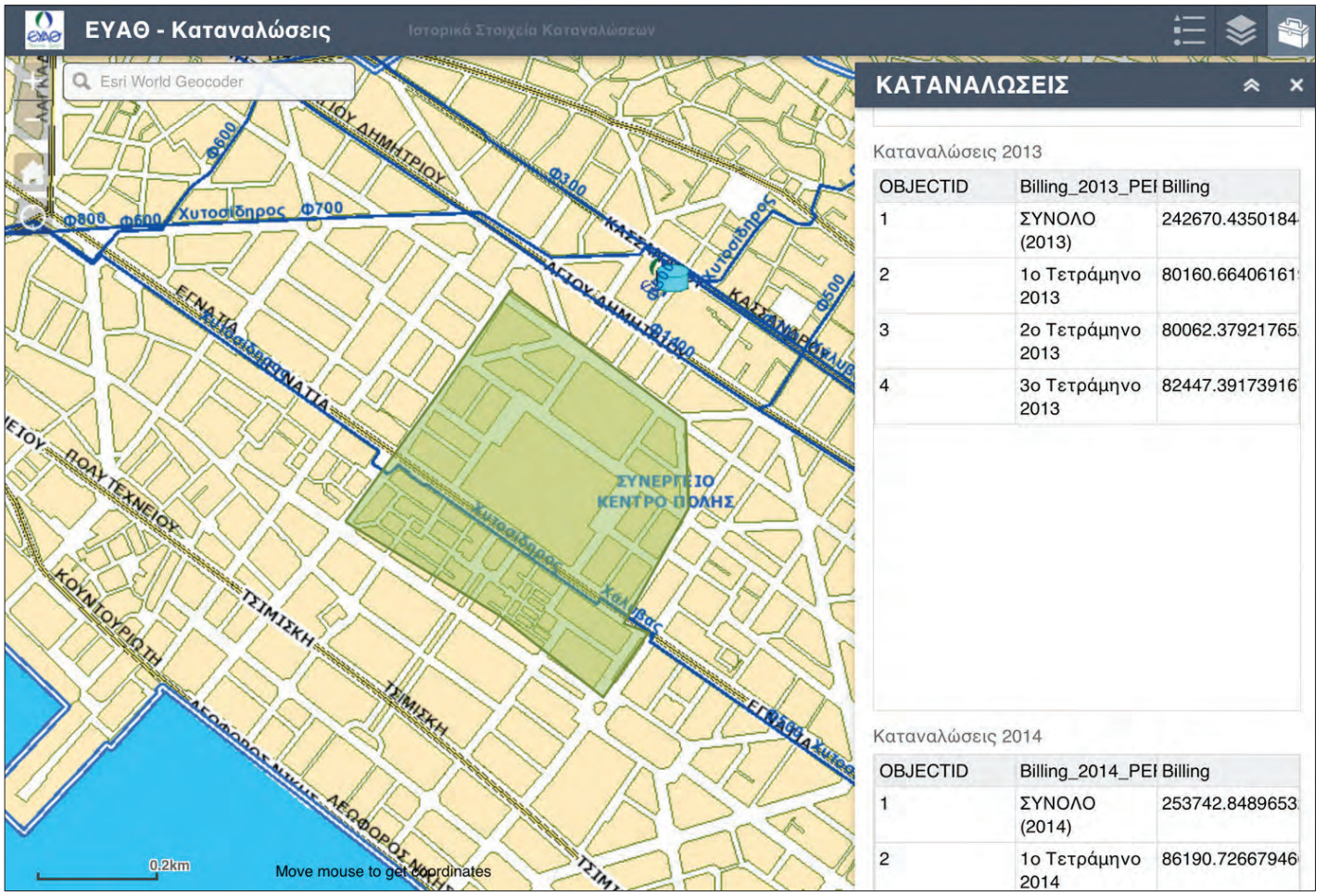
"We manage the risk of our heat networks in such a way that our customers won't feel any disruptions in heat or hot water supply," said Simaitis. "That makes them happy, and that keeps us hitting our goals."

Greek Utility Company Operates 24/7 with Mobile GIS

By Ioannis Kavouras, Thessaloniki Water Supply and Sewage Company

Keeping water and sewer pipes operating smoothly in Greece's second-largest city of Thessaloniki, with 1.5 million inhabitants, is a complex endeavor. The Thessaloniki Water Supply and Sewage Company, known by its Greek acronym *EYATh*, manages more than 1,400 miles (2,300 kilometers) of water pipes and almost 1,200 miles (1,900 kilometers) of sewer and storm water pipes, in addition to numerous tanks, pump stations, and waste treatment plants. The utility has to coordinate the activities of many different divisions and departments, field crews, and external contractors 24 hours a day. Most of the work happens out in the field rather than in a fixed office space, and response times have to be fast.

To manage its entire network from the field—without having to rely on the office for support—requires mobile GIS, which emerged just a few years ago.



↑ To better estimate future consumption needs, the GIS team developed a model to calculate historic billing for user-loaded areas of interest and deployed a website that staff could use to see historic consumption data.

Making Constant Mobility Easier

The nature of utility management requires constant mobility, which entails using maps in the field and can result in a decentralized flow of information.

EYATh had been using GIS technology for more than a decade. Early on, it used ArcGIS for Desktop to create map books that it printed and handed out to field crews. This gave rise to a disjointed process, however. The GIS team had to periodically replace these map books to keep them updated. And field crews weren't able to contribute up-to-date information to the GIS database when they were out in the field because they weren't digitally connected to the office or the GIS database.

To foster greater connectivity from the field, in 2012, EYATh implemented ArcGIS for Windows Mobile on Windows 7 tablets. Using the Mobile Project Center, the GIS team packaged the data and deployed it on the tablets, allowing GIS to be combined with GPS technology.

Although this was a big step forward from using paper maps, crews still weren't connected to the GIS database when they were out in the field. The utility wanted field crews to be able to relay new information from the ground back to the GIS department quickly and easily so the team could update the GIS server on the spot.

The GIS team created web maps in ArcGIS Online and stored them in a JavaScript Object Notation (JSON) format so they could be accessed via mobile sites and apps built for various iOS and Android devices, including iPhones, iPads, and Samsung Galaxy tablets and mobile phones. Field crews then downloaded ArcGIS for iOS and ArcGIS for Android on their devices so they could access the GIS database from anywhere, connecting to EYATh's GIS server securely via a VPN that works over cellular networks. With help from Marathon Data Systems (Esri's distributor in Greece), the GIS team also used ArcGIS API for JavaScript to build mobile apps that linked customer calls with the GIS server to provide more precise information about each incident.

Through smartphones and tablets, everyone at EYATh, regardless of their expertise, gained access to user-friendly GIS. What used to be recorded in spreadsheets and on paper maps—from electrical drawings and billing data to network failure information and historical flooding data—is now stored in EYATh's GIS server and is instantly accessible online.

↓ Field crews have instant, online access to all the same technical information, data (vector and raster), and images as staff at their desks.

Keeping the GIS Server Updated

More recently, EYATh began using Web AppBuilder for ArcGIS to construct its mobile sites. Hosted in ArcGIS Online, these mobile sites allow maps and technical data to be disseminated easily—through the web—to all involved parties, whether they work inside or outside the company. And the applications, which are built with wizards, are platform-independent, meaning they work on multiple operating systems without needing to be modified. Maps are also accessible through a browser rather than a separate application. Most importantly, the applications allow users in the field to give up-to-date information to the GIS department in a timely manner so the team can keep the GIS server updated.

EYATh has deployed these mobile sites to address different needs in various departments. For example, ground crews can employ EYATh's mobile applications to pinpoint exactly where a failure occurs—even if the asset is underground—to ensure that they dig in precisely the right spot. The department of new customers can also use a desktop application to locate buildings that need to be connected to water and sewer service. And, based on information collected and recorded in the field, such as how far away a structure is from existing pipelines, the department of new customers can estimate the cost of service.

The utility can also put its complex geoprocessing tools (built with ModelBuilder in ArcGIS for Desktop) into mobile apps by publishing the tools to ArcGIS for Server and then using the wizard in Web AppBuilder for ArcGIS to insert them into web applications. For instance, when the department of design was trying to design a more efficient network, it needed to estimate future consumption needs. The design staff realized that it would benefit from knowing historic billing data for specific

↑ Aided by mobile GIS, an EYATh employee uses a ground-penetrating radar device to more accurately identify underground network assets.

areas. So the GIS team extracted historic billing data from the company's enterprise resource planning software; used ModelBuilder to come up with a model to calculate it for specific, user-loaded areas of interest; and employed Web AppBuilder to deploy a website that staff could use to easily see historic consumption data for particular areas.

Putting the Office in Employees' Pockets

By now, mobile GIS has become a necessity for keeping EYATh operating 24 hours a day, seven days a week.

"On Saturday night at 2200 *[10:00 p.m.]*, a water network failure in the center of the city occurred, where hotels, restaurants, and bars are located," said Eleni Karlafti of EYATh's water network operation and maintenance department. "With mobile GIS, I had all the necessary information in my mobile phone…to fix the failure on-site, without *[needing to drive]* to the office and back, managing to *[reduce the]* time of water interruption in the area and, consequently, minimizing citizen annoyance on a Saturday night."

Mobile GIS is part of all major network management processes that take place at EYATh

↑ When customers report damages to the network, field crews using mobile technology can respond more quickly and effectively.

daily. With smartphones, tablets, and mobile GIS, the utility has managed to put the office in employees' pockets. Field crews have instant, online access to all the same technical information, data (vector and raster), and images as staff at their desks. Supervisors use mobile technology to oversee network expansion design and construction—both in the office and in the field. And mobile GIS has even improved route optimization for collecting meter data.

Customers are benefitting as well. When they report damages to the network or needs for repair, field crews using mobile technology respond more quickly and effectively. As the call center takes a customer's call, that person's location comes up already zoomed in on a map. On-the-go field crews have immediate access to both the failure description and a map of the network status in the area. Before even arriving, crews know where to dig to unearth the failure and what additional network failures to expect.

Over the past few years, EYATh has managed to transform GIS from a useful piece of software into a central component of its everyday operations. Mobile GIS has made fieldwork less complicated, enhanced customer support, minimized costs, and spatially enabled technical data everywhere. With mobile GIS, EYATh can now be more efficient and proactive.

About the Author

Ioannis Kavouras is the GIS manager for the Thessaloniki Water Supply and Sewage Company. He holds a bachelor's degree in rural and survey engineering, a master's of science in GIS, and a master's of business administration. He can be reached at ikavouras@eyath.gr.

The Thessaloniki Water Supply and Sewage Company won a Special Achievement in GIS (SAG) award for this project at the 2015 Esri User Conference.

3D GIS Unearths Source of Arsenic in Drinking Water

Sandy Davis, a resident of Cerro Gordo County in Iowa, learned in 2004 that her shaky hands and neurological issues were a result of having unknowingly consumed high levels of arsenic in the water from her private well. Even more disconcerting, she could have prevented long-term exposure simply by testing her water for the known carcinogen.

Davis wasn't the only person in Cerro Gordo County whose health was at risk from drinking well water that contained more arsenic than the public maximum contaminant level (MCL) of 10 parts per billion (ppb). Nearly 15 percent of the county's population—about 7,000 people—relies on unregulated private well water. And Davis's case wasn't the first time the Cerro Gordo County Department of Public Health had been alerted to elevated levels of arsenic in the water. In 2003, the Iowa Geological Survey and the US Geological Survey discovered the chemical's presence in every major aquifer in the state. Thus, at the time of Davis's discovery, the department was conducting a limited public awareness campaign about arsenic in the water, since the agency didn't have the staff or the funding to orchestrate a targeted drive. Years later, however, GIS helped Cerro Gordo County determine the root cause of its water's high arsenic levels and, in turn, discern where awareness needed to be raised the most.

Protection Without Regulation

The Cerro Gordo County Department of Public Health aims to guard residents from contaminants in private wells, but this is often difficult because public agencies don't have the authority or the resources to regularly check well water quality before it flows into household taps. After private wells are drilled, property owners are responsible for maintaining the safety of their own water supplies.

To educate private well owners about the elevated levels of arsenic found in the county's water system, the Department of Public Health worked with environmental health scientists at the Iowa Department of Natural Resources to develop a mapping tool. Using ArcGIS for Desktop, the department merged its private well water records with arsenic test results and mapped out every known well in the county that tested above the MCL. By doing so, a clear "arsenic zone" emerged on the map, indicating which properties were likely to have arsenic in their private well water. From this, officials created a new ordinance in 2007 that dictated stricter well drilling and testing requirements.

Three years later, with Davis's story still circulating and public health still at risk, department officials turned once again to GIS for solutions—this time, to locate the source of the arsenic and develop a targeted plan to protect residents' health.

Mapping a Better Path Forward

To determine whether arsenic-contaminated wells were concentrated in a certain area, the department collaborated with Doug Schnoebelen of the University of Iowa, Paul Van Dorpe and Chad Fields from the Iowa Department of Natural Resources, the State Hygienic Laboratory at the University of Iowa, and private well drilling operator Shawver Well Company. The team received a grant from the Centers for Disease Control and Prevention to carry out the three-year study.

First, team members pulled geologic information about select (mostly private) wells from the Iowa Geological Survey. The information included data on well and casing depths, well locations, and the aquifers from which water is drawn. Twice a year, the team collected data from 68 test wells on variables that could affect arsenic levels. These factors include the water's pH, levels of dissolved oxygen, sulfide amounts, total arsenic, and the likelihood of arsenic speciation. The team also analyzed rock chip samples in study wells and all newly drilled wells for traces of arsenic.

As the study progressed, the team learned that half of all the private wells tested had detectable levels of arsenic in the water, and a third of them contained unsafe amounts of arsenic (above 10 ppb).

Using ArcGIS for Desktop again, the department mapped the data to show the geographic distribution of the sample sites plus the arsenic levels at each site. Surprisingly, however, there was no indication that the arsenic-contaminated wells were concentrated in a specific location. But going beneath the earth's surface revealed a completely different story.

3D Yields Improved Insight

The common thread was uncovered using the ArcGIS 3D Analyst for Desktop extension. The extension's ArcScene application allowed the team to interact with its geospatial data in 3D for the first time.

"Visualizing our data in 3D gave us insights that just weren't possible in 2D," said Sophia Walsh, GIS coordinator and environmental health specialist with the Cerro Gordo County Department of Public Health.

Researchers overlaid the data on arsenic levels with information on well depth, casing, and aquifer elevations. The resultant interactive 3D map let the team see which aquifer each well was withdrawing water from. It turned out that the wells with consistently higher arsenic levels had all been drilled into the same source: the Lime Creek Aquifer.

Though half of all wells countywide were contaminated with arsenic, well water from the Lime Creek Aquifer was much more likely to have unsafe levels of arsenic. The highest measured contamination for wells cased through the Cedar Valley Aquifer, located directly below the Lime Creek Aquifer, was less than 10 ppb, the MCL for municipal water supplies. Rock chip samples from these wells average 1.2 ppb of arsenic. But rock chip samples from the Lime Creek Aquifer showed nearly 10 times that—an average of 11.4 ppb of arsenic.

Geospatial Data Drives Change

Knowing this equipped the Department of Public Health with the critical information it needed to determine which populations were at high risk for arsenic contamination. Using parcel data, the team then geocoded at-risk wells in ArcGIS for Desktop.

From there, the department launched a targeted outreach plan to notify residents of the potential danger in their well water. The team sent postcards and flyers to private well owners recommending that they test their water for arsenic. Department staff followed up with these residents to confirm that they had received and understood the information. According to feedback, 99 percent of the well owners the department contacted said they would treat their well water or use a different water supply.

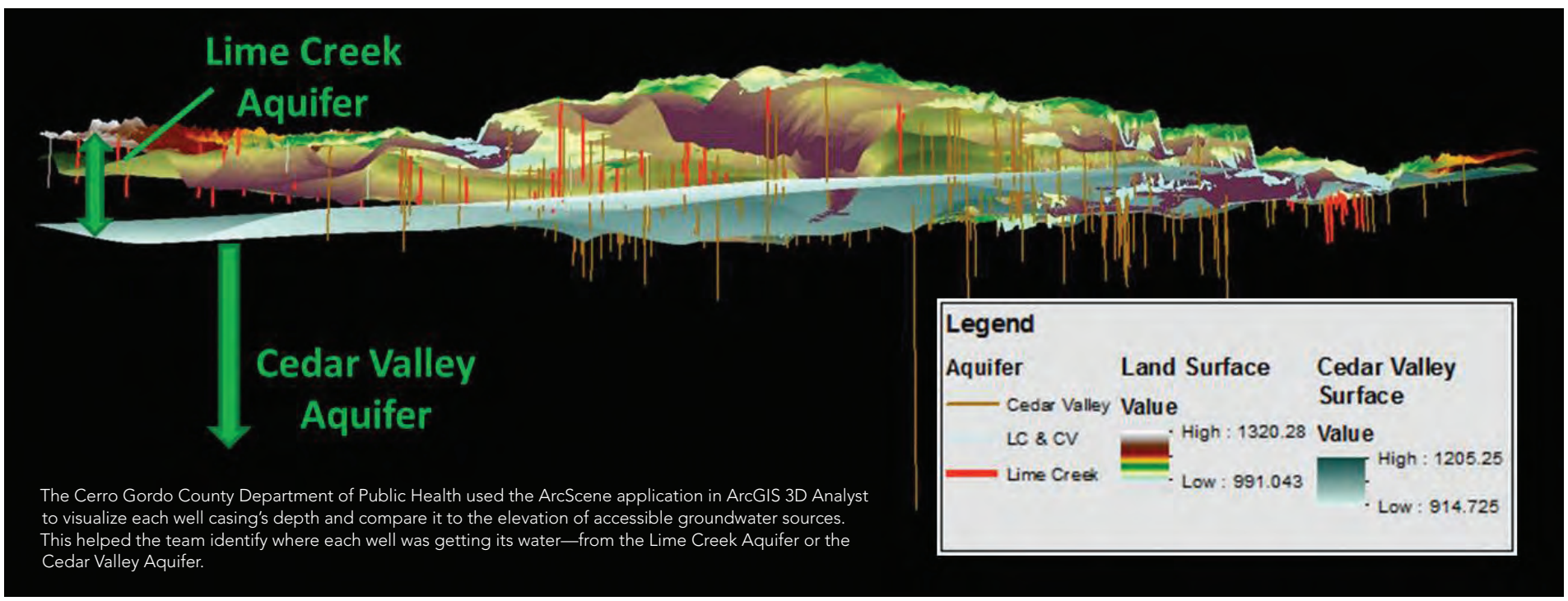
As Walsh pointed out, the vital role GIS played in this project was twofold: "On the research side, GIS allowed us to figure out which aquifer the arsenic was coming from and begin to construct a model," she said. "On the public health side, GIS allowed us to find and target at-risk well owners in our community who were sent pertinent information about the risk of arsenic in their water and offered well water testing. Without the use of GIS to research arsenic in groundwater and target specific well owners, there would be hundreds of well users in our community still drinking arsenic-contaminated water."

Digging Deeper with GIS

But change didn't stop there. Based on the knowledge gained through this project, Cerro Gordo County is taking measures to improve how wells are drilled. As of July 1, 2015, all new wells in the county must be drilled to use water from the Cedar Valley Aquifer only.

The county is also seeking funding from the National Institutes of Health to develop a web GIS model and predictive database using the ArcGIS platform. The GIS team envisions that the online mapping tool will inform the public about how deep wells should be drilled to reduce the risk of arsenic contamination.

For more information, contact Sophia Walsh, GIS coordinator and environmental health specialist with the Cerro Gordo County Department of Public Health, at swalsh@cghealth.com or (641) 421-9318.



The Cerro Gordo County Department of Public Health used the ArcScene application in ArcGIS 3D Analyst to visualize each well casing's depth and compare it to the elevation of accessible groundwater sources. This helped the team identify where each well was getting its water—from the Lime Creek Aquifer or the Cedar Valley Aquifer.

THE NEW MULTIFUNCTION SURECOLOR® T-SERIES

- Produce presentation-quality 24" x 36" color copy in under 40 seconds*
- High productivity with color scanning speeds up to 6" per second*
- Advanced image processing hardware for superb image quality
- Scan to file, email and remote SureColor T-Series multifunction printers
- Single-roll or Dual-roll models available in 36" and 44" print widths

Epson® SureColor T-Series

MFP Configuration Starting at $7,140† Single Roll

EPSON®
EXCEED YOUR VISION

*Speeds are based upon print engine speed only. Total throughput times depend upon factors such as computer, file size, printer resolution, ink coverage, and networking. EPSON and SureColor are registered trademarks and EPSON Exceed Your Vision is a registered logomark of Seiko Epson Corporation. Adobe and PostScript are either registered trademarks or trademarks of Adobe Systems Incorporated in the United States and/or other countries. Copyright 2014 Epson America, Inc.

†Estimated street price after instant rebate and dealer discount. Please visit epson.com/prorebates for details. Check with an Epson Professional Imaging Authorized Reseller for actual price, as dealer prices may vary.

Adobe® PostScript® 3™

EPSON.COM/**PLOTTERINFO**

Geodesigning Nature into Cities

Biophilic Cities Use GIS to Support Nature-Focused Urban Planning

By Tim Beatley, University of Virginia

Nature is not optional. It is absolutely essential to leading a meaningful, healthy life.

Evidence is growing that nature can ameliorate a host of modern ills. Being around it can relieve chronic stress and propel people to relinquish their sedentary lifestyles. Nature induces creativity, encourages generosity, and facilitates longer-term thinking. Employees tend to be happier and more productive when their offices have ample daylight, greenery, and views of nature.

Biophilia is the innate connection people have with nature, that hard-wired need for contact with other life forms and the natural world. Popularized by Harvard biologist E. O. Wilson, biophilia is becoming more mainstream in architecture and design—especially in urban settings, where nature should be all around, not just something to occasionally visit.

In recent years, the focus of my own work has been similar: to raise awareness about applying biophilic concepts and principles to the design of cities. In 2011, I launched the Biophilic Cities Project at the University of Virginia to further explore the idea of biophilic cities, which are metropolitan areas that foster deep connections to the natural world by prioritizing the protection and restoration of flora and fauna and integrating new forms of nature—from trees and gardens to green walls and rooftops—into urban neighborhoods and built environments. At the heart of this concept, really, is geodesign.

Being a Biophilic City

The biophilic cities movement is a novel way to understand cities—one that sees them not as disconnected from nature but, rather, embedded in it. The movement encourages urban planners to take a more holistic view of places and spaces within a city and make room for biodiversity. This requires infusing all levels of urban design—from buildings to neighborhoods to entire cities—with scientific information about the natural environments at hand, as well as a sense of how people can and would want to interact with nature.

The Biophilic Cities Project has worked with a number of partner cities—including San Francisco in the United States, the city-state of Singapore, Wellington in New Zealand, and Birmingham in the United Kingdom—to explore the different ways a city could be biophilic.

Singapore, for example, has an impressive network of trails and pathways that connect parks and green spaces to one another. These park connectors allow people to walk, bike, and jog between various green spaces without leaving vegetated areas. The city-state has also made considerable efforts to integrate nature into its vertical spaces. A number of high-rise apartments, office buildings, and hotels have installed green roofs and indoor hanging gardens to help reduce the effects of urban heat island (wherein a metropolitan area is warmer than its surroundings because of escalated human activity). Through these and other efforts, the Ministry of National Development wants Singapore to be known as a City in a Garden rather than the Garden City (its previous sobriquet)—a small but important change to help overcome the bifurcation of what's considered urban and what's deemed nature.

Developing an ecologically rich and intertwined network of natural features and habitats—from installing vertical gardens and green roofs to planting trees and expanding urban trail networks—allows cities to deftly reduce their carbon emissions and inherently adapt to climate change. Additionally, when metropolitan areas make room for the natural movement of fauna, they gain a better understanding of the locations and movements of birds, bats, pollinators, and other animals. Edmonton, Canada, and Brisbane, Australia, for example, have both invested in wildlife bridges and faunal passages of various kinds, which allow animals to move and thrive in the midst of built environments and overcome significant habitat barriers, such as roads and highways. All of this informs biophilic design and planning.

Imbuing Cities with Nature Using GIS

Each city participating in the biophilic cities movement uses GIS in some way to support nature-focused geodesign. Many of these cities employ GIS to take stock of the natural environment around them—calculating tree canopy coverage, for example, or estimating how much of the urban population can walk to a green space in 5 or 10 minutes. Other cities use the technology to do analysis. Birmingham, which is aiming to be the first biophilic city in the United Kingdom, has mapped out urban heat and air quality levels to identify locations where green and blue interventions, such as planting trees and vegetation or incorporating water, would be most effective. In collaboration with the University of Birmingham, the city also recently developed a high-resolution map of its nighttime lights to better understand their impact on the community (which tends to have less of a relationship with the night sky where streetlights are more prevalent) and local ecological systems (such as the bat population and its changing flight patterns that dodge lit areas). The eventual goal is to balance the need for public lighting with preserving wildlife habitats and reducing light pollution.

Biophilic cities recognize that urban areas could support even more nature, as the High Line in New York City does.

Singapore's quest to be known as the City in a Garden is boosted by hotels planting rooftop gardens, like these sky gardens on top of the Parkroyal on Pickering Hotel.

Mapping urban soundscapes is important, too. One metric of success for biophilic cities is ensuring that every resident in every neighborhood can hear rich birdsong. To this end, Wellington has implemented a bold initiative called Zealandia that seeks to restore native bird populations to places where they were previously decimated by nonnative predators like house cats. The city erected a predator-proof fence around a preserve, where several bird species endemic to New Zealand have rebounded. Because of the preserve's proximity to downtown Wellington, native birdsongs have once again become profuse in the city.

New Ways of Understanding Urban Life

Cities are ecosystems composed of humans, animals, insects, and their respective, though not mutually exclusive, habitats. Biophilic cities grasp this. They also, crucially, recognize that urban areas could support even more nature.

As the world continues its shift toward increased urbanization, serious challenges to sustainability and resilience remain. New solutions are needed—many of which lie in creating new ways to understand urban life. Geodesigning biophilia into cities creates and strengthens urban connections to nature, meaning that biophilic cities are, almost by definition, sustainable and resilient cities.

This profoundly new way of understanding urban environments is framing people's aspirations for the future of urban living. The Biophilic Cities Project is gaining momentum globally, with new initiatives emerging across the United States—from Portland, Oregon, and Milwaukee, Wisconsin, to Washington, DC—as well as in European cities, such as Vitoria-Gasteiz in Spain's Basque Country. Ideally, in all these cities, and more, there will come a point when residents and visitors cease thinking that they must travel to parks and green spaces—or even outside the city—to find nature. Instead, they will be immersed in nature all the time.

About the Author

Tim Beatley is the Teresa Heinz Professor of Sustainable Communities in the Department of Urban and Environmental Planning at the University of Virginia. With funding from the Summit Foundation and the Cynthia and George Mitchell Foundation, his Biophilic Cities Project has shared many stories about emerging biophilic cities. His new book, *Handbook of Biophilic City Planning and Design*, continues that effort. For more information on the Biophilic Cities Project, visit biophiliccities.org or email Beatley at beatley@virginia.edu.

Park connectors, like this one in Singapore, allow urban dwellers to walk, bike, and jog from place to place without leaving vegetated areas.

Geodesign Helps City in California Plan for Facebook's Growth

Menlo Park Uses GeoPlanner for ArcGIS to Prepare for Rise of Tech Employee Residents

People who lived in Menlo Park, California, in the 1950s and 1960s reminisce about the small, entrepreneurial businesses—such as the first Round Table Pizza, Joe Prein's Music Store, and Jiffy Burger—that have long served the town.

Today, however, much of the talk centers on the Frank Gehry-designed Facebook headquarters, which opened in the city at the south end of San Francisco Bay last year. About 2,800 employees work in the 430,000-square-foot (40,000-square-meter) facility, according to news reports.

Anticipating enormous growth, the company continues to plan for more office space for its employees. Because Facebook's workforce is made up of many Millennials who, in general, want to live and socialize in the same areas where they work, these employees also need nearby homes and services.

Menlo Park city planners face the challenge of managing the housing plan for incoming tech workers without spoiling the community's charm. In the Bay Area, housing is at a premium. Water is a concern as well. So how will the Menlo Park community, with a current population of 33,000, maintain its city's character while accommodating accelerated growth?

Geodesign is helping Menlo Park answer this question, offering design options to build a sustainable community of the future.

Using Geodesign for City Planning

Menlo Park hired the California-based community planning and urban design company PlaceWorks to analyze questions related to the city's land use and development.

The firm, an Esri partner, got Menlo Park decision makers and other stakeholders involved in the process. To do analysis, PlaceWorks decided to use the geodesign tools in GeoPlanner for ArcGIS, a web-based app that helps users make location-driven decisions about land use, natural resource conservation, forestry management, and landscape architecture. The app enabled city planners to evaluate the impacts of development, envision scenarios of how the city would grow, and provide input for informed policy decisions.

"We chose GeoPlanner to allow Menlo Park staff, stakeholders, and decision makers to play with the data and see different alternatives," said Robert Kain, PlaceWorks GIS manager. "With GeoPlanner for ArcGIS, they don't need any GIS experience. *[…]* GeoPlanner comes with a built-in library and a multitude of context-appropriate landscape layers that are easy to add into your analysis."

Conducting Web-Based Planning

PlaceWorks consultants met with community leaders to review the city's general plan and discuss their concerns. City planners needed to know how land-use changes and potential new development would impact transportation, water consumption, job creation, and city revenue.

PlaceWorks mapped constraints on growth and analyzed how an increase in population would affect the city. The firm also weighted the city's performance indicators in traffic, jobs, and water use and the impact on tax revenues. Planners and community members were able to use these outcomes to evaluate and compare the impacts of growth and see where there was a need for more infrastructure, services, and housing.

Although the measurement tools in GeoPlanner seem simple to a GIS expert, planners working in Menlo Park appreciated their underlying complexity. Users remarked on how easy it was to see land area, measure the distances between areas, and calculate drive times.

"That's the power of GeoPlanner," Kain noted. "It doesn't need to do everything, but it can do many things. People quickly pick it up and get going. When people are able to use the tool to do alternative planning, they seem to take greater ownership in the project. Further, we can make GeoPlanner available on the Internet so that the public can also look at the data and play with it. This way, people feel involved."

Building Community Consensus

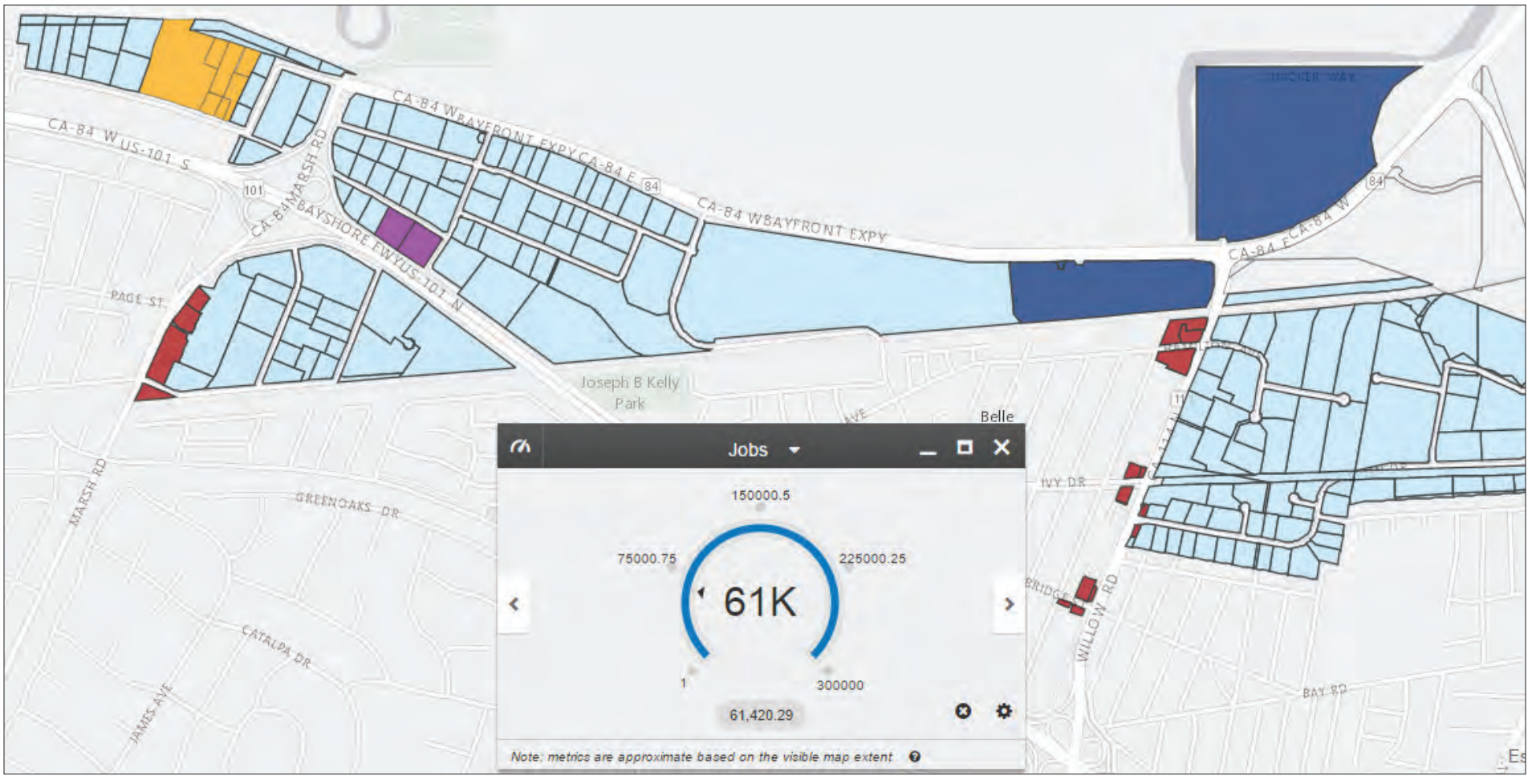
GeoPlanner comes with dashboards that help users compare design alternatives. These dashboards help planners visualize existing land-use conditions and the number of residences in the city. Planners can create geospatial scenarios for their various ideas, see how these would modify land-use features, and estimate the costs and benefits of the proposed development.

For example, PlaceWorks used the app to create a model for water use metrics based on standardized rates of water consumption. With California's years-long drought still ongoing, water is allocated to cities based on anticipated population growth. With GeoPlanner, users in Menlo Park entered population numbers into the app and ran the model, which then displayed the areas on a map where water demand would change and by how much. Scientific information presented in a geospatial context, like this, can then assist the city with ever more important water rights negotiations.

Dashboards created with GeoPlanner also help urban designers quickly query data and create scenarios to understand the effects of their concepts. Any city's design needs—whether adding developments, establishing response systems, or managing sea level rise—can be configured into GeoPlanner. Additionally, as part of the Esri platform, the app can be used with other products, such as Esri Maps for Office and ArcGIS Online.

"GeoPlanner made it possible for anyone with Internet access to compare the potential effects of future growth," said Charlie Knox, a principal for PlaceWorks who worked on the Menlo Park project. "People *[from the city]* have been able to comment in a meaningful way. City officials could incorporate *[that feedback]* into their decision making. In this way, GeoPlanner provided a valuable tool for building community consensus."

↓ City planners in Menlo Park, California, used GeoPlanner for ArcGIS to evaluate the impacts of development driven by the growth of tech jobs in the community.



Saving Time and Serving Citizens

Using the Living Atlas of the World and ArcGIS Online to Create Maps, Apps

When residents in Westminster, Colorado, want to view the city's comprehensive land-use plan, see where permits for solar power systems have been issued, or find a dog park, they can view web maps created and shared using ArcGIS.

Westminster's online map services page includes a map gallery of recreational facilities, vacant developable land, recycling drop-off spots, city facilities, and public art sites.

Located 10 miles northwest of downtown Denver, Westminster is a growing city with a population that tops 100,000. The Denver metropolitan area is tech-savvy, and Westminster has been one of the leaders in developing new ways of using GIS data and making geographic information available to residents. The four-member City of Westminster GIS group develops GIS applications and manages spatial data for the city. The team also does much of the municipality's mapping work, which includes creating web-based and traditional plotted maps.

Staying Ahead of the GIS Curve

The Westminster GIS group generated a series of interactive web maps for the map gallery, giving residents an intuitive visual tool for learning more about city services and administration.

Westminster was also an early adopter of ArcGIS Online, giving the city the ability to publish web maps that made information easily accessible to constituents. Many of these web maps are in the Living Atlas of the World or on ArcGIS.com. The Living Atlas contains beautiful, authoritative maps on hundreds of topics. The maps are created and shared by Esri, Esri partners, and members of the ArcGIS user community.

Saving Time Benefits Multiple Departments

Dave Murray, the city's GIS manager, recognized the value of making authoritative local data available online by contributing to the Living Atlas. Contributed data is incorporated into the Esri *World Topographic Map*, which is used as a ready-made backdrop for a wide range of maps, from interactive story maps to printed displays.

The Esri *World Topographic Map* is made up of 20 maps of different scales. When you zoom out, the scale of the basemap decreases, meaning you will see a simpler-looking map with fewer features, such as street names. Thus, participating communities have a basemap, easily accessible in ArcGIS for Desktop or ArcGIS Online, that can be quickly dropped into maps with little concern that street labels are too small or the map symbology unattractive.

Westminster regularly uses ArcGIS Online basemaps from the Living Atlas in the city's map products, including many interactive web maps. Sandy Malesky, GIS specialist for the city, estimates that she saves up to two hours each time she uses the basemap, as she doesn't have to re-create a basemap for each individual web application she makes.

"I can focus on highlighting Westminster's features instead of wasting time making street labels and symbols for building footprints," said Malesky.

The Planning Department is one of the city departments that has benefited from using the Living Atlas. ArcGIS Online provides a convenient contextual tool for citizens to browse data related to planning and project development. Internally, the time saved using the basemaps from the Living Atlas has increased staff productivity and helped the city provide more meaningful information to the public.

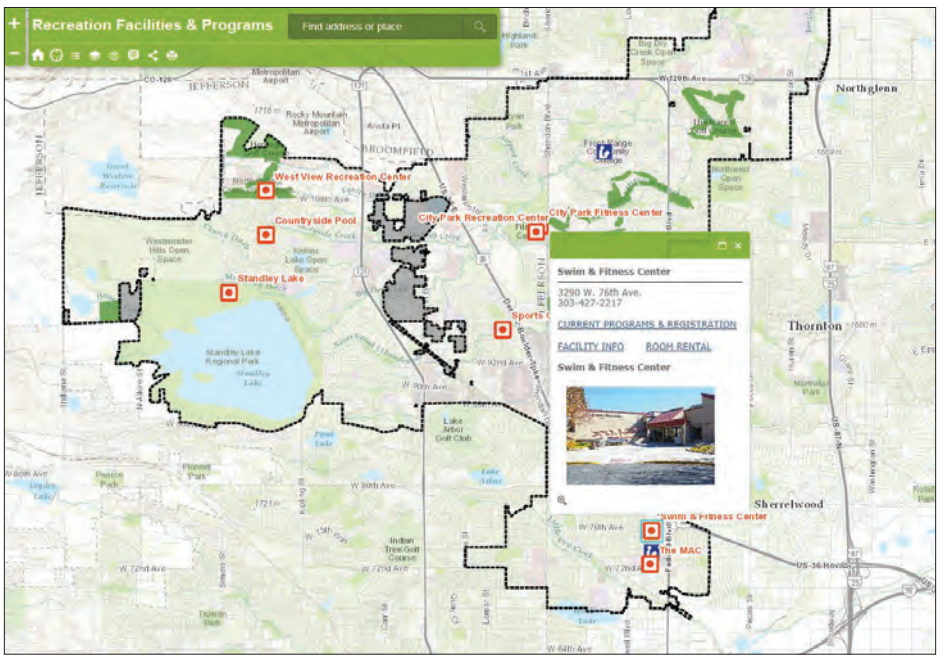
Increasing Community Involvement

The GIS team also created an interactive story map that highlights the public art and architecture that are within walking distance of City Hall. The *World Topographic Map* provides a high-quality backdrop for users navigating the route of the walking tour.

The City of Westminster's Public Art Program represents the evolution of public and private investments, consistently high development standards, and the continual establishment of partnerships between the city and the development community. More than 100 individual works of art are included in the program.

According to GIS technician Joe Simpson, the story map "allows Westminster to showcase an interactive map with eye-catching photographs of art and landmarks, all in one user-friendly application."

By using innovative GIS technology and the Living Atlas to share information with the public, Westminster is showing its strong commitment to bringing local government and citizens closer together.



↑ This web map, created using Esri's Web AppBuilder for ArcGIS, shows recreation facilities within the City of Westminster, with pop-up hyperlinks to program and activity lists.

Using the ArcGIS Platform to Visualize Facility Information

County in Georgia Uses GIS for Facility Maintenance and Strategic Planning

Fulton County, Georgia, needed an easy way to locate and inventory office assets, fulfill maintenance work orders, and improve security and communication. With 295 government facilities across 22 government sections, it was preferable to do this from one system, where facility managers could gain operational awareness for strategic planning.

The county decided to employ the ArcGIS platform. The IT group maintains the enterprise GIS and integrates it with county departments' core business systems. The ArcGIS platform allows staff to analyze data, map water and sewer systems, create tax parcel maps, and perform a host of other tasks.

Now, with 3D maps of buildings and 2D maps of interior spaces, Fulton County can easily access its facility information and quickly realize smart solutions.

Keeping Up with Building Changes

One issue that the county kept encountering was that computer-aided design (CAD) drawings of its buildings—which were saved as PDF paper printouts—failed to keep pace with changes. Many of them were decades old, and as buildings matured, the drawings were not updated to reflect modifications.

It was a logical step to bring CAD data into the GIS platform, where it could be repurposed for multiple types of applications. To better visualize county buildings and simulate architectural changes, the IT group deployed Esri CityEngine.

"Because CityEngine is based on procedural modeling, we designed the model with one set of instructions and continued modeling other buildings by mimicking that workflow," explained Farrah Prewitt, a GIS analyst with the Fulton County IT group.

The IT group integrated GIS with applications that help the facility management department assign and track work orders. Staff access CityEngine 3D exterior space renderings on the platform to see buildings, facility landmarks, assets, and offices. The 3D visualizations make it easier to conceptualize architectural ideas and changes. They also help managers coordinate the physical work environment with the organization's goals. Facility and real estate managers use GIS to bring information together in various ways to show space, time, relationships, patterns, costs, key performance indicators, and more.

Precise Interior Modeling

A facilities management database can be highly detailed. It can contain an array of inventory information, such as printer installations and their maintenance history, requests to repair cracks in a wall, and notes about rotted door trim in a basement. Because of the complexity of facilities management, Fulton County wanted to add GIS capabilities to interior floor plan modeling as well.

A GIS-enabled interior floor plan is essentially a basemap that can have data layers—such as office inventory, electric infrastructure, and office occupancies and vacancies—added on top of it. Staff can map the interior floor plan once and then use the same map for different purposes, including managing work orders and calculating asset replacement costs.

For its interior floor plans, Fulton County implemented the Esri Building Interior Space Data Model.

"We wanted to continue designing from an internal, very detailed model and expand out," said Prewitt. "We decided to use the Esri Building Interior Space Data Model, which is a logical and physical UML diagram that can be directly imported into ArcGIS."

Unified Modeling Language (UML) diagrams are data organizational charts that are customized to a specific industry's needs. The Esri Building Data Model provides the geometry needed to map specific facilities data—even from various perspectives, such as construction, facilities management, and security and emergency preparedness.

Additionally, given that both the Building Interior Space Data Model and CityEngine operate on the same platform, users can easily switch between 2D and 3D interior renderings.

Since implementing this solution, Fulton County has used its GIS-enabled interior floor plans to modernize its security systems and improve communication.

Updating Security Systems

With the ArcGIS platform implemented, Fulton County wanted to update its security system by modernizing the security camera network. The project, which is still a work in progress, aims to put new security cameras in the most advantageous locations.

Using Collector for ArcGIS, county staff members are capturing the data needed for creating a virtual interior floor plan. With Collector downloaded on their smartphones, these employees use their cameras to capture images and video of every corner of a building. Collector georeferences the images and adds them to the county's geodatabase. Prewitt uses the georeferenced images to build the interior floor plan map and posts it to ArcGIS Online.

Once the camera inventory is completed, security personnel will access the floor plan model and interact with it to see the exact locations of existing security cameras. They will then analyze space and line of sight to see where new cameras are needed.

Floor leaders in charge of evacuation are also using the interior floor plan to make evacuation plans that route to the safest stairwells and exits. Because the floor plan is GIS enabled and tied to a database, other variables, such as occupancy distribution, can be factored into evacuation plans.

Improving Communication

At Fulton County, the ArcGIS platform is improving communication between staff members because everyone is working from the same plan.

When a new chief information officer (CIO) came on board, she didn't know where people sat. The IT group added an employee directory layer to the interior floor plan. With that, the CIO could see the locations of the department's five divisions and specific staff. This will be helpful if she decides to move people or relocate any divisions to meet the county's business objectives.

Other administrative staff use these interior visualizations to understand office occupancies and vacancies and make decisions, too.

Fulton County integrates ArcGIS with its core business systems as well to enhance communication across divisions. For instance, the county's building land and lease management system (BLLIS) database includes data about departments and buildings, as well as the county services they provide. After ArcGIS was integrated into BLLIS, the facilities staff could open a GIS web app and add buildings, departments, divisions, and more, to the facilities plan. Staff members could also make edits and automatically upload them to the SQL server for others to see. Users do not need to know anything about IT or GIS to work with these apps.

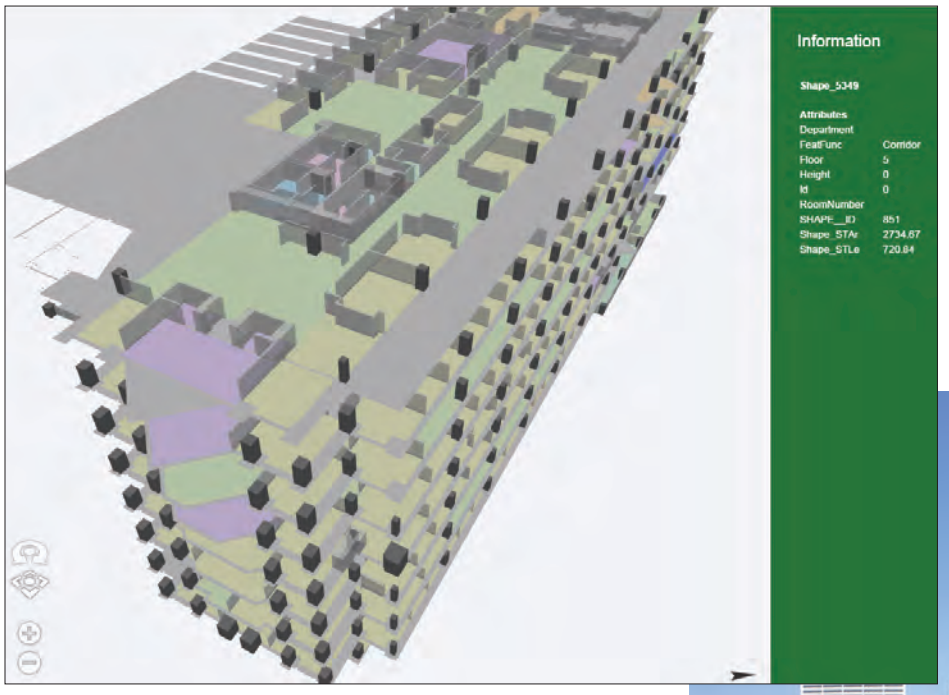
Since the county began this GIS floor plan facilities project, it has completed 8 of the 12 buildings located in the county center. The IT group continues to refine its approach and will pick up speed as it deploys the GIS facilities solution across the county.

Always Innovating with GIS

Fulton County staff members are learning to use the 2D and 3D views, as well as the schematics, to help with their day-to-day tasks. County workers use web apps to search interior floor plans to locate and map facility assets, such as plotters and printers; they can even find details as precise as the assets' model numbers. Managers use the maps to know where their assets are located, who is using them, and their level of usage so they can better control costs.

As the number of ArcGIS users continues to grow across Fulton County, staff keep finding new ways to apply GIS to their daily work.

For more information, contact Fulton County GIS analyst Farrah Prewitt at farrah.prewitt@fultoncountyga.gov or (404) 612-2716.



↑ A 3D model of the interior of the Fulton County government center shows general locations in the buildings and includes two-way links to a very specific 2D floor plan map.

→ A 3D rendering of the Fulton County center made it easy for administrators to conceptualize changes to the building's exterior and grounds.

Making Local Parcel Data Open at State, National Levels

By Nancy von Meyer, David Salzer, and Patrick Santoso

Managing GIS

A column from members of the Urban and Regional Information Systems Association

URISA The Association For GIS Professionals www.URISA.org

Data is a commodity that private enterprise and governments seek to harvest and analyze. It is the fuel that powers our maps and applications, and its breadth and depth directly impact the value of those maps and applications.

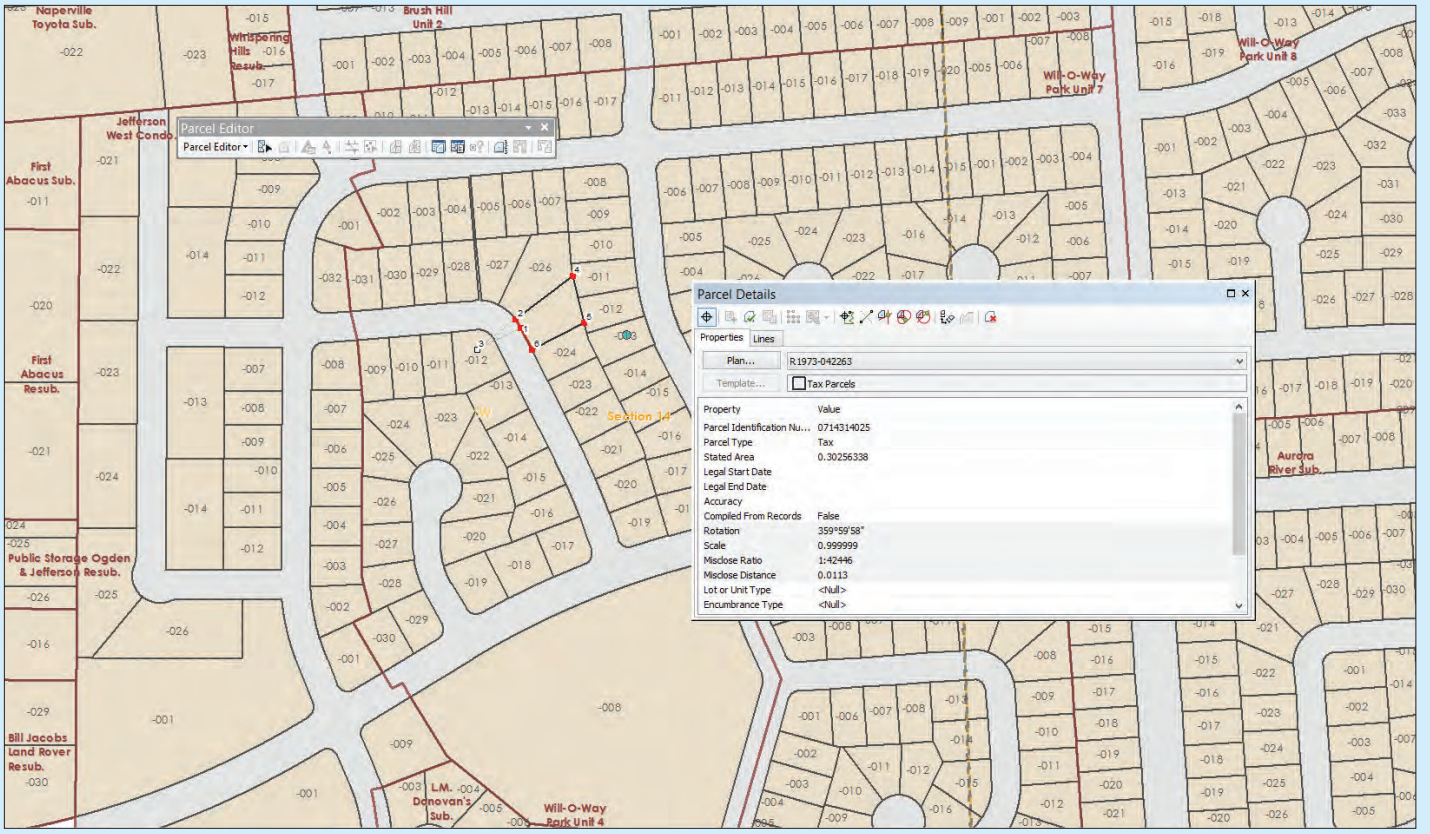
Would anyone use a navigation application that only included interstate highways? Probably not. How helpful would a package tracking service be if it only contained business addresses? Not very.

Sometimes, however, this is how data is compiled and stored: One organization has access to business locations but not residential addresses, or a transportation agency only has data on highways but no concrete information about city roads.

Parcel data supports and drives a variety of business needs and is of immense value to local, state, and federal governments. It is the foundation of good GIS repositories and systems. Yet in the United States, a readily available national parcel and assessment dataset has been, at best, elusive.

Parcel data is typically created and maintained at the local level, with states and national-level organizations aggregating existing data. But building and maintaining extensive, rich, and useful datasets requires more than collecting new information or compiling existing data. It is a nuanced and challenging task to unify disparate datasets, make them consistent and contiguous, and have them correspond to business and governmental needs.

With some relatively recent technological and institutional advancements, however, it is becoming easier to create and maintain publicly available parcel datasets.



↑ Local governments are the best and most authoritative source for parcel and assessment data. To make this more widely available, however, local data producers need tools that enrich data attributes and normalize local content.

Aggregating Local Datasets to Fit State Needs

Local governments are the best and most authoritative source for parcel and assessment data. Their datasets are rich in content and highly accurate.

Vast amounts of property data are collected, maintained, and managed at the local level, primarily to support real property tax and land development (for code enforcement, zoning, and permitting, for example). With high-quality information on parcel boundaries, building footprints, property attributes, and electronic deeds and mortgages, local governments can levy taxes to support schools and municipal and county governments.

Many states have embarked on parcel aggregation projects, which essentially fuse together local data to create regional and state composites. But aggregating local datasets into regional or statewide datasets is not the same as collecting and compiling them.

Most local datasets do not include information such as state and county names. Local data in states that use the Public Land Survey System of subdividing land seldom has information on the principal meridian (the main north-south line that surveyors use), let alone other information that remains constant across data, such as ZIP codes. And one local dataset rarely matches up with its neighbors' datasets, meaning that states can't just compile a bundle of local datasets and come up with a complete picture. In part, that is because there are no common data standards for attributes such as land-use codes, building conditions, and building grades.

What's more, while states do need high-quality parcel and assessment data, they generally do not need the extensive detail or high levels of accuracy that local organizations do. It is typical, for instance, to have a local assessment dataset (that is linked to parcels) with as many as 150 attributes ranging from owner names and the parcels' values to types of flooring and wall coverings. This information is critical for valuation but is not generally beneficial at the state level, which deals more with oversight.

Another issue is that states are unable to harvest the same number of attributes from each local government jurisdiction. A rural county in upstate New York, for example, has less detailed data than New York City. This results in an uneven dataset with gaps and varying attribute densities. Thus, many states try to focus on gathering a core group of attributes geared toward their business needs or what they can realistically collect, such as address, value, and types of improvements.

It is also very common for two properties in the same state to have the same parcel identification number. To amend this in a more encompassing dataset, states have to perform data enrichment—and that can take many forms. Massachusetts, for example, keeps local parcel identification numbers but also assigns a state-managed geospatial identification number (based on latitude and longitude) to each parcel. New Hampshire, however, adds a county and town prefix to local parcel identification numbers to distinguish different jurisdictions. Both methods solve the same problem, just in distinctly different ways.

Enhancing Data Quality for Aggregation

One of the solutions to improve data quality for aggregation is to provide local data producers with tools that enrich data attributes and normalize local content.

The Esri Parcel Editing toolbar has standardized tools and workflows that help people who maintain cadastral data generate more consistent content with higher levels of accuracy. This is especially true for maintaining vertical integration among related data, such as parcels, zoning, and administrative boundaries. Additionally, the Esri Community Parcels configuration enables local data producers to normalize a copy of their data by employing widely used standards.

Making National Parcel Data Viable

With state governments now creating rich composites of local parcel data to power their own decision making and analytics, the idea of a publicly available national parcel dataset is becoming more feasible. This could serve the needs of many federal agencies whose work mirrors that of state governments, such as the US Department of Housing and Urban Development, the US Department of Homeland Security, and the Consumer Finance Protection Bureau. But this has set in motion a great debate within the geospatial community: Who will make national parcel data publicly available?

To date, private industry is the largest compiler of parcel data. These datasets are being sold to anyone who wants them, including state and federal governments. But there are questions about the quality and accuracy of the information they contain.

Therefore, it will be up to states and their local partners to begin aggregating and, most importantly, sharing the valuable datasets that they compile themselves. For example, data that can currently be seen online but not downloaded will need to be made accessible. This is essential to getting a comprehensive, publicly available national parcel dataset.

The lessons learned in state parcel aggregation will be compounded as state datasets are put to use at the national level. Issues of accuracy, attribute difference, contemporaneity, and quality will become more apparent when comparing data across state lines. But the technology is there. So it's really only a question of when, institutionally, it will become a reality.

About the Authors

Nancy von Meyer is president of Fairview Industries, an information technology services firm. David Salzer and Patrick Santoso are principals at Axiomatic, a company that specializes in business process reengineering.

How to Tap the Strategic Potential of GIS

By Gary Maguire, South Australia Department for Communities and Social Inclusion

Some GIS teams just keep winning within their organizations. They're not necessarily the biggest GIS teams or the ones with the most resources. But something sets them apart.

The business and location intelligence services (GIS) team at the South Australia Department for Communities and Social Inclusion (DCSI) is one such team. It operates in the health and community sector, where GIS has much to offer. Yet it still stands out as a leader.

From my perspective, successful GIS teams focus on six objectives in particular that help them excel. For my team, this has made all the difference.

1 Dream to Change the World

Many geospatial professionals have dreams for designing better spaces, achieving more streamlined outcomes, improving organizational capacity, and enriching the lives of others. Unlocking these dreams and turning them into reality, however, requires alignment. Dreams need to be situated within an organization's overarching strategy and designed to complement the organization's vision. They should be articulated in a way that shows how these dreams will help the organization accomplish its goals.

At DCSI, each person on the GIS team brought his or her dreams to the table. For example, one team member wanted to use GIS to manage housing opportunities. So we built this and other dreams directly into the team's GIS vision: to have location information enhance DCSI decisions and drive better outcomes for citizens.

We also folded these dreams into our GIS strategy, which aims to, among other things, provide the best services, support both independence and participation, and connect people to place. The four principles of our geospatial strategy are to coordinate, simplify, innovate, and enable. Under each principle, there are three or four actions that the team can use to measure performance.

Adhering to this plan allows the GIS team to deliver on each of its priorities, in turn communicating why DCSI should continue investing in GIS.

2 Reflect to Effect Change

Great leaders reflect on the past so they can understand how to move forward. GIS professionals should reflect on their work, too. These reflections should encompass successes and failures and focus especially on what was learned.

As a senior manager in DCSI, I often reflect on what we on the GIS team have done. What I see overall is that demand for our services has increased while our resources have stayed the same. But, because the GIS team and DCSI as a whole have embraced GIS as a platform, we continuously improve our business.

This is due, in part, to keeping in stride with technological advancements. In 1998, the GIS team at DCSI only serviced the public housing sector, so a database GIS approach—where data is stored on local drives and network sharing is minimal—worked well. But once demand for GIS services increased in 2004, the group shifted to a GIS server-centric approach, eventually opening up its services to the whole organization in 2006. In early 2014, with even more people catching on to the importance and dynamism of GIS, the team began its transition to a hybrid system that focused on web GIS but still maintained server-centric applications.

Keeping our GIS current has enabled DCSI to better contend with economic ups and downs and serve the strategic targets that all government departments in South Australia strive to achieve.

3 Lead from the Balcony *and* the Dance Floor

Leaders can describe the future or an idea that does not yet exist. They take the front line during troubling times. When celebrating success, they stand behind their colleagues rather than overshadow them.

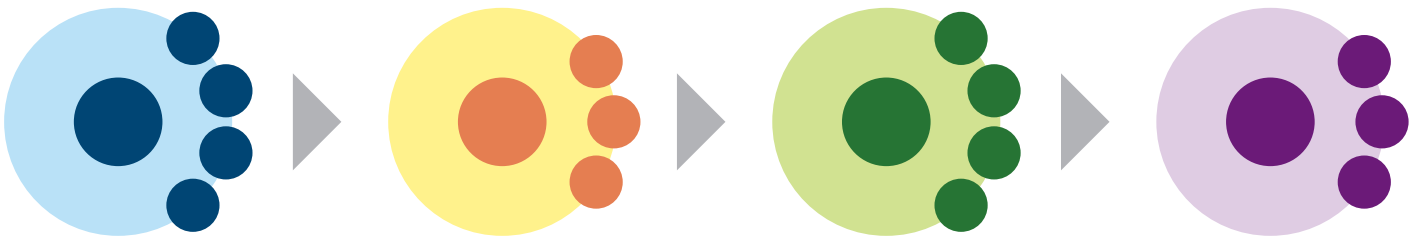
For GIS to succeed in an organization, GIS practitioners need these leaders—and often become them.

One basic leadership skill that all GIS professionals possess is being able to analyze problems from two levels, the "balcony" and the "dance floor." From the balcony, GIS professionals look over the entire problem. From the dance floor, they scrutinize the details of how to solve it.

At DCSI, we used line-of-sight management to expand this balcony-to-dance floor philosophy so we could understand the connections between people, resources, agendas, and aspirations while also leveraging each team member's

DCSI's Geospatial Strategy

↓ Under each of the four principles of DCSI's geospatial strategy, there are three or four actions that the team can use to measure performance.



Coordinate
FACILITATE COLLABORATION

Simplify
IMPROVE BUSINESS PRACTICES

Innovate
DEVELOP SMARTER SERVICE OFFERINGS

Enable
EQUIP INFORMED DECISION MAKERS

strengths. This created tangible key performance indicators that help different divisions realize their targets at all levels. This is what helped the GIS team build its geospatial strategy.

4 Prioritize Relationships

Hierarchical structures can work for medium or large organizations, especially ones that deal with security and safety. But for smaller organizations that want to get more out of everyone, a synergistic approach works better. It lets staff members focus on collaboration and engage in mutually stimulating projects that foster respect and trust and drive productivity and innovation.

GIS and IT professionals operate in a unique space where they regularly interact with different departments and levels of management, allowing them to see across hierarchical divisions. With this view from the balcony, they can connect people, systems, and workflows in ways that create exceptional outcomes.

These boundless relationships are valuable not only to the GIS team's own work but also to the organization as a whole. Thus, in most cases, they need to be encouraged and respected rather than constrained by organizational hierarchies.

5 Speak the Same Language

GIS professionals talk great geo-jargon. But this language does not typically capture the minds of C-suite executives or clients. To get these people to listen, GIS professionals need to speak their language.

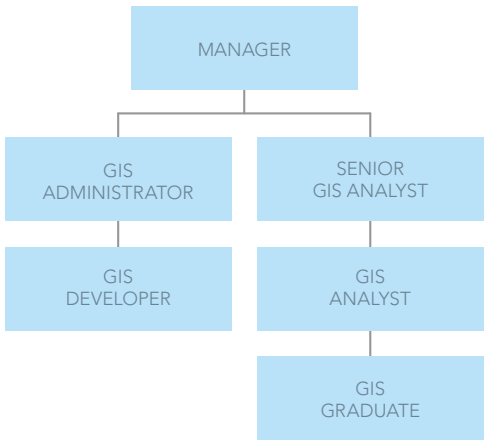
Decision makers are impelled by tangible benefits (revenue generation, cost avoidance, production efficiency, and health and safety), as well as intangible values (customer satisfaction, staff well-being, and improved service offerings). Incorporating these words into conversations with people throughout an organization helps everyone understand the value that GIS brings to these bottom lines.

At DCSI, we have developed two documents that communicate, in generic terms, the advantages of technical services. The service charter explains what the GIS team does and what stakeholders can expect from a project, and the service catalog lays out our offerings, such as doing geospatial analysis and building web-based geospatial solutions. We also generate stakeholder reports that measure the GIS team's successes via metrics such as customer satisfaction and the availability of web GIS applications. Taken together, all these help everyone at DCSI understand GIS.

Hierarchy Versus Synergy

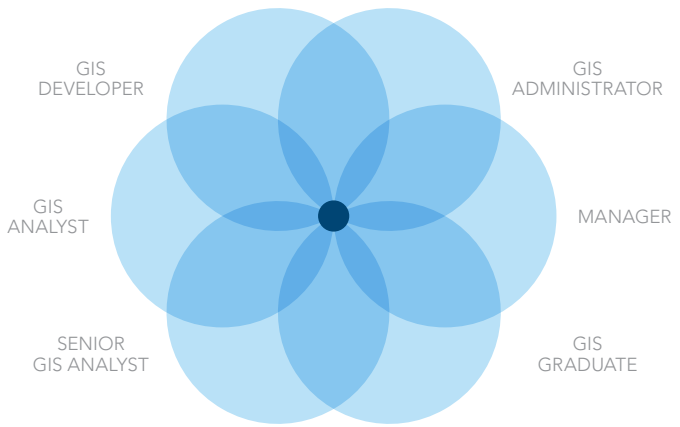
Hierarchical Approach

ROLES AND CLASSIFICATION



Synergistic Approach

TRUST AND RESPECT



↑ A synergistic approach to organization allows GIS staff members to focus on collaboration and engage in mutually stimulating projects.

6 Invest in People

Everyone has internal strengths. However, not even 2 out of 10 people reportedly use their strengths at work every day. In most cases, then, these talents need to be identified and put into play.

This requires something more than annual performance reviews. It demands having a day-to-day understanding of each team member's strengths and ensuring that people get projects that play up their talents.

All GIS professionals have been educated in geographic information sciences, business theory, and many forms of technology. We all have a wealth of technical skills to get any job done. But at DCSI, developing people's broader skills—from improved technical and operational agility to being able to think like the client—has helped transform the GIS team into leaders both within the organization and in the broader community sector.

GIS: The All-Encompassing Enabler

For GIS to be the all-encompassing enabler of business at any organization, the GIS team has to tap the technology's strategic potential. These six focal points do not encompass everything that has made the GIS team at DCSI a success, but they do offer a constructive starting point.

About the Author

Gary Maguire is the manager of business and location intelligence services (GIS) at the Department of Communities and Social Inclusion in South Australia, which won a Special Achievement in GIS (SAG) award at the 2014 Esri User Conference. With 30 years of experience in GIS, including a past term as president of Australia's Surveying and Spatial Sciences Institute, Maguire has been repeatedly recognized for his leadership and services to the spatial community. He can be reached at gary.maguire@sa.gov.au.

The Relevance of Cartography

A Cartographer's Perspective

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

The Importance of Context

Travel is part of life as president of the International Cartographic Association (ICA). The purpose is usually to participate in workshops, seminars, conferences, and business meetings.

Unsurprisingly, maps play an important role in all of this—and not just the ones I talk about during meetings. I also have to use maps to get to my destination and find my way around locally.

In preparing for a trip, an interesting pattern emerges: Following what is essentially computer science professor Ben Shneiderman's visual information-seeking mantra, I—like many people—tend to look at an overview of the place first, then zoom in and filter out the information I don't need, and then dive into the details. For example, if I were to visit a new place for the first time—say, Redlands, California, as a not-so-arbitrary example—I might first pick up an atlas to try to get a rough idea of which country and region or state it is in. Getting more focused, my research would take me to Southern California. Then, the details might reveal the exact address I am set to visit. This is the process of orienting oneself to a place.

Some people, however, might find it more expedient to skip the first two steps and zoom directly into the point of interest. Using interactive mapping tools, they can find nearly every location in the world. And with voice navigation, they can be guided to exactly where they need to go—no map even needed.

While some could argue that maps are like cars—as long as they drive, there's no need to learn about the engine—blindly following navigation systems has a mind-numbing effect. What if I don't know how far east Redlands is from Los Angeles or whether it is north or south of San Diego? Would this affect anything? My (only slightly biased) answer is yes. That is because maps give context.

Of course, navigation systems have made traveling much easier, especially on the local level in unknown cities. I love to use and even experiment with them. They always tell me where I am, and everything runs smoothly—as long the maps are up to date and the device's battery does not die.

If the device does run out of battery, though, paper maps always come in handy. And then a person definitely needs map-reading skills to ascertain where he or she is and navigate to his or her destination.

To do this, orientation is key. It constitutes figuring out the relationship between reality, the map, and the mind. Orienting oneself to a map reveals how skillfully reality is represented on the map, how well the person can convert the map into a mental image, and how effectively he or she can link this image to reality.

In some situations, this is harder to do than one might think. For instance, when emerging from a metro station, it is difficult to figure out which side of the street the exit is on and whether it faces north, east, south, or west. That is why getting an overview of a place is essential: It draws heavily on a traveler's spatial abilities and, I would argue, is fundamental to the experience of traveling itself.

These skills would especially be put to the test if, while carrying a dead smartphone, the wind took a person's paper map on its own trip. In that case, the works of author Tristan Gooley would come into play. In his book *The Natural Navigator*, he challenges readers to venture outside without maps or other navigation aids, such as compasses or GPS devices, and travel based on nature's signposts.

For centuries, humans have navigated using the stars and the sun, though most people likely lack those abilities now. Even on cloudy days, it is possible to navigate based on vegetation. But to do this, one needs context. Knowing predominant wind directions and observing how trees are positioned would help. In urban environments, perceiving which sides of the buildings have moss and lichens on them (while still taking wind direction into consideration) would yield useful information for navigation. In both situations, observing the surroundings is indispensable.

Thus, with or without maps, having context while traveling is beneficial. That is why getting an overview of a new place is a step that should not be skipped.

Today, there is a profusion of tools and programs that can help with this. The ICA alone has several commissions dedicated to increasing map use and spatial awareness. The commission on location-based services aims to use mobile technology to increase the use of maps and geospatial information anywhere and at anytime, while the commission on ubiquitous mapping concentrates on context-aware mapping services for information and communications technology. A handful of committees also focus on how people actually use maps and GIS applications, including the commission on cognitive issues in geographic information visualization and the commission on use, user, and usability.

Good maps are created with users and context in mind. When both of these elements are reflected in the map content, map readers at once attain a sound overview and the details of each location they plan to visit.

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.

Immersive education for a global profession

The Master of Science in GIS Program

Our Master of Science in Geographic Information Science (GIS) Program provides an unparalleled learning and growth opportunity. We are located at the epicenter of GIS—Redlands, California, home to the world's leading GIS company, Esri®.

Our program is designed for professionals seeking to improve their knowledge of analysis and management of geographic information. We provide an open learning environment in which international faculty and students learn together about the cutting edge of GIS technology, theory and applications.

Small class sizes provide a close-knit environment and the opportunity for students to consult one-on-one with supportive professors.

Program Features:

- One-year, full-time residential program (may be extended to two years)
- Access to extensive Esri resources
- In-depth education with hands-on experience
- Real-world projects with a global perspective
- State-of-the-art facilities with the latest GIS technology and a fully wireless campus

UNIVERSITY OF Redlands

msgis.redlands.edu | 909-748-8128

Crossing Borders

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

Don't Know Much About Geography

Singer and songwriter Sam Cooke was right, and now it's official: K–12 students in the United States really don't know much about geography, according to a major report recently released by the US Government Accountability Office (GAO).

The congressionally mandated study found that nearly three-quarters of eighth graders in the United States are "not proficient" in geography and that the proficiency levels of American students have shown no improvement since 1994.

This is a clarion call for the need to support geography education in the United States.

Knowledge of Geography Is Crucial

In 2013, a Senate report from the Appropriations Committee expressed concern about Americans' preparedness for pursuing careers in skilled fields, especially in geospatial technologies.

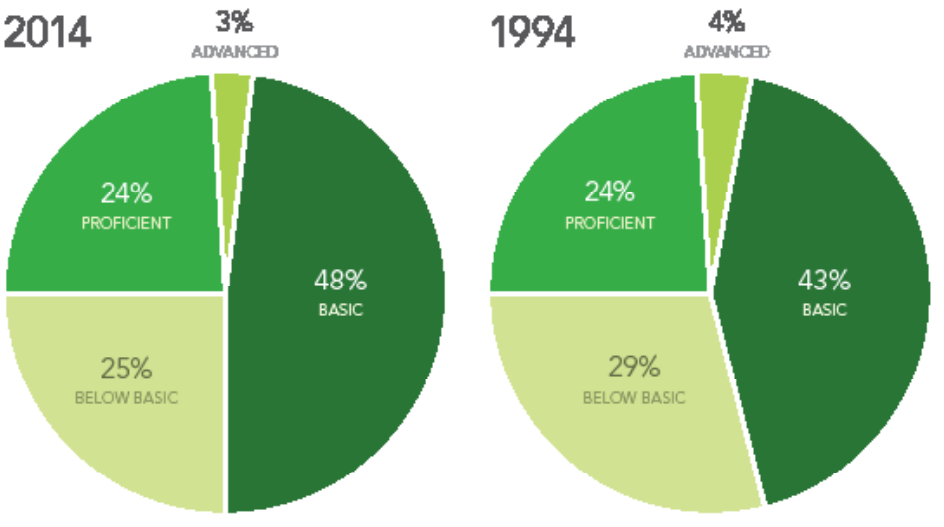
"The Committee recognizes that a sound understanding of geography is critical to ensuring that the American workforce is qualified for jobs in geospatial technologies and other emerging industries," states Senate Report 113-71.

The GAO study, which was conducted pursuant to this report, makes it clear that geography is indeed integral to nearly all aspects of life today, from the economy to foreign policy. It also shows that employment of specialists in geography, or geographers, is expected to grow by 29 percent from 2012 to 2022, according to a US Department of Labor projection. That is much faster than the average growth for all occupations, which is 11 percent.

"Geographic information and geospatial, or location-based, technologies are growing sectors of the American economy, influencing almost every facet of modern life, from tracking lost cell phones to monitoring disease outbreaks like Ebola," affirms the study's cover letter to US senators Roy Blunt and Patty Murray. "The emergence of these technologies has increased demand for workers who can analyze and interpret geographic information. Research suggests that K–12 education is critically important for learning the fundamentals of geography, which is the study of places and the relationship between people and their environment."

But only 27 percent of eighth grade students are proficient in geography, with just 3 percent of them in the advanced category. Meanwhile, 48 percent of eighth graders have just a basic understanding of the subject, while 25 percent scored below proficient.

Geography Proficiency Levels of Eighth Graders



SOURCE: GAO analysis of National Assessment of Educational Progress (NAEP) Geography Assessment data for 1994 and 2014. | GAO-16-7

More Investment in Geography Education

The GAO study specifically noted that the lack of adequate funding designated for geography-focused programs in national education legislation has hindered US Department of Education officials in their ability to support geography education.

This reinforces the recommendations of the Association of American Geographers' (AAG) Resolution Supporting K–12 Geography Education, which calls on Congress to include funding for K–12 geography as part of the reauthorization of the Elementary and Secondary Education Act (ESEA), otherwise known as No Child Left Behind. The AAG's resolution (aag.org/resolution) has already been endorsed by a number of former US secretaries of state and defense, 24 bipartisan incumbent governors, and more than 25 Fortune 500 companies.

The GAO report's findings also underscore the critical importance of Esri's far-reaching donation of ArcGIS Online to all K–12 schools in the United States via the Department of Education's ConnectED program. This extraordinary philanthropic action opens up broad new opportunities to bring GIS and underlying geographic concepts into US schools right now. And with the joint AAG-Esri GeoMentors program, Esri's talented and extensive user community can also play a direct role in improving geography and GIS education in the US by supporting teachers as they introduce ArcGIS Online and geography into their schools. (To learn more and to volunteer as a GeoMentor, visit geomentors.net.)

Wider Recognition of the Need for Geography

While the lack of progress in improving K–12 geography education has been frustrating, it is clear that the need to change this is now becoming more widely recognized—within both governmental and educational circles and, perhaps most significantly, in society and the business world.

Efforts from Esri, AAG, and many others, are making real headway, and the GAO report adds to the rationale for campaigning for fundamental change. Together, we can make this change happen.

A copy of the full GAO report is available at gao.gov/products/GAO-16-7. Please direct questions about the report to Jacqueline M. Nowicki at nowickij@gao.gov or (617) 788-0580.

Contact Doug Richardson at drichardson@aag.org.

Australian Students Develop Apps to Build Smart Communities

Students in Western Australia got a hands-on understanding of how important location is to sustainable living, environmental change, and cultural understanding at the state's recent junior app development hackathon.

One hundred twenty students from seven high schools in the Perth metropolitan region were brought together in August for HackED, a first-of-its-kind initiative that gave some of the city's most forward-thinking youth the opportunity to tackle community planning and infrastructure issues using location data.

Hosted by Landgate, Western Australia's land and property statutory authority, and the Western Australian Land Information System (WALIS), the event encouraged students to tap into their ambitious ideas by building map-based apps using ArcGIS Online. Teams of students developed a range of smart community solutions, connecting innovation with location to improve livability throughout the state.

Solutions included a proposed telecommunications upgrade for Perth, Australia's fourth most populous city, which would see 5G rolled out across the state capital; an app to help alleviate traffic congestion issues; and a social awareness app relating to the impact humans have on the environment.

Another app, which promoted breaking down cultural barriers by uniting people through common threads, won best pitch of the day. Based on the principles of social media, the app highlighted international events on a world map. It linked countries that recognize the same holidays and festivals and educated users on the unique traditions celebrated in each place.

WALIS director Damian Shepherd said HackED's overarching aim was to reinforce the importance of science, technology, engineering, and mathematics (STEM) education by creating a progressive new learning environment where real-world, geographic challenges could be addressed.

"Everything happens somewhere, so all of those problems have a location-based element to them," said Shepherd. "Many of the projects developed by students were centered on building things at a particular location, so they had to think about related services like power and water and whether those resources were readily available. Location helped them address those considerations."

Shepherd said that once students conceived their solutions, they used ArcGIS Online to help bring those ideas to life.

"While many students started their design work on paper and undertook some research on the web, they still needed to bring their rough ideas together," he said. "ArcGIS Online allowed them to create a living, breathing picture of their concepts that revealed the interdependencies of various key factors."

The HackED hosts weren't looking for highly polished apps, according to Shepherd. Rather, the primary objective was to encourage students to look at problems spatially.

Esri Australia senior consultant Christopher Brown, who helped students flesh out their ideas in ArcGIS Online, was impressed by their ingenuity and teamwork. He was also in awe of the smart, community-minded solutions they developed.

"Once groups became comfortable with ArcGIS, they worked quickly to capture their ideas using the software's various features," said Brown. "Some groups were using *[Esri]* Story Map Journal templates, others were working on more editing-type workflows, but all of them were actively leveraging GIS to work around the development application scenarios."

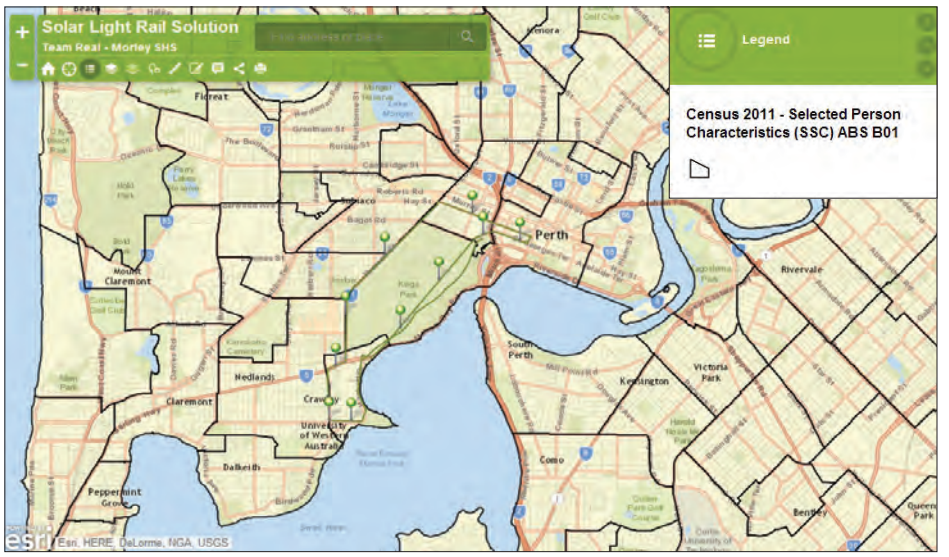
Brown said that introducing students to GIS and encouraging them to think spatially helps them see the world's challenges in a more complete way. He also acknowledged the long-term potential of a number of the students' projects.

In addition to providing students with a platform to create community solutions, HackED also brought awareness to the Western Australian Whole of Government Open Data Policy.

After realizing that its data was being underused, the Western Australian government introduced the policy in July to help maximize this constantly evolving resource. The aim was to clearly communicate the government's position on open data, as well as increase understanding of the value the data offers to every member of the community.

Citizens can now access a wealth of data collected by the state. This approach assists scientific research, education, and innovation across various industries while improving the transparency of government activities.

Landgate is already planning HackED 2016 and is looking to expand both the number of participating schools and the number of industry partners involved in the event.



↑ Students from Morley Senior High School won best hack of the day for their transportation solutions app.

GIS Goes Far Beyond Geography at Texas A&M

By Daniel W. Goldberg, Andrew G. Klein, Douglas Wunneburger, John R. Giardino, Sierra Laddusaw, Eric Irwin, and David M. Cairns, Texas A&M University

Deep in the heart of Texas lies Texas A&M University (TAMU), known to generations of former students as Aggieland.

Founded in 1876, TAMU was the first public university in Texas and is now one of the largest research universities in the United States, with more than 58,000 students, including nearly 14,000 graduate students. It was one of the first US universities to hold the triple distinction of being a land-, sea-, and space-grant institution, meaning it does leading research in all three domains. Thus, it is prime breeding ground for GIS.

The Organic Growth of GIS

During the 1980s, GIS research developed organically across TAMU. Professors in several departments—including landscape architecture, entomology, parks and recreation, forest science, and geosciences—used the emerging technology to support their diverse research needs.

Due to the high costs of computers at the time, TAMU began GIS instruction in 1985 only in the forest science department after PhD student (and now associate professor) Douglas Wunneburger developed microGIS. This homegrown program ran on 20 Tandy 2000 personal computers in the university's then state-of-the-art computer lab.

Interest in microGIS spread quickly. The College of Medicine used it, along with electron micrographs (digital images taken through an electron microscope), to calculate the density of whole viruses. The plant pathology department also employed microGIS to create spatial models for controlling oak wilt, a fungal disease that can kill oak trees quickly. Those models have since become standard practices.

Student interest escalated, too. By the end of the 1980s, the forest science department's class, GIS for resource management, had expanded to six sections, reaching more than 100 students per semester.

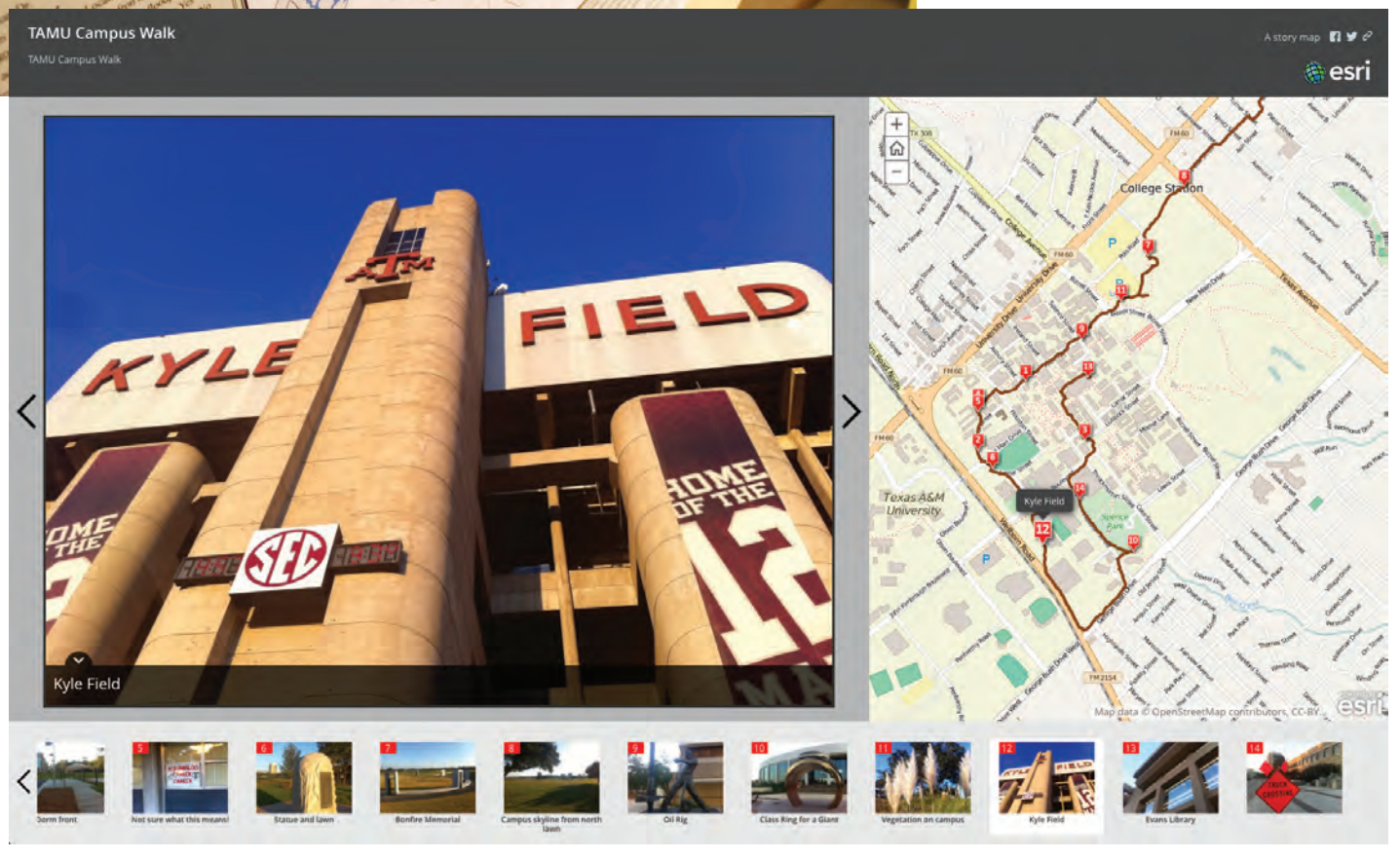
At the same time, workstation costs decreased and Esri became the standard GIS software on campus. This gave the department of geography in the College of Geosciences the impetus to become TAMU's second venue for GIS coursework, even motivating the geography faculty to construct its own GIS laboratory.

From its inception, GIS instruction in the geography department focused on the underlying philosophy and theory of GIS rather than just keyboarding. Before long, GIS instruction in the geography department began to nurture research, and masters and doctoral students started submitting theses and dissertations in which GIS played key roles.

In 1994, the College of Agriculture and Life Sciences opened the Mapping Sciences Laboratory (MSL). This was an important milestone for GIS research at TAMU, as it expanded the university's capabilities in GIS, remote sensing, and GPS navigation. Resident scientists were initially from the department of forest science, though scientists and students across campus used the laboratory. Scientists from the Center for Infrastructure Engineering later joined the facility. Campus GIS projects managed by the administrative GIS team under the Planning and Institutional Research Office also contributed to the strong cohort of GIS specialists housed in the lab. In fact, the combination of talents from each of these groups gave rise to a significant body of knowledge that, to this day, still tackles mapping science problems on campus and around the world.

Finally, because of needs in landscape architecture, urban planning, architecture, and construction science, the College of Architecture became the third school to teach GIS in 1998. Based in the department of landscape architecture and urban planning, the GIS program has evolved greatly from "eight computers running off of a single extension cord," as Wunneburger put it, to a lab that houses several research centers that allow students to collaborate with groups throughout the university, such as the Texas A&M Transportation Institute.

↓ GIS supports research in nearly every college and agency at Texas A&M University.



↑ A land-, sea-, and space-grant institution, Texas A&M University is prime breeding ground for GIS.

Three Decades of GIS-Based Facilities Management

At the same time that GIS research and instruction progressed at TAMU, the technology's use in campus administration burgeoned, too.

As one of the nation's largest universities, sprawling over 5,200 acres (21 square kilometers), GIS has been an important tool for managing TAMU's infrastructure for almost three decades. In 1988, committees within the division of finance and administration met to discuss developing a campus GIS. Around the same time, TAMU joined a multi-agency partnership with the Texas Department of Transportation to take aerial photography of the main campus and its outlying properties. This enabled the university to digitize information on campus infrastructure and create computer-aided design (CAD) drawings of university buildings.

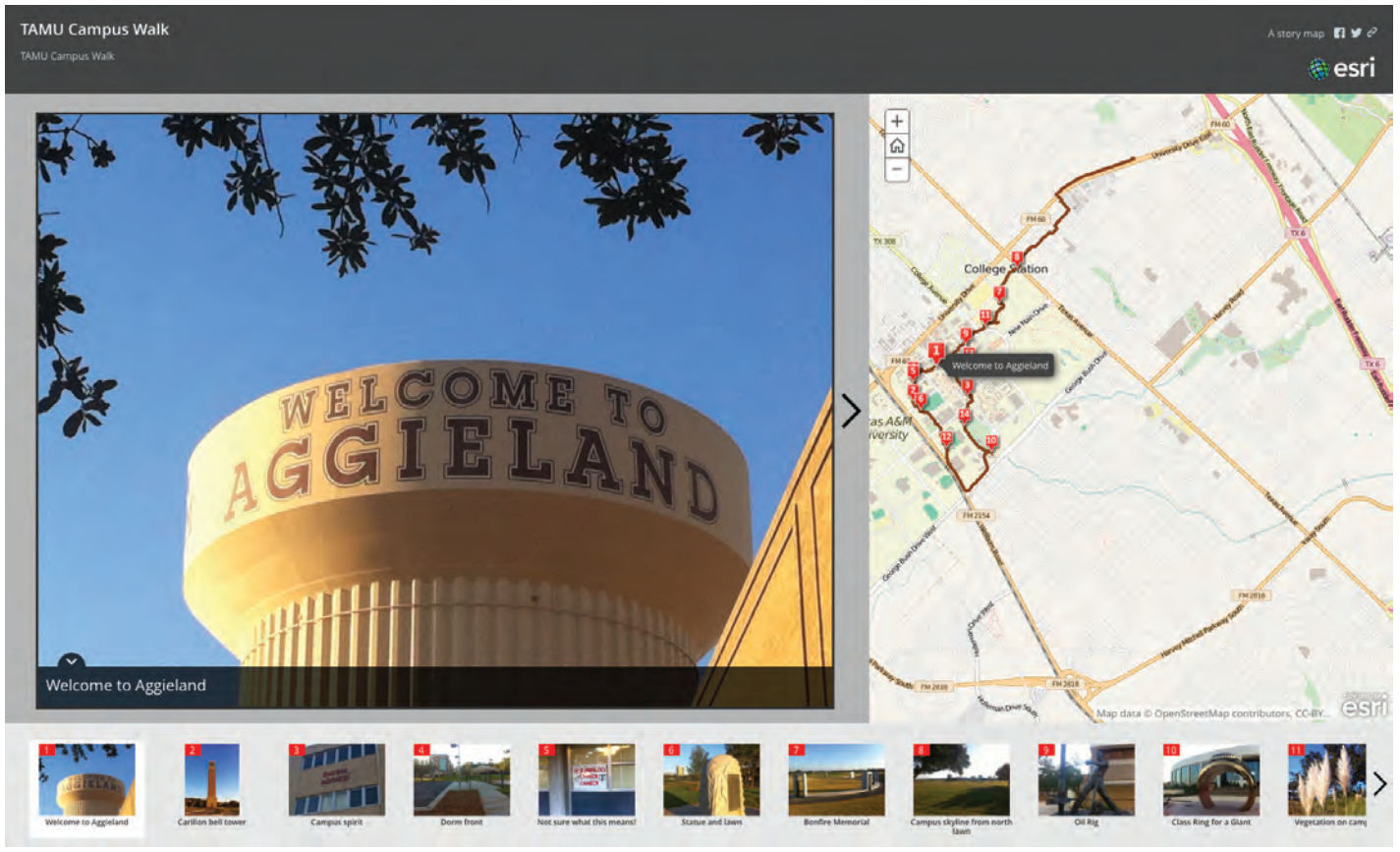
These initial projects have since evolved greatly, and facilities organizations continue to use GIS heavily today. Transportation services, for example, uses GIS to create specialized event maps, route buses, and help residents and visitors traverse campus and safely park. GIS is also critical for planning and communicating updates about various construction projects.

"GIS has…brought better information into decision making and in the campus master planning process," said Jim Culver, assistant director of the office of facilities coordination. "At A&M, GIS has grown from an entity entirely unto itself to a tool used by many people across campus."

Now, GIS Instruction for the Thousands

From its humble beginnings, GIS at TAMU has grown to support research in virtually every college and agency at the university.

Eight departments now instruct thousands of students each semester in courses ranging from



↑ GIS will continue to be carefully and innovatively cultivated at Texas A&M University, just as it has been for the past three decades.

introductory GIS to highly specialized graduate classes. Students can select GIS-centric majors in three different colleges, leading them into a diverse choice of careers in fields that include natural resources, agriculture, urban planning, geodesign, oil and natural gas, and national security, to name a few. The university has a full-time GIS librarian who provides GIS research assistance and outreach and does data curation for the libraries' large collection of local, state, national, and international data. TAMU has also been designated an Esri Development Center, which enables students to build software that extends the functionality of Esri products.

The university is also home to numerous federally and state-funded academic research centers that focus on using and developing GIS to solve wide-ranging social challenges. The College of Architecture contains the Hazard Reduction and Recovery Center and the Center for Housing and Urban Development, which focus on research and building applications for general and disaster planning. The Texas Research Data Center in the College of Liberal Arts conducts census research that serves the south-central region of the United States and is one of only eight secure census research facilities at US universities. The Dwight Look College of Engineering hosts the Center for Autonomous Vehicles and Sensor Systems, which houses one of six authorized drone test sites in the country. And the Texas A&M GeoInnovation Service Center in the College of Geosciences provides research and commercially applicable geoprocessing and data collection solutions for various industries; nonprofits; and local, state, and federal agencies.

A Bright Future for GIS

TAMU's GIS enterprise reflects two of the university's defining traits: its decentralized administration model and its friendliness.

Because of TAMU's large size, individual colleges have a lot of independence. So GIS is also dispersed. But the numerous GIS entities across campus have long been friendly with one another, with faculty and staff recognizing contributions from educators and researchers around the school.

This sense of respect drove the TAMU GIS community to establish the Center for Geospatial Sciences, Applications, and Technology (GeoSAT) in 2014. Its core mission is to foster multidisciplinary collaboration among faculty, researchers, and students to advance geospatial knowledge and provide practical solutions for the development and use of geospatial technology in the realm of economic development.

GIS will continue to be carefully and innovatively cultivated at Aggieland, just as it has been for the past three decades. Here, the technology faces a bright future.

About the Authors

Daniel W. Goldberg is an assistant professor of geography in the departments of geography and computer science and engineering. Andrew G. Klein is a professor in the department of geography. Douglas Wunneburger is an instructional associate professor in the department of landscape architecture and urban planning. John R. (Rick) Giardino is a professor in the geology and geophysics department. Sierra Laddusaw is the maps and GIS library supervisor. Eric Irwin is a GIS specialist for the university's transportation services. David M. Cairns is head of the department of geography.

Esri Story Map Brings New York's Brewing History to Life

By Jane Mulcahy and Jonnell A. Robinson, Syracuse University

It is a little known fact that Central New York State was the leading producer of both hops and beer throughout much of the nineteenth century. Central New York was the largest hops-producing region in the state, and New York as a whole was responsible for more than 80 percent of national hops production in some years, exporting the crop all over the world.

Unique histories like this are the types of stories the Onondaga Historical Association (OHA) of Syracuse, New York, likes to illuminate to connect and engage community members with their local history. To explore innovative ways of conveying the local history and geography of pre-Prohibition beer brewing to a diverse audience, OHA recently partnered with the Syracuse Community Geography program at Syracuse University, where students used ArcGIS for Desktop and a story map to bring the topic to life.

A University-Community Partnership

Established in 2005, the Syracuse Community Geography program partners with community-based organizations to map and spatially analyze topics of interest to the Central New York community.

Any community member can submit a project request for GIS mapping. He or she then works with the community geographer and university students to collect, analyze, and map data. The benefits of the projects are twofold: While community partners gain access to GIS and spatial analysis skills and learn the benefits of applying geography to their work, students improve their GIS, research, and critical thinking abilities.

OHA, located in the city of Syracuse (the county seat of Onondaga County, in the heart of Central New York), has encouraged residents to explore and appreciate the past for more than 150 years. It has hosted exhibits on topics ranging from the Underground Railroad to the Erie Canal.

The partnership between OHA and the Syracuse Community Geography program was a natural fit as OHA began to explore new ways of communicating the region's rich history through interactive, web-based tools and digital storytelling technologies. The Historical Breweries project provided an opportunity to connect students to the local community through experiential learning, while the story map linked an expanding audience of community members to their local history.

Blending History, Geography, and Photography

To reconstruct the beer brewing history, students worked with OHA staff to access OHA's archives. They collected historical images, maps, newspaper articles, books, and government documents related to beer brewing, hops production, and Prohibition.

Since one of OHA's major goals was to create a map of the locations of the most prominent historical breweries, the students used historical atlases and business directories to determine the location of each brewery. After accounting for changes in the street network and street names, they found the present-day locations of the historical addresses. Students then used ArcGIS for Desktop to produce a map that shows the historic brewery locations on a modern street grid.

Using the new maps and archival images as references, Drew Osumi, a photography student from the university, photographed the modern-day locations where each brewery once stood. He then employed a process called re-photography to overlay black-and-white photos of prominent turn-of-the-century breweries onto his photos of the current locations, painstakingly editing the edges and angles to get the overlays to line up exactly.

The re-photography, or digital composite photography, embodied the entire project: It captured the geographic context of the historical breweries and connected them to the city as residents experience it today.

What's more, the hierarchical template of the Story Map Journal allowed students to showcase the juxtaposed images and maps as the main features of the story. They complemented them with supporting text and historical images of other aspects of the brewery industry as well, such as beer labels, brewery workers, brewing methods, and historical maps.

"It's almost like a little exhibit," said Jon Zella, development associate at OHA. "It allows people to get what they want out of viewing *[each]* page—a little interactive of the history of brewing history here in Syracuse. If you want to look at photos, that's great. But it also provides more information for those who want to learn more about it."

The story map's user-friendly interface made it simple to add sections, edit text, and alter or replace images as well. This was conducive to having multiple students work on the story map over time, making it easy for a student to pick up where someone else had left off.

An Alternative History

Throughout the research and development stages of building the story map, several interesting aspects of Central New York's beer brewing history emerged. The main elements of the story were German brewers, "hop digs" (post-hops-picking dance parties), beer advertising, technological advancements, brewery architecture, and tensions over the temperance movement. But the team also discovered an alternative explanation for the ultimate demise of the Syracuse brewing industry.

While the decline has mostly been attributed to the temperance and prohibition movements of the early twentieth century, student research found that a fungus called blue mold wreaked havoc on New York's hops crops beginning in the 1880s. Reduced cultivation in New York created a gap in hops production for regions in the western United States to fill. Encouraged by the demand for hops and the recently built transcontinental railroad, hops production in the west escalated, and small-scale breweries in Syracuse began to dwindle. Syracuse's prominence in hops and beer production waned and wouldn't see a resurgence for almost another century.

Amid the reemergence and popularity of craft breweries and hops farming in Central New York and elsewhere across the United States, OHA wanted to showcase Syracuse's historical significance to the beginning of beer making in America. Using ArcGIS for Desktop, OHA and the Syracuse Community Geography program were successful in creating the first map of Syracuse's most prominent breweries at two points in history—the end of the nineteenth century and the beginning of the twenty-first century. And the use of re-photography gives community members a sense of what the Syracuse landscape once looked like and how it has changed.

↑ The use of digital composite photography illustrates where the 1881 Central City Brewery would have stood in present-day Syracuse.

"In this kind of way, you're actually teaching people about history and industry in Syracuse, and it's something that if they find an interest in it, they can connect with it," said Zella.

Additionally, students had the opportunity to connect with their community and local history, and OHA gained knowledge of new tools to make local history relevant and accessible.

"It was an interesting approach to research, to put the research into action," added Zella.

To learn more about the Syracuse Community Geography program and to view the History of Beer Brewing in Syracuse, NY, story map, visit communitygeography.org.

About the Authors

Jane Mulcahy is a graduate assistant for Syracuse Community Geography. Jonnell A. Robinson is an assistant professor at Syracuse University and the Syracuse community geographer for Syracuse Community Geography.

Esri Startup Program Pairs GIS with Innovative Hardware

The Esri Startup Program gives emerging businesses an edge by helping them integrate spatial functionality into their products and services. Program participants receive ArcGIS platform technology, training, support, and marketing opportunities to help them succeed.

Some startup developers are using the Esri Startup Program to build solutions that combine ArcGIS with innovative hardware. Smart glasses, spherical monitors, and drones can help companies better understand their work and natural environments.

Using these devices helps organizations gather, visualize, and analyze data, bringing the purpose of GIS—to deliver actionable information—into the forefront.

To learn more about the Esri Startup Program, visit developers.arcgis.com/en/startups.

A Second Set of Eyes in the Field

Wearable GIS technology gives frontline workers a new perspective on facilities maintenance. Equipping wearers with a second set of eyes, VisualSpection's augmented reality smart glasses include a touchpad, camera, and visual overlay (which displays images on top of video).

Wearing the glasses, fieldworkers drill, dig, scale towers, and go down sewers while accessing and collecting data. At the same time, asset managers get a first-person perspective on facilities through the eyes of field crews. A utility worker wearing the glasses could walk up to a power pole and see its transformer information in the visor. The glasses record the worker's comments, take photos, and capture location information. They are voice driven, so the worker can safely maintain three points of contact with the pole.

The smart glasses allow georeferenced data to flow from the worker to the office in near real time. An audio application transcribes any recorded comments into digital field notes. To make the information easily accessible, VisualSpection (visualspection.com) automatically transfers the field data to ArcGIS Online and ArcGIS for Server.

↑ A fieldworker for Manitoba Hydro, a major energy utility in Manitoba, Canada, uses VisualSpection augmented reality smart glasses to record GIS information about a power line corridor.

Viewing Global GIS Data Spherically

Pufferfish (pufferfishdisplays.co.uk) designed PufferSphere, a spherical projection display, for visualizing many types of information, including map projections. By integrating its sphere solution with ArcGIS, Pufferfish has opened exciting prospects for users to showcase global GIS data in an intuitive globe format.

The globes are popular with museum visitor centers. Visitors interact with the spherical data to understand the surface of Mars or Earth's tectonic plates. Users access global data from NASA, for example, to understand ecology and climate change stories in a visually appealing way. The sphere also projects videos.

Working with Esri, the startup's designers have equipped the sphere technology with ArcGIS workflows. Users publish their maps to the globe and seamlessly interact with data layers and features. They can drill into information, add map layers to a basemap, and interrogate data.

PufferSphere allows many people to work with the sphere at once. The globe image divides into three independently controlled segments, each with identical functionality.

Pufferfish and Esri continue to add more GIS capabilities to the sphere, such as real-time data visualization. The sphere has potential for corporate applications, too, such as visualizing global assets, wind layers, and shipping routes. Its natural shape makes for intriguing geographic storytelling.

↑ A pair of analysts works with ArcGIS on the PufferSphere globe to collaborate on two aspects of the same project. They use gestures to access data and tools.

Drones and Aircraft Offer Ideal Vantage Points

InspecTools (inspectools.com) has created an asset inspection solution that uses drones and other methods to mitigate power generation and transmission problems. Utility companies use it to keep wind turbines, transmission and distribution lines, and more, in working order.

The inspection tool solution employs ArcGIS to process sensor data collected by aircraft, unmanned aircraft systems, infrared aerial inspection devices, and other sensors. It generates intelligent map products that help managers understand the conditions of their assets so they can take action. ArcGIS serves as a system of record for the entire life history of each asset.

To mitigate wear on wind turbine blades, InspecTools uses image sensors and custom-made drones that can withstand high winds to take very-high-resolution images of the blades. The data goes into a geodatabase along with the turbine's factory blade information, status, and maintenance history. Users can open a schematic of the wind farm, click a tower, check blade wear, and draw a polygon around the problem right on the photo.

Utilities in the United States and Europe use manned and unmanned aircraft (respectively) to fly along power line corridors and locate vegetation that endangers the network. Comparing tree encroachment to tree heights, users can figure out where vegetation needs tending. Users can also lay lidar-generated digital elevation models on the photos to locate vegetation risks more accurately.

As the Federal Aviation Administration incrementally introduces drone regulations in the United States, more room will open up for the use of drones in industry. When it does, GIS solutions will already be in place.

↑ A quadcopter captures images of a wind turbine blade that are then added to an asset management map.

Well-Traveled Esri T-shirts

Math and engineering teacher Marcel Duhaime poses in his Esri T-shirt behind a sign pointing to the Djuma Research Camp in northeastern South Africa. Students and teachers from Hopkinton Middle High School and Bow High School in New Hampshire recently spent three weeks in the area helping to install ArcGIS for Desktop at Acorn to Oaks Comprehensive High School. In addition to teaching 30 South African students how to make and analyze maps of their area, the visitors got a chance to enjoy the sights while on safari.

Tom McConnell, who calls himself an ancient GIS guru, wears a similarly antediluvian Esri T-shirt while meeting with GIS students Auliantya Ayurin Putri (left) and Rosita Andari Eka Putri (right) from Gadjah Mada University in Yogyakarta, Indonesia. McConnell met Auliantya Putri at the 2015 Esri User Conference in San Diego, California, where she received the 2015 Esri Young Scholars Award for her ArcGIS Online service-based application that allows people to report poor conditions at and around schools.

The Amazing Mapman and The Magnificent Mapgirl were spotted recently in South Dakota. Minnehaha County GIS analyst Josh Hellman and GIS coordinator Heidi Jerke were using Collector for ArcGIS to do some fieldwork at the county line.

Partners Meet Users' Needs in New, Diverse Ways

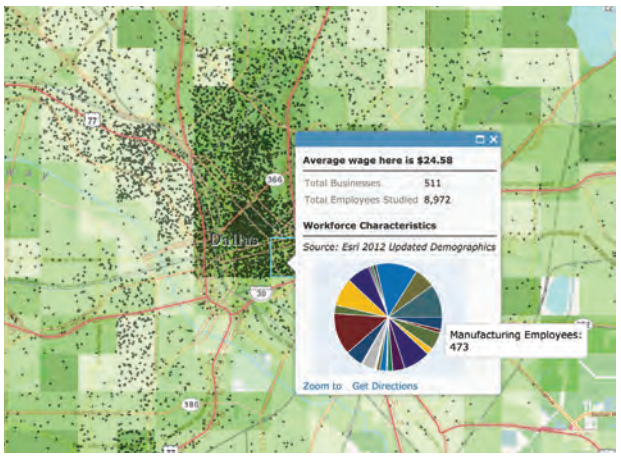
GIS is no longer just for geographers, field crews, and those who have been using the technology for decades. Today's GIS practitioners work in a variety of industries all over the globe, and their roles range from GIS experts and business development staff to CEOs and administrative professionals.

Esri's partners are contributing to this progression by developing groundbreaking ways to use GIS throughout organizations. They offer web GIS solutions, services, and content for new and emerging markets, as well as various departments just getting started with GIS, to help them make better decisions faster.

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, visit esri.com/partners.

GIS for Real Estate Market Expansion

To gain insight into new and unfamiliar markets, Texas-based real estate firm Stellar Development needed to do extensive analysis on prospective expansions. The company reached out to **Datastory Consulting**—which serves a variety of real estate professionals, including developers, brokers, investors, and managers in small and large organizations—to get the ArcGIS platform implemented. With some creative thinking plus ArcGIS Online, Stellar Development is now able to curate large amounts of government information alongside the business and demographic data provided by Esri. Employees around the innovative company now use maps and analytics to make smarter decisions. Learn more at datastoryconsulting.com.



↑ Employees at Stellar now have access to the data, maps, and analytics they need anywhere, at any time.

Managing Thousands of Fields Offline

For years, Southern Minnesota Beet Sugar Cooperative (SMBSC), a farmer-owned beet sugar producer, collected crop information, tracked activities, and managed contracts for more than 100,000 acres of planted fields using all-terrain vehicles, Toughbook laptops, and various applications. Ensuring well-maintained and accurate data was difficult due to inadequate Internet connectivity in rural locations. So **Pro-West & Associates**, which provides highly specialized GIS and data management consulting, worked with SMBSC to migrate its projects to ArcGIS Online and Collector for ArcGIS. With offline data collection, on-demand data synchronization, and GPS streaming, the cooperative greatly improved its efficiency. Learn more at prowestgis.com.

↑ SMBSC maintains accurate field data using Collector for ArcGIS and ArcGIS Online.

Organizations Worldwide Use ArcGIS to Share Data

ArcGIS Open Data is helping more than 2,600 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:

Pinellas County Open Data Portal
opendata.pinellas-egis.opendata.arcgis.com
Pinellas County, Florida, worked with data stewards from departments across the county to create an open data portal for its internally managed datasets, which include information on economic development, infrastructure, and public safety. Other municipalities can easily access this data through ArcGIS Open Data.

Alberta Geological Survey
geology.ags-aer.opendata.arcgis.com
The Alberta Geological Survey in Canada uses ArcGIS Open Data to share GIS data about the geology of Alberta—from bedrock and surficial information to details about minerals. The site supports the organization's interactive web mapping applications and augments its well-developed open data repository with active map services.

VicRoads Open Data
vicroadsopendata.vicroadsmaps.opendata.arcgis.com
VicRoads, the road and traffic authority for the State of Victoria, Australia, was the first Victorian government agency to launch an ArcGIS Open Data site. With information about road projects, traffic, public transportation, and vehicle registration and licensing, the site highlights the agency's commitment to open data and prompted several other agencies to follow suit.

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

New Training and Certification Offerings

Training

Geoenabling Mission Success

Military, intelligence, and national security organizations have unique functions, meaning they have special training needs as well. Esri has created a holistic curriculum to help these organizations build and sustain the geospatial capabilities needed to anticipate threats, make better decisions, determine a course of action, and share information with stakeholders.

Instructor-led courses emphasize best practices and hands-on applications of ArcGIS using realistic, scenario-driven examples. Two new offerings are as follows:

- **Image Analysis with ArcGIS**
  This class takes learners on an in-depth exploration of image classification, covering the dynamic raster processing options available in ArcGIS. Participants establish best practices and workflows to enhance visualization and extract meaningful information from satellite imagery, lidar, and other remotely sensed data.
- **Portal for ArcGIS: User Workflows (for Defense and Intelligence)**
  This course prepares intelligence professionals to work efficiently with the content on their organizations' portal websites so they can better support intelligence production and dissemination. Learners will master the essentials of discovering, using, making, and sharing web maps, applications, and other geospatial content.

E-learning courses and seminars also provide focused coverage on topics such as terrain analysis, lidar data, and 3D visualization. Find additional information and view more courses at esri.com/geospatial-skills.

Certification

Free e-learning classes are available for candidates preparing to take an Esri technical certification exam. Each course contains sample questions that mimic the exam structure and relate to the knowledge and skills measured by the exams. Links to additional resources are included in each course. For details, visit esri.com/skillsreview.

Did You Know?

Esri technical certification exams are covered under the education and training provision of the GI Bill. Qualified candidates can purchase an exam through Esri's testing partner, Pearson VUE, and then submit a form for reimbursement. For more information, visit the Register page at esri.com/certification.

Go to 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.

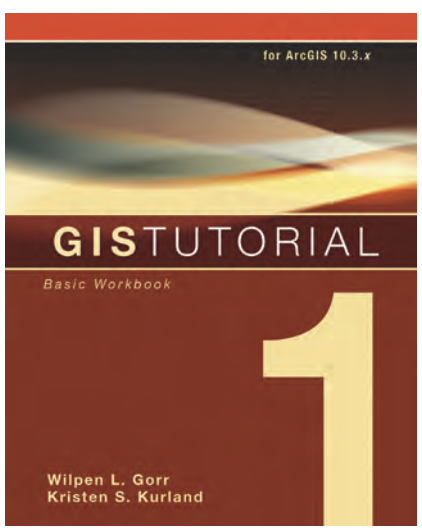
Esri Press

For information on all Esri Press publications, visit esri.com/esripress.

GIS Tutorial 1: Basic Workbook

By Wilpen L. Gorr and Kristen S. Kurland

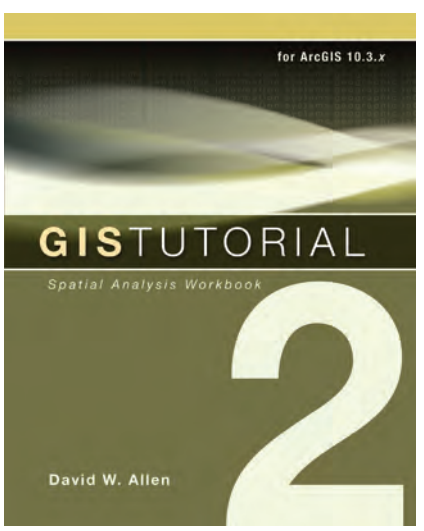
Updated for ArcGIS 10.3.x, *GIS Tutorial 1: Basic Workbook* is a foundational text for learning ArcGIS for Desktop. The workbook covers GIS tools and functionality, including querying interactive maps, collecting data, and running geoprocessing tools. The latest edition includes a new chapter about analyzing street network data to solve routing and facility location problems using ArcGIS Network Analyst. With detailed exercises, "Your Turn" sections, homework assignments, and instructor resources, this book is suited to the classroom. Data for completing the activities and a free trial of ArcGIS are available for download. March 2016, 486 pp. Paperback ISBN: 9781589484566 and e-book ISBN: 9781589484641.



GIS Tutorial 2: Spatial Analysis Workbook

By David W. Allen

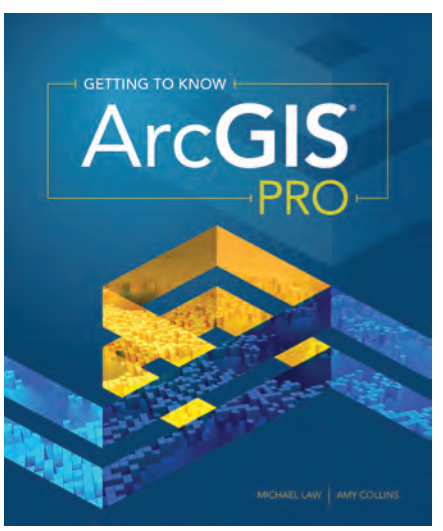
GIS Tutorial 2: Spatial Analysis Workbook contains hands-on exercises that help intermediate GIS users build problem-solving and analytical skills. A companion to *The Esri Guide to GIS Analysis* book series, *GIS Tutorial 2*—which has been updated for ArcGIS 10.3.x—builds on the series' core concepts by exploring spatial analysis methods such as change over time, location and value comparisons, geographic distribution, pattern analysis, and cluster identification. Data for completing the exercises and a free trial of ArcGIS are available for download. Instructors have access to additional resources as well. January 2016, 424 pp. Paperback ISBN: 9781589484535 and e-book ISBN: 9781589484597.



Getting to Know ArcGIS Pro

By Michael Law and Amy Collins

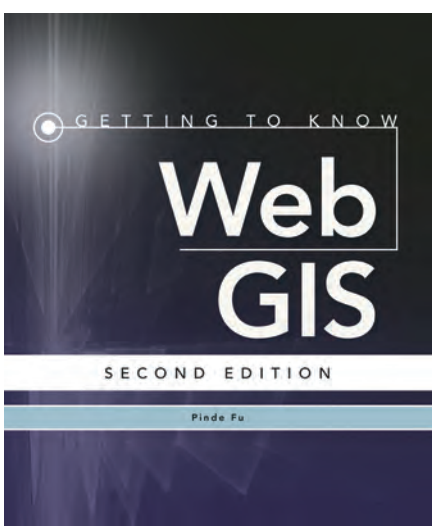
Getting to Know ArcGIS Pro shows new and existing GIS users how to get started with mapping and solving problems using ArcGIS Pro, the newest application included with ArcGIS for Desktop. The book guides users through the program's easy-to-use interface and demonstrates how to visualize, query, create, edit, analyze, present, and share geospatial data in both 2D and 3D environments. Designed to facilitate an efficient and effective learning process, *Getting to Know ArcGIS Pro* uses practical project workflows to teach the basic functions and capabilities of ArcGIS Pro, an indispensable component of the ArcGIS platform. Data to complete the exercises and a free trial of ArcGIS are available for download. March 2016, 478 pp. Paperback ISBN: 9781589484573 and e-book ISBN: 9781589484580.



Getting to Know Web GIS, Second Edition

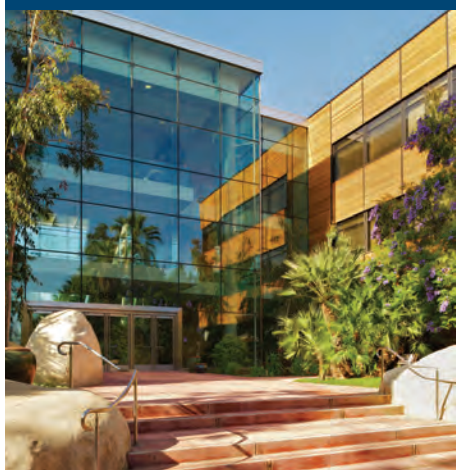
By Pinde Fu

Featuring detailed, step-by-step exercises, *Getting to Know Web GIS*, Second Edition, shows readers how to share resources online and build web GIS applications quickly and easily. Teaching web GIS as a holistic platform, this workbook covers the Esri suite of web GIS technologies, including ArcGIS Online, Portal for ArcGIS, ArcGIS for Server, Web AppBuilder for ArcGIS, ArcGIS API for JavaScript, Collector for ArcGIS, mobile SDKs, Esri Story Map apps, and 3D web scenes. The second edition covers Esri's latest upgrades, such as smart mapping, AppStudio for ArcGIS, ArcGIS Pro, and real-time GIS. In each chapter, readers do a project using multiple products. Data for completing the exercises is available for download. March 2016, 350 pp. Paperback ISBN: 9781589484634 and e-book ISBN: 9781589484610.



Esri Corporate Headquarters

esri.com



Esri Technical Support
esri.com/support

Esri Desktop Order Center and Software Information
Tel.: 1-800-447-9778 (USA only)

Esri Products
esri.com/products

Esri Store
esri.com/store

Esri Developer Network
edn.esri.com

Customer Care Portal
my.esri.com

Esri US Regional Offices

Boston—Middleton, MA
Tel.: 978-777-4543

California—Redlands, CA
Tel.: 909-793-2853, ext. 1-1906

Charlotte—Charlotte, NC
Tel.: 704-541-9810

Denver—Broomfield, CO
Tel.: 303-449-7779

Minneapolis—St. Paul, MN
Tel.: 651-454-0600

Olympia—Olympia, WA
Tel.: 360-754-4727

Philadelphia—Chesterbrook, PA
Tel.: 610-644-3374

San Antonio—San Antonio, TX
Tel.: 210-499-1044

St. Louis—St. Charles, MO
Tel.: 636-949-6620

Federal Office

Washington, DC—Vienna, VA
Tel.: 703-506-9515

For additional information about Esri US regional offices, visit esri.com/about-esri/usa.

Esri Distributors Worldwide

Esri Australia Pty. Ltd.—Australia
www.esriaustralia.com.au

Esri BeLux N.V.—Belgium
www.esribelux.com

Esri Bulgaria Ltd.—Bulgaria
www.esribulgaria.com

Esri Canada Limited—Canada
www.esri.ca

Esri Chile S.A.—Chile
www.esri.cl

Esri China (Beijing) Holding Co. Ltd.—China
www.esrichina.com.cn

Esri Colombia SAS—Colombia
www.esri.co

Esri Northeast Africa—Egypt
www.esrinea.com

Esri Finland Oy—Finland
www.esri.fi

Esri France S.A.—France
www.esrifrance.fr

Esri Deutschland GmbH—Germany
www.esri.de

Esri China (Hong Kong) Limited—Hong Kong
www.esrichina.hk

NIIT GIS Limited (Esri India)—India
www.esriindia.com

Esri Italia Sp.A.—Italy
www.esriitalia.it

Esri Japan Corporation—Japan
www.esrij.com

Esri Eastern Africa Limited—Kenya
www.esriea.co.ke

Esri Lebanon sal—Lebanon
www.esrilebanon.com

Esri Southern Africa—Mauritius
www.esri-southernafrica.com

Esri Nederland B.V.—The Netherlands
www.esri.nl

Esri Muscat Co LLC—Oman
www.esrimuscat.com

Esri Panama, S.A.—Panama
www.esri.pa

Esri Polska sp. z o.o.—Poland
www.esri.pl

Esri Portugal—Sistemas e Informação Geográfica, S.A.—Portugal
www.esri-portugal.pt

Esri Romania S.R.L.—Romania
www.esriro.ro

Limited Liability Company ESRI CIS—Russia
www.esri-cis.ru

Esri Saudi Arabia Ltd.—Saudi Arabia
www.esrisaudiarabia.com

Esri South Africa (Pty) Ltd.—South Africa
www.esri-southafrica.com

Esri Korea, Inc.—South Korea
www.esrikr.com

Esri South Asia Pte. Ltd.—Singapore
www.esrisa.com

Esri España Soluciones Geospaciales SL—Spain
www.esri.es

Esri Sverige AB—Sweden
www.esri.se

Esri (Thailand) Co. Ltd.—Thailand
www.esrith.com

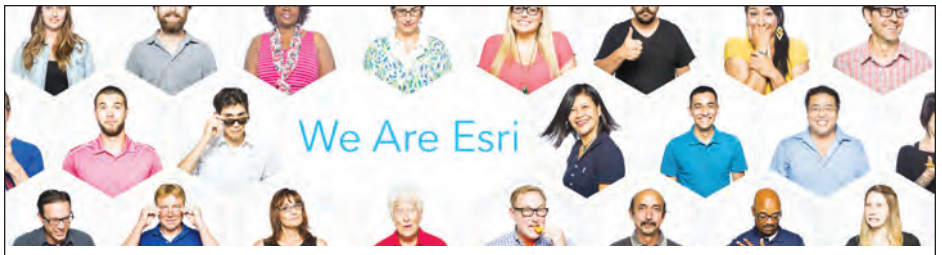
Esri Bilgi Sistemleri Muhendislik ve Egitim, Ltd.—Turkey
www.esriturkey.com.tr

Esri (UK) Ltd.—United Kingdom
www.esriuk.com

Esri Ukraine Ltd.—Ukraine
www.esri.ua

Grupo Esri de Venezuela, C.A.—Venezuela
www.esriven.com

Esri has more than 80 distributors in other countries around the world. For more information, contact Esri (tel.: 909-793-2853, ext. 1-1235; fax: 909-307-3070) or visit **esri.com/distributors**.



Career Opportunities

Esri is hiring smart people with all levels of experience for positions at our headquarters, regional offices, and R&D Centers. Your work will affect the way people live and how organizations solve problems. We offer exceptional benefits, competitive salaries, profit sharing, and a collaborative and stimulating environment. Join us and be part of Esri's mission to make a difference in our world.

Software Development and ArcGIS Product Engineering

Application Software Developer—ArcGIS Pro C#: Are you passionate about working with off-the-shelf solutions that impact hundreds of thousands of users? Join our ArcGIS Pro team in developing next-gen software.

Software Developer—Geodatabase: Build data access technologies that let server, desktop, and mobile applications work with a rich spatiotemporal information model.

ArcGIS for Server Technical Writer: Blend your passions for writing and technology to advance software documentation. You will study design documents, interact with core developers, and test software.

Solution Engineer—State and Local Government: Build industry-specific applications, maps, and tools on the ArcGIS platform and provide input on product design.

Product Management

Product Manager—Big Data: Help guide the development of Esri's big data offerings and define the evolution of ArcGIS for Server by gathering requirements and understanding market expectations.

Product Manager—Demographics Content: Work with development teams, regional offices, international distributors, and partners to provide sales support for Esri's demographics and business content.

Professional Services and Consulting

Platform Configuration Engineer: Work closely with customers and partners to identify, design, and certify key GIS workflows for the ArcGIS platform.

Test Lab Engineer—Utilities and Telecom: Interact with Esri users and partners to understand how GIS shapes the business capabilities of enterprise systems.

Consultant/Project Manager: Work closely with clients to establish solutions to make them successful and broaden the presence and effectiveness of GIS within their businesses.

Educational Services and Technical Support

Instructor—Server: Help customers be successful with Esri software by providing a rich learning environment through hands-on training and instruction.

Support Analysts: Draw from your extensive technical knowledge and collaborate with others to help Esri customers successfully use ArcGIS products to achieve their organizational goals.

Business Development

Account Manager—State Government: Utilize your experience in enterprise sales to help Esri's state government customers leverage geospatial information and technology.

Account Executive—Electric and Gas: Work with an account team to sell and promote the adoption of the ArcGIS platform within electric and gas organizations.

Presales and Solution Engineering

Solution Engineers: Are you a problem solver who's passionate about technology? Shape strategies that exhibit the power of the ArcGIS platform to prospective customers in a number of domains.

Marketing

Analyst Relations Manager: Influence positive industry analyst recommendations by driving Esri's outreach, influence, and visibility with key industry analysts.

Product Marketing Specialist: Work with product, industry, and sales managers to develop and implement effective marketing plans that increase awareness of Esri's products.

Esri is an equal opportunity employer (EOE). All qualified applicants will receive consideration for employment without regard to race, color, religion, sex, national origin, disability status, protected veteran status, or any other characteristic protected by law.

esri.com/careers **Follow @EsriCareers on Twitter**

MASTER'S DEGREE in GIS

Liz Ducey is a proud alumna of UMBC's GIS Master's Program and a Geospatial Analyst for Booz Allen's Defense and Intelligence Group. She works with a variety of data, dealing with areas such as fire and emergency services, public safety, renewable energy, and facilities management.

Through her UMBC education, Ducey gained skills in cartography, geoprocessing and model building that she uses in current projects. As a lead analyst on a fire and emergency project, Ducey utilized Esri's ArcGIS® Network Analyst extension to build a network dataset for a performance analysis. This project examined how emergency responders reach incidents within the required time perimeters.

When asked what prepared her for career success, Ducey said it was UMBC professors incorporating practical insights into the classroom. "Seeing examples of actual data used in the field allows for better application of knowledge and skills to solve real-world problems."

"The GIS Master's program at UMBC helped increase my confidence as a professional, developing me into a strong analyst who can execute new ideas for clients, thereby creating valuable business opportunities."

— Liz Ducey

UMBC

AN HONORS UNIVERSITY IN MARYLAND

umbc.edu/gis

Add a Subscription, Change Your Address, or Unsubscribe

Subscribe, unsubscribe, or update information at **esri.com/updates**.
Outside the United States, contact your local distributor.
To request other publication services, see page 2.

149219

esri
380 New York Street
Redlands, CA 92373-8100

Presorted
Standard
US Postage
Paid
Esri

INNOVATION THAT INSPIRES CHANGE

Esri Federal GIS Conference

February 24–25, 2016 | Washington, DC

Join GIS professionals, government leaders, elected officials, and tech experts at a conference where innovative ideas and geospatial knowledge abound.

Explore ready-to-use GIS solutions and new approaches to solving problems. Get real-world answers that make it possible to achieve your agency's goals in 2016.

Register at **esri.com/fedgis2016**

esri