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The Magazine for Esri Software Users

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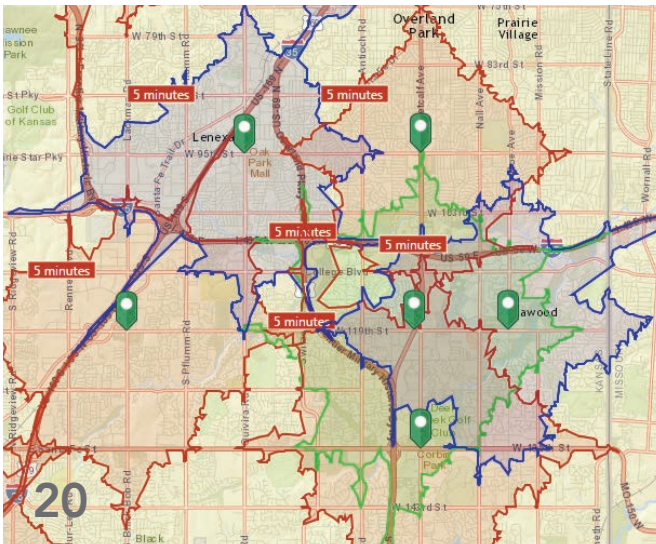
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On the Cover

Hema Maps sends out its Map Patrol to ground truth thousands of miles of roads and tracks in the Australian Outback to obtain the highest levels of cartographic accuracy. Read the article on page 64.

Changing the World with Geographic Insight

Science drives the technologies that profoundly change our lives. This is brought home to us as we mark the 100-year anniversary of the publication of Albert Einstein's general theory of relativity. The practical application of this theory and Einstein's other theory, that of special relativity, not only guides our steps but is an integral part of gathering geospatial information.

These theories underpin the adjustments made to the rates of satellite clocks in global navigation satellite systems (GNSS) and the mathematical corrections built into computer chips that solve for locations that would otherwise continually accumulate positional errors each day.

GNSS is just one part of the vast array of sensors that have unleashed a flood of data in this increasingly "wired-up world." As Esri president Jack Dangermond explained in an article in this issue, "We Are Limited Only by Our Collective Imaginations," GIS has a vital role to play in the Internet of Things (IoT) because it provides the geolocation context that transforms unwieldy amounts of raw data into manageable, actionable intelligence.

He used the GIS-based response to Superstorm Sandy in 2012 as an example. GIS and Tweets generated geotagged outage data that was normalized against population density, which was used to produce outage maps for Manhattan. Adding location analytics to the existing ecosystem of connected devices—rather than some dedicated monitoring system—produced immediate answers.

This is just one example of how GIS is expanding our ability to understand not only complex interactions of our world at levels that range from local to global but also take meaningful action.



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ArcUser Editor

editor's page

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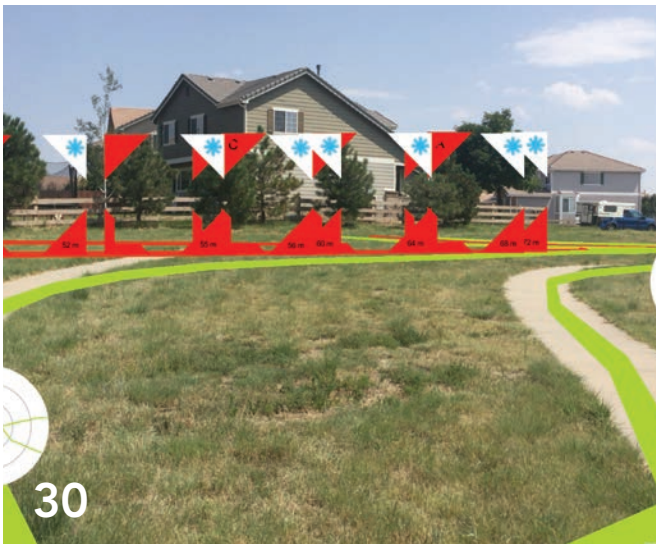
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Bringing the R and ArcGIS Communities Together

At the 2015 Esri User Conference (Esri UC) in San Diego, Esri announced a new initiative that will build a collaborative community for R and ArcGIS users.

R (or formally, the R Project for Statistical Computing) is the fastest-growing environment for statistical computing. In addition to the core R software, it includes more than 6,000 community-contributed packages for solving a wide range of statistical problems, including a variety of spatial statistical data analysis methods. It is widely used by all types of environmental scientists as well as statisticians.

Because R has limited data management and mapping capabilities, many R users have found using R and ArcGIS together beneficial. In the several years that Esri has been promoting the integration of ArcGIS with R at the Esri UC and the Esri Developer Summit, there has been a significant increase in interest in the use of R with ArcGIS.

The success of Duke University's Marine Geospatial Ecology Tools (MGET) provides evidence of this interest. MGET, a free, open-source geoprocessing toolbox for solving a variety of marine research, conservation, and spatial planning problems, plugs into ArcGIS for Desktop.

Based on feedback from ArcGIS and R users about their needs and techniques for integrating ArcGIS and R, Esri has started a community for developing and sharing useful tools and promoting learning and collaboration. This community will include a repository of free, open-source R scripts,

geoprocessing tools, and tutorials.

The community of tools will be user developed and user driven. "Esri will develop a few sample toolboxes and tutorials, but our primary interest is to facilitate the community and help users build what they find useful," said Steve Kopp, Esri senior product engineer on the spatial analysis team.

"This project is about helping the ArcGIS and R users become more successful in combining these technologies. This community will be important and useful for R users who need to access ArcGIS data, for ArcGIS users who need to access R analysis capabilities from ArcGIS, and for developers who are familiar with both ArcGIS and R and want to build integrated tools or applications to share with the community," according to Esri chief scientist Dawn Wright.

A component of this effort is the R-ArcGIS Bridge.

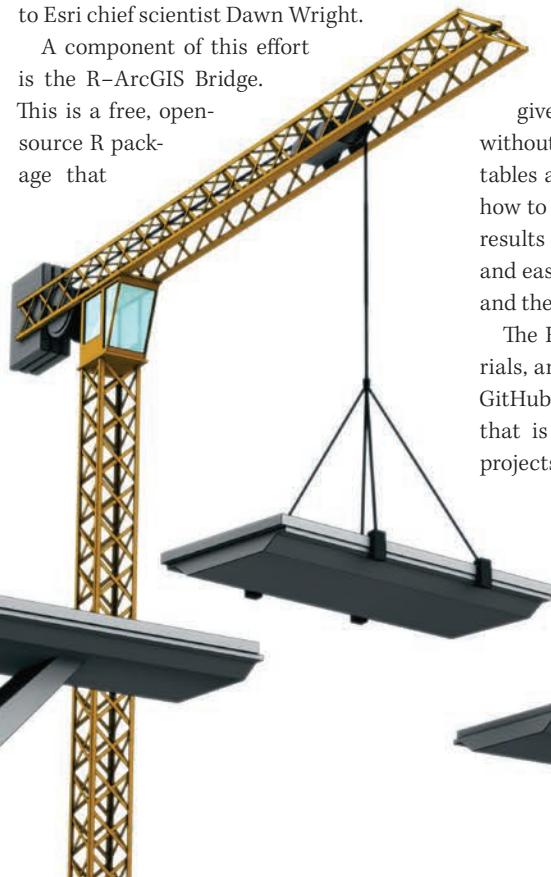
This is a free, open-source R package that

allows ArcGIS and R to dynamically access data without creating intermediate files on disk. It was built to improve the performance and scalability of projects that combine R and ArcGIS, create a developer experience that is simple and familiar to the R user, and enable an end-user experience that is familiar to the ArcGIS user.

The R-ArcGIS Bridge allows developers who have experience with R and ArcGIS to create custom tools and toolboxes that integrate ArcGIS and R for their own use and for building toolboxes to share with others, both within their organization and with other ArcGIS users. It allows ArcGIS users to integrate R into their workflows without necessarily learning the R programming language directly.

For R users who don't use ArcGIS but need to be able to work with GIS data, the R-ArcGIS Bridge will give them direct access to ArcGIS data without creating intermediate shapefiles or tables and without requiring them to know how to use ArcGIS. R developers can save R results back to ArcGIS datasets and tables and easily convert between ArcGIS datasets and their equivalent representations in R.

The R-ArcGIS community samples, tutorials, and bridge are available from a public GitHub community site (r-arcgis.github.io) that is similar to other Esri open-source projects.





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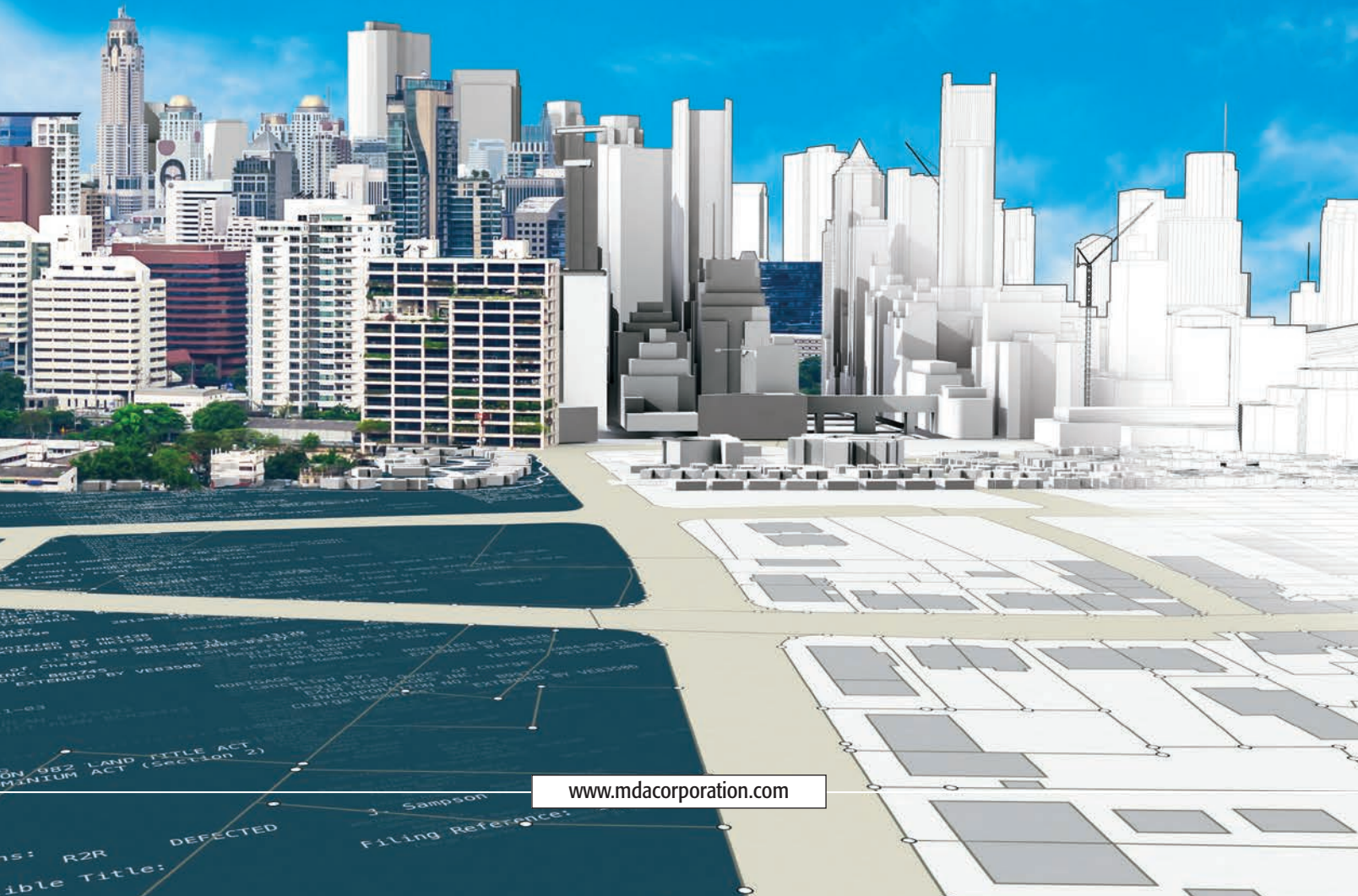
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Mind the Gap

ArcGIS helps San Diego residents adopt active transportation

By A. J. Mangum



Ross Martin imagines a new and improved San Diego County. He envisions communities in which residents commute to work on foot or by bicycle and where a network of safe routes offers easy access to schools, parks, shopping, and mass transit so that no San Diegan goes without daily exercise.

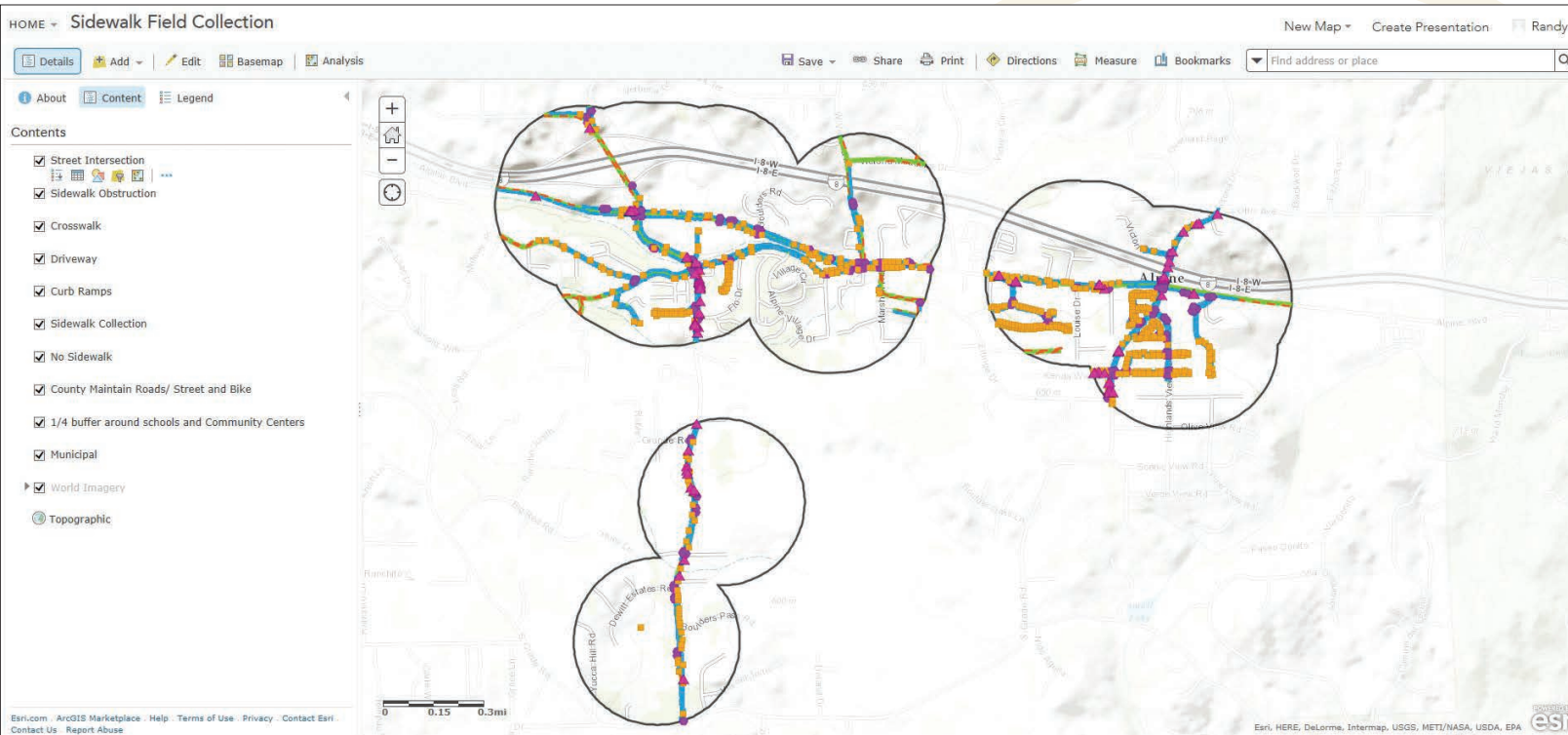
It's no fantasy.

Martin, San Diego County's GIS manager, is one of many participants in a decade-long effort—enabled by the ArcGIS platform—to bring such a utopian quality of life closer to reality through intensive study of the county's pedestrian infrastructure.

"The county is halfway through a 10-year plan—called Live Well San Diego (LWSD)—to create healthy, safe, thriving communities," Martin explained. LWSD is a multiagency initiative funded by an Active Transportation Program grant from the California Department of Transportation (Caltrans), the California state authority responsible for managing highways, bridges, and railways. LWSD participants include the county's Health and Human Services Agency (HHSA) and Department of Planning and Development Services as well as its GIS team. Other partners include city governments within San Diego County, community-based organizations, nonprofits, and entities within the private sector.

"LWSD examines the root causes of illness and ties them back to safety, jobs, housing, and transportation," Martin said. "The plan is built on a realization that we can't simply provide health programs and education on how to make better choices.





↑ Pedestrian Gap Analysis identified the gaps that exist in pedestrian and bike routes.

It has to be more systemic, more holistic. We're now in a phase focused on community health based on the built environment."

The effort includes an ambitious countywide walkability study—dubbed the Pedestrian Gap Analysis (PGA)—designed to collect actionable data on the availability and conditions of pedestrian routes in San Diego County. The study will help the county gain an understanding of the factors influencing residents' transportation choices (*Should I drive, or can I walk or bike?*). It will assess where improvements in pedestrian infrastructure, such as sidewalks and bike paths, can provide maximum benefits in terms of both easier mobility and healthier lifestyles. For county residents, getting from point A to point B should involve more physical activity than steering a vehicle.

Employing Collector for ArcGIS in its data-gathering effort, San Diego County has been able to create more than just a comprehensive picture of its pedestrian network. The data emerging from PGA has provided the county with insights that could prove vital in reshaping the region and lead to smarter land use, less vehicle traffic, and healthier residents.

With an environment that ranges from beaches to deserts, an abundance of parkland, a comfortable climate, and a wide variety of outdoor recreational opportunities, San Diego already boasts one of the healthiest populations in the country. In its 2015 American Fitness Index, the American College of Sports Medicine listed San Diego as the third healthiest US city in which to live, citing an abundance

of farmers' markets and the popularity of biking and walking to work as factors that influenced the region's ranking. San Diego's AFI ranking has steadily improved over the last few years, most recently from 14th in 2013 to eighth in 2014.



"For county residents, getting from point A to point B should involve more physical activity than steering a vehicle."

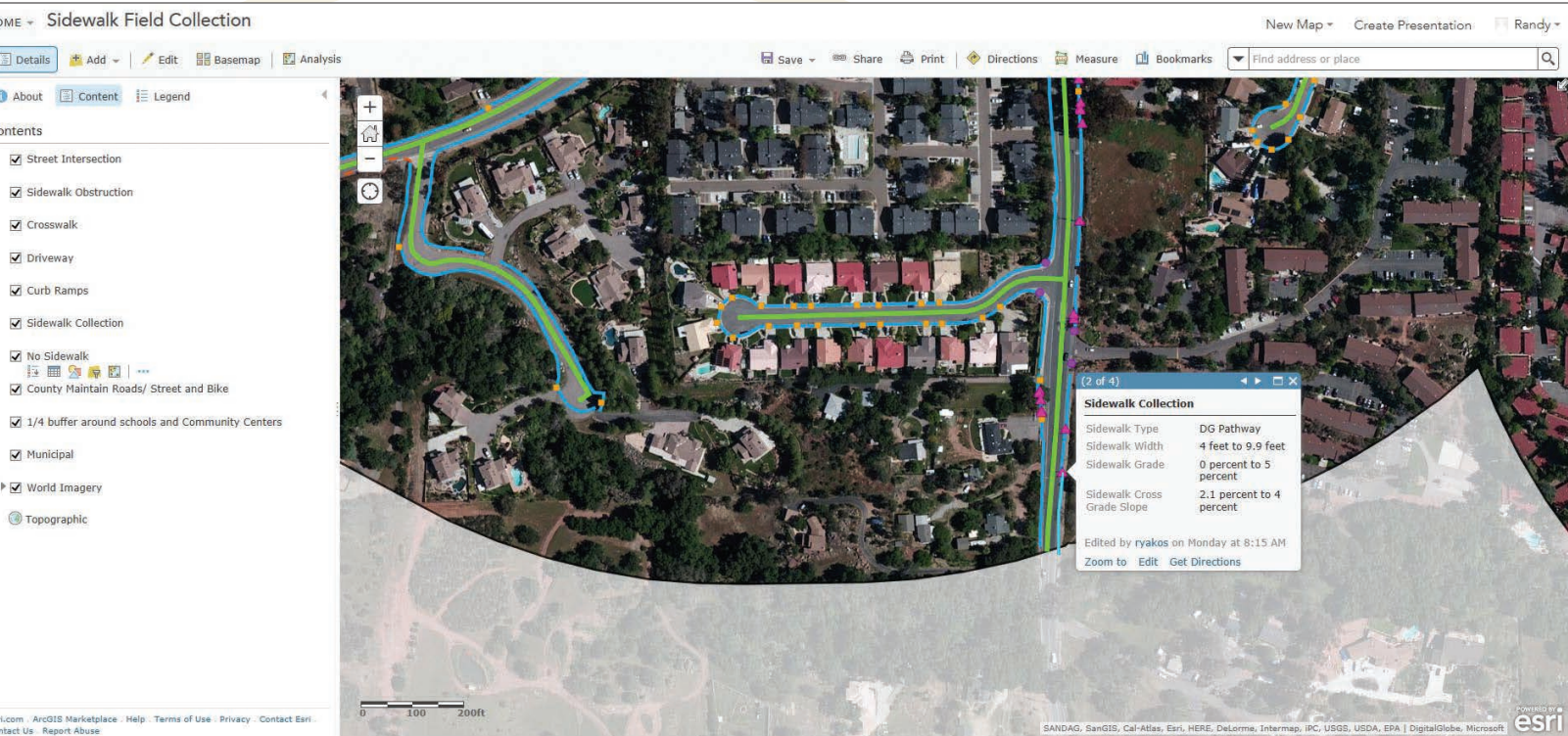
of farmers' markets and the popularity of biking and walking to work as factors that influenced the region's ranking. San Diego's AFI ranking has steadily improved over the last few years, most recently from 14th in 2013 to eighth in 2014.

Despite these positive indications, 54 percent of deaths in San Diego County can be attributed to diabetes, heart disease, strokes, cancer, and respiratory disease—ailments

for which a lack of physical activity is known to be a contributing factor, according to Dale Fleming, strategy director for San Diego County's HHSA. Fleming said that development strategies focused on the efficient movement of vehicle traffic, rather than on universally accessible multimodal transport, are partly to blame.

"This type of development is creating communities where streets are unsafe for

pedestrians and bicyclists," he explained, "and physical activity is no longer naturally a part of the everyday routine. Activities such as walking to school or using a bicycle to run errands have become unconventional. Since the 1970s, there has been a dramatic reduction in the number of children biking or walking to school and, conversely, a large spike in childhood obesity in that same 30-plus-year time span."



↑ Teams used tablets equipped with the Collector for ArcGIS app to gather data on hazards, impediments, and connectivity gaps.

As part of its mission to foster a safer, healthier environment in San Diego County, LWSD aims to reverse such trends by encouraging residents to engage in active transportation, such as biking or walking, on a daily basis.

Unfortunately, for many San Diegans, these choices are out of reach. Connectivity gaps in the pedestrian infrastructure—damaged sidewalks or pathways that simply don’t connect to other pathways—create barriers that prompt residents to drive rather than walk or bike.

For residents who don’t own cars, connectivity gaps are more than an inconvenience. “Pedestrian infrastructure becomes an important factor in providing equitable access to services for people who don’t have, or can’t access, means of transportation other than walking,” said Mark Wardlaw, director of San Diego County’s Department of Planning and Development Services. “If people need to walk to access transit services, pedestrian infrastructure becomes essential in making sure people can safely complete their trips.”

Enabling the lifestyle shifts embodied by the LWSD mission required a detailed assessment of San Diego County’s

pedestrian infrastructure, which led to the PGA. This study has enabled the creation of a baseline that can inform decisions regarding community planning and targeted improvements to existing sidewalks and pathways. Field teams equipped with Samsung tablets used Collector for ArcGIS to gather data on the county’s pedestrian routes. They recorded hazards, impediments, and connectivity gaps.

“They looked at simple things—like whether or not there were ADA [*Americans with Disabilities Act*]-compliant curb grades—to more complex hazards,” Martin said. “For instance, there’s a lot buried in sidewalks related to utilities. Are those [*elements*] too close to main travelways? Are bike pathways actually wide enough for bicyclists? Does a sidewalk transition to decomposed gravel, then to nothing but a shoulder, with heavy traffic traveling nearby?” Any of these conditions can dissuade residents from walking or biking along those routes.

Field data also included the locations of accessible public services and mass transit as well as recreational opportunities and grocery sources. Rates of crime and traffic accidents along pedestrian routes

were added.

Tablets were paired with Arrow 100 units, high-precision global navigation satellite system (GNSS) receivers from Esri partner EOS Positioning Systems, to record pathways with geospatial accuracy to within one meter. Data could be accessed via ArcGIS Online, which provides opportunities for quality control and feedback to field personnel.

PGA data will inform county-level decisions regarding targeted capital improvement projects to repair damaged pedestrian infrastructure and close connectivity gaps between sidewalks and pathways. Benefits may be especially apparent in rural areas, where such gaps are more common.

“It’s eye-opening to see the gaps that exist,” Martin said. “The assumption may be that, since there’s a road, there must be an easily traveled pedestrian route next to that road. That’s not always the case.”

Even a short connectivity gap, such as a bridge shared by a street and a pedestrian/bike route, can pose a significant barrier.

“Imagine a family on bicycles having to cross that bridge,” Martin said. “Their travelway narrows, and they’re closer to cars. That’s a big concern for parents.”

Beyond creating a picture of the ways the county's existing pedestrian infrastructure can be improved, PGA offers a unique planning tool that could enable future development decisions backed by a comprehensive sense of geographic order.

"In making planning decisions, we need to look at the community as a whole and the needs and resources of a community so it can be sustainable," Martin said. "For instance, groceries have to be available. If you have to drive 45 minutes, that means changes are needed in land use. And one of the goals is to get people out of their cars—walking, biking, or taking their bikes to the bus stop. Pedestrians will walk about a quarter mile or bike as much as a half mile before distance becomes a deterrent. In the planning stage, we need to consider where those people want to go. Where are the parks, the libraries, the markets?"

The picture provided by PGA data could

enable planning strategies that bring residential, commercial, and recreational spaces into closer proximity, as land use, transit, and public services are considered in conjunction, rather than as independent efforts, each on its own timeline. Martin



"In making planning decisions, we need to look at the community as a whole and the needs and resources of a community so it can be sustainable."

foresees developers working to maximize pedestrian features in new developments as well as in existing communities. Meanwhile, Fleming reports that planning discussions at county and city levels have already begun to emphasize "complete streets projects"—those that keep all

types of road users in mind.

"As communities become more pedestrian-oriented, families can walk to dinner rather than drive," Martin said. "Children can safely bike to school rather than be driven. People can live and work in the

same area, and neighborhoods can thrive. Long term, this enhances the sustainability of these communities."

About the Author

A. J. Mangum is a Colorado-based writer, photographer, and editor.



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Slashing Development Time and Cost with COTS

By Matthew DeMeritt, Esri Writer

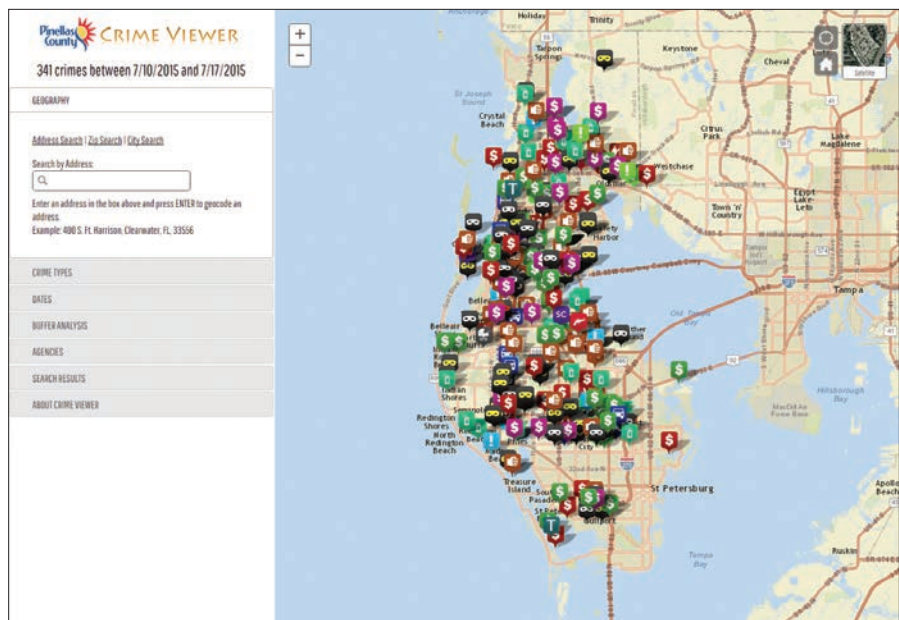
To keep pace with its enterprise vision, Pinellas County, Florida, created a GIS governance committee to guide county GIS projects—in particular, web map and app creation with Esri commercial off-the-shelf (COTS) software. With help from Esri professional support staff, the county upgraded its public GIS website (egis.pinellascounty.org/apps/egis/#publicapps) and created an ArcGIS Open Data site (opendata.pinellas-egis.opendata.arcgis.com/) to serve the needs of county residents as well as its municipalities.

Power Steering

Since 2006, Pinellas County's eight-person GIS staff has tirelessly provided application development, data analysis, and cartography services to all county departments. As a result, practically every department manager understands the benefits of GIS and has vouched for it as a tool that promotes efficiency.

Impressed by that consensus, the county chose executives from various constitutional offices around the county to form the Pinellas County Enterprise GIS Steering Committee to prioritize and potentially fund projects. Concurrently, the county assembled the Enterprise GIS Working Group, a team of GIS practitioners that would actualize the projects and applications ordered by the committee. At the recommendation of Esri Professional Services, the county used ArcGIS Online so specialized web maps and apps could be built quickly.

"The Working Group's departments rely heavily on ArcGIS Online to meet the county's GIS demands across a broad spectrum of business applications," said Bryan Zumwalt,



↑ The Enterprise GIS team created a Crime Viewer, which displays all crime statistics for the current week to the media and citizens.

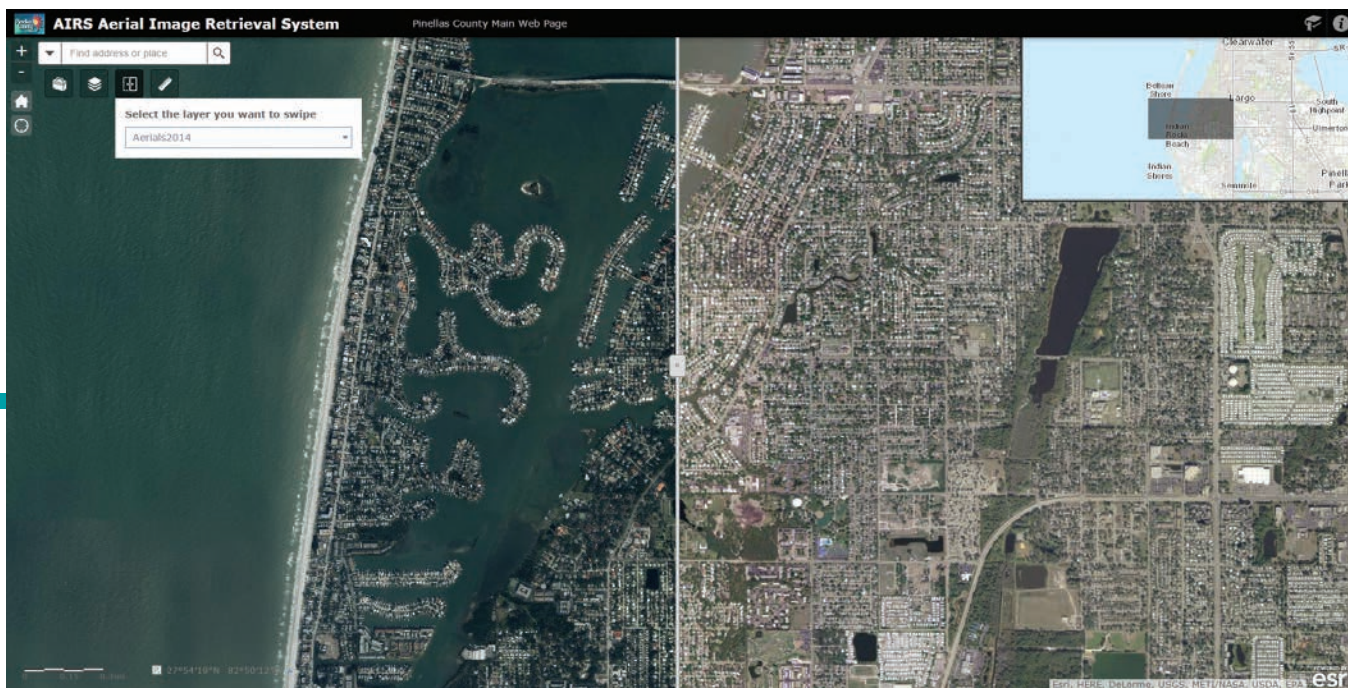
GIS manager, business technology services. "Many of the COTS solutions in ArcGIS Online enable us to create applications fast without any need to code and with great business impact to our GIS user community."

"In less than one day, we solved the problem of delivering timely FEMA and county data to the public," said Michael Dawson, senior GIS developer at Pinellas County. "Using ArcGIS Online and COTS technologies helped us cut our development time and costs to a fraction of what a custom application would've been."

Within months, the county built a professional collection of GIS viewers using ArcGIS Online preconfigured

resources—specifically, templates that easily display county data. For example, tapping the county's aerial imagery database, they made a web map for land managers who needed to assess land change and compare older imagery with newer datasets. When county and city police departments requested a web map that displayed crime statistics for media and citizens to access, the Enterprise GIS team created a Crime Viewer.

Within weeks, the group created and published on the Pinellas County website an impressive collection of viewers that provide access to information on topics ranging from manatee sightings to construction projects.



↑ The swipe feature in Pinellas County's Aerial Image Retrieval System juxtaposes any two imagery datasets such as the imagery from 2014 and 2004 shown here.

Moving from Legacy Systems

All this work didn't happen overnight. Pinellas County needed a plan to replace its legacy Autodesk MapGuide viewers so it could maintain a sustainable web presence. Pinellas used its credits for the Esri Enterprise Advantage Program (EEAP) to implement recommended best practices. The group also asked EEAP staff to conduct security vulnerability, scalability, and testing workshops for departments migrating to ArcGIS Online.

"Using EEAP takes all the guesswork out of how we should configure our infrastructure," said Zumwalt. This allowed the county's staff to focus its efforts on delivering business applications and serving the end users. "It's nice to have high-caliber personnel from Esri make sure that we're following the best practices that will continue to make our program successful," Zumwalt observed.

Sharing Open Data

Other cities and towns in Pinellas County have become members of the county's ArcGIS Online subscription. This allows them to create their own maps. To help those municipalities more rapidly create web maps and apps, the county worked with data stewards from internal county departments to create an Open Data Portal and publish the county's internally managed

datasets for use by other municipalities. In just weeks, Pinellas made 117 of its layers publicly available in a portal created in ArcGIS for Server.

"Our municipal partners can create and publish applications straight from the ArcGIS Online platform rather than us having to export shapefiles from geodatabases and e-mail them," said Zumwalt. "It's been much easier for them to come in and participate in our ArcGIS Online organizational account and retrieve the data they need and publish the data they collect."

For example, the City of Oldsmar has fewer than 14,000 people and just 66 parcels. It has used ArcGIS Online to create damage assessment maps after storm strikes. For Oldsmar and other cities that need to perform damage assessment, the Enterprise GIS Working Group configured Collector for ArcGIS with specific fields for gathering data on various kinds of storm damage. This data collection app for iOS and Android platforms is available on the Esri Solutions site.

"For residential, commercial, industrial, or public properties, each has a different set of information for insurance and FEMA reimbursement purposes," said Zumwalt. "The Collector app is the perfect platform to collect data that will eventually aid the county

in potential reconstruction efforts, as well as share data among internal departments and other agencies."

Now many municipalities within Pinellas County continually populate the portal with data, thus making it a robust mapping resource.

Asset Inventory Mapping

Pinellas County used several ArcGIS for Local Government solutions to inventory department-specific assets and organize this information for future maintenance management needs. For instance, its transportation group now uses the Sign Inventory solution to inventory all county street signage. The Urban Forestry group has similarly begun using the Street Tree Inventory solution to collect data on all of Pinellas County's managed trees.

"The county's asset management program will involve an implementation of a new GIS-based system for work management and capital improvement planning," said Zumwalt. "Using Collector and several ArcGIS for Local Government solutions to inventory county assets will help us get the full value and maximum return on investment from our enterprise asset management implementation."



Improving Forest Management Using the ArcGIS Platform

The forestry department of a Czech city has expanded its use of the ArcGIS platform to provide improved data collection and more robust decision support.

management plans and other aspects of environmental management, work with large datasets every day.

Editing paper maps is quite difficult, especially in the middle of a forest. Staff working in the field used to bring along paper documents, notepads, and cameras. It could take hundreds of hours to complete the fieldwork for a forest.

The first step taken to improve this situation was to store PDF versions of maps on tablet devices. These were maps that used an imagery basemap with a cadastral map layer. The IT administrator prepared PDF maps for selected areas until, little by little, maps for the whole district had been created.

The City of Jihlava, located at the center of the Vysočina region in the Czech Republic, which has been using GIS for decision support for more than 15 years, already used the ArcGIS platform.

Collector for ArcGIS, a free app for collecting spatial data in the field using iOS or Android devices, was already used by the city for managing its cemetery. The city's forestry department was interested in using Collector for ArcGIS for forest management tasks. More than 30 percent of total district

area is covered with forests. However, mobile connectivity is a problem in the Vysočina Mountains. This made use of online GIS impossible until a new release of Collector for ArcGIS provided offline capabilities.

A Long Way from Paper Maps

The Forestry and Hunting Department of Jihlava is responsible for sustainable forest management activities that include hunting and forest health monitoring. The department's officers, who create and review forest

✎ Forest officers now need just one device—a tablet with Collector for ArcGIS—for both data collection and navigation. Photo courtesy of the City of Jihlava.

➤ The City of Jihlava, located at the center of the Vysočina region in the Czech Republic, has been using GIS for decision support for more than 15 years.

was not reliable. A new release of Collector for ArcGIS, which promised offline capabilities, seemed to be the solution.

Improving Input

Before implementing Collector for ArcGIS, some important deficiencies needed to be addressed. The City of Jihlava lacked the authoritative land records needed for forest management. However, the Vysočina region, which encompasses the City of Jihlava, had more complete datasets. Using the Vysočina geoportal, both organizations shared datasets and created a complete forest cover map for the district of Jihlava. In cooperation with forest officers, an imagery basemap, cadastral map, and the forest cover map were combined. To prepare the web map, they used tile packages and synchronization GIS services with attachment support.

Ready to Work Offline

In fall 2014, everything was in place. Esri tutorials and resources, such as Python scripts, had been helpful in solving issues. When this solution was presented to forest officers in November 2014, they were surprised by its efficiency and accepted it enthusiastically. Collector for ArcGIS is now used throughout the organization, even by nontechnical officers, who previously used only paper maps. All have come to value the

simplicity and ease of use of this tablet solution. Officers need just one device—a tablet with Collector for ArcGIS—for both data collection and navigation.

Solving Problems Every Day

GIS helps forest officers make better decisions more rapidly. In the past, when a land owner needed to know if his land was classified as forest land, an officer had to search the database for the associated land record, check for previous requests and documents, evaluate the vegetation type, and do a few other tasks before he could determine the land's status.

Now, most of the required information is stored in an ArcGIS geodatabase. Officers can explore a map of the area, examine current information on an individual plot, and view any related attachments. If additional data is needed, it can be gathered in the field using Collector for ArcGIS.

The ArcGIS platform has improved forest management overall. Furthermore, collaboration with other departments from the City of Jihlava and the Vysočina region has encouraged these organizations to adopt Collector for ArcGIS for fieldwork.

For more information, contact Jaroslav Skrobak, City of Jihlava (jaroslav.skrobak@jihlava-city.cz).

GIS provides much more information than simple PDF maps. That's why the GIS department started to explore the use of online apps. Maps created by the National Forestry Programme of Czech Republic include data about owners, forest cover, economic plans, timber harvesting, forest age, and other information. Officers initially used a basic desktop viewer that had been designed especially for exploring economic forest plans.

Data from this viewer was exported to ArcGIS. The GIS administrator prepared online maps that were used with a JavaScript web app that included location furnished by GPS. This was a big step forward, but the connectivity of mobile devices in the forest



Land Records Search SIMPLIFIED

By David McMillan, County of Riverside

↓ The pop-up for a corner record provides a link directly to the Laserfiche record.

The County of Riverside, California, has made land records investigation much less complicated and far more sustainable by replacing less efficient methods with a GIS-centric approach that uses ArcGIS Online.

The County Surveyor's office maintains Riverside's land records. These records include—but are not limited to—corner records [records documenting the placement of survey monuments], survey records, final parcel and tract maps, field notes, benchmarks, horizontal control, right-of-way records (such as vacations, street name changes, dedications), unrecorded maps (such as plans and right-of-way maps), and certificates of correction.

These records have been made available to the public via microfilm, Mylar, and paper. Survey staff wrote the physical records by hand and filed records in large-scale counter books or hanging files. While these records are still available, they have not been updated in more than a decade.

The County Surveyor developed a tool called Map Inquiry for searching these records that returned a list of values based on how the original data was entered into the system. Typically, that data was entered by map number, project number, or street name or used the Public Land Survey System (PLSS) and was identified by township, range, and section. An individual section will touch a minimum of four other sections that will be included in the results and require examination of each returned document.

In 2009, that system was retired and replaced by an online scanned repository system called Laserfiche. Laserfiche allows for querying the above-mentioned information using a variety of search terms such as street intersection; project number; map

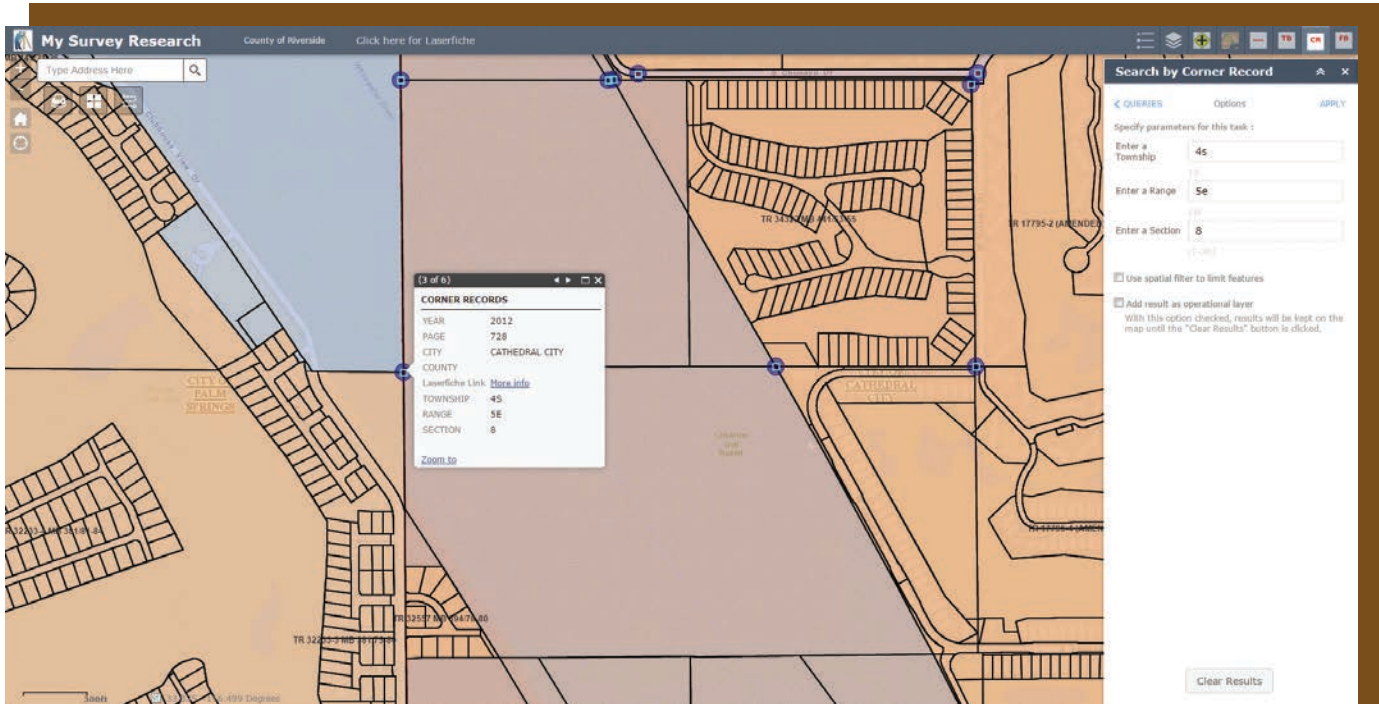
The screenshot displays the Laserfiche WebLink interface for document 012_0728. The left sidebar shows metadata including 'Last Modified: 11/6/2012 8:20:24 AM' and 'Creation Date: 11/6/2012 8:14:27 AM'. The main content area shows a 'CORNER RECORD' document with the following details:

- City of: CATHEDRAL CITY, County of: RIVERSIDE, California
- Document Number: 12-0728
- Brief Legal Description: PORTION OF THE W 1/2 OF SECTION 4, T.4 S., R.5 E., S.B.M.
- APN: 075-040-055
- Project Type: CR - Corner Record
- FSM/TR - Final Subdivision
- Map/Tract Map
- Project Number: 17795-1
- Survey Document Type: CR - Corner Record
- Survey Document Type Number: 12-0728
- Book: 72
- Page: 728
- Street Name: VISTA CHINO
- N CHIMAYO DR
- N PORTALES DR
- DESERT PRINCESS DR
- N NATOMA DR
- S CHIMAYO DR
- N NATOMA DR
- N LAGUNA DR
- RC Cities: CATHEDRAL CITY
- Section: 8
- Township: 4S
- Range East
- Year: 2012

The document viewer shows a 'SURVEYOR'S STATEMENT' and a 'COUNTY SURVEYOR'S STATEMENT' section. The 'SURVEYOR'S STATEMENT' section includes a signature and the date 'JUNE 28, 2012'. The 'COUNTY SURVEYOR'S STATEMENT' section includes a signature and the date '2012'. The document also includes a 'SEE SHEET 2' section and a 'DESCRIPTION OF THE PHYSICAL CONDITION OF THE MONUMENT AS FOUND AND AS SET OR RE-SET' section.

number; or section, township, and range. Although a much more user-friendly system that retrieves all the information related to search criteria entered and allows review of the documents, it's still a record-by-record search and, thus, inefficient.

Riverside County has a long history as an Esri software user, starting with ARC/INFO in the 1980s and transitioning to ArcGIS in 2000. The county stores point, line, polygon, and raster data in a versioned geodatabase using ArcGIS for Server. In addition to centralizing all the records, ArcGIS for Server allows multiple users to simultaneously edit layers in the geodatabase. The county began publishing



↑ A search by corner record zooms to the location specified by township, range, and section.

web maps and apps using ArcGIS Online, which allowed the county to launch services quickly and keep information updated.

The County Surveyor's office manages and maintains the following layers in the geodatabase:

- Tie books
- Field books
- Benchmarks
- Geodetic survey control
- Corner records and certificates of correction
- Recorded instruments related to rights-of-way
- Unrecorded maps—Caltrans rights-of-way maps, plans, and Riverside County rights-of-way maps
- Recorded Maps—Tract/Final Maps, Parcel Maps, Records of Surveys
- Historical Maps—San Diego and San Bernardino maps and Riverside Automated Mapping Program (RAMP) maps
- Counter books and hanging files containing maps with handwritten annotations showing rights-of-way, recorded maps, and important notes relating to these maps

The County Surveyor's office created an in-house research interface that combines Laserfiche, ArcGIS for Server, and ArcGIS for Desktop into a single map. This map is used by survey staff and the Transportation Department and is shared at the county's public research counter.

The county has an ArcGIS Online organizational account so it can publish maps and apps with hosted feature and tile layers. Both feature and tile layers can be used by ArcGIS Online or non-ArcGIS Online applications. ArcGIS Online has made resources, previously only accessible on a limited basis internally, available to the public through ArcGIS Online apps.

Web AppBuilder for ArcGIS

The County of Riverside's ArcGIS Online subscription included Web AppBuilder for ArcGIS, which let the county quickly build custom web maps with widgets and custom styles, then share and publish apps to internal groups and the public. Items in web maps can be linked to a website.

The county created My Survey Research, an app for searching land records. It also includes a custom search widget for locating land records by assessor parcel number, intersection, field book, tie book, and corner records. For example, the corner record search locates records within a section, township, and range that fit the entered search criteria. Clicking a corner record invokes a pop-up window that displays more information and a link. Clicking the link takes the user to the actual scanned corner record in the Laserfiche system.

Future Proofed

Now anyone can conduct research from the office, field, or favorite coffee shop. The new system simplifies the land records investigation process maintained by the County Surveyor's office and will enable efficient research for years to come.

About the Author

David McMillan, a licensed land surveyor, has worked for the County of Riverside for more than 11 years. He currently supervises Geodetic Section & Counter Services, which is part of the Survey Division under the Transportation Department. McMillan obtained a bachelor's degree in geomatics engineering from California State University, Fresno and is currently a graduate student, pursuing a master's degree in GIS at the University of Redlands.

Verifying Valuation Rates

Data enrichment supports better appraisals

By Jennifer Kuntz, Esri Solution Engineer

The County Appraiser for Johnson County, Kansas, was looking for a method for independently verifying that assessed valuation rates for retail properties were equitable across the county.

Paul Welcome, County Appraiser for Johnson County, Kansas, and his staff understand that variations in wealth and population density across the county affect property values. The county needed to ensure that its valuations of retail properties accurately took into consideration these variations across the jurisdiction.

Locations that Welcome refers to as “wealth corners” are commercial districts in affluent, highly developed locations. County staff uses a higher value per square foot when calculating the assessed values for properties in wealth corners.

Welcome was searching for a method to verify differences in per-square-foot value that would be easy to implement, use current data, and capture the business appeal of specific locations. After discussing this problem with Esri staff, Welcome determined that the location analytics processes used by businesses might meet his needs.

Data and Tools for Location Analytics

Businesses use location analytics for site selection, merchandising, and other business decisions. The web-based data enrichment tools in ArcGIS make it simple to get information about the people, places, and businesses in a specific area or within a certain distance or drive time from a location. The power of cloud computing provides instant access to thousands of up-to-date demographic, consumer spending, lifestyle, and business data variables.

For example, a developer can choose a site for a shopping center using web-based tools

that summarize variables, such as total population, median household income, other businesses nearby, and spending habits, for an area within a specified drive time of candidate sites. Once a site is selected, analysis of nearby market segments and spending habits can help determine the ideal mix of stores for the shopping center.

An analysis is only as good as the data that goes into it. A wealth of data is available online from Esri to support location analytics. Thousands of variables are available for population, lifestyles, spending, market potential, and other characteristics. The beauty of the web-based approach used by ArcGIS is that basemap and many other data layers available from ArcGIS Online are maintained by Esri.

Tools for performing location analysis also exist online, are always available, and are ready to use. Outputs from these tools can be accessed from any device and easily exported to other systems.

Applying Location Analytics to Johnson County

The county began looking at specific datasets on businesses and populations available from Esri to use in its analysis of retail property values. To measure retail activity in the areas surrounding retail properties in the county, Johnson County looked at the Total Retail Sales database from Esri's Retail MarketPlace database.

Another option for analyzing retail activity is Esri's Consumer Spending database, which provides information about actual spending for retail goods as well as other

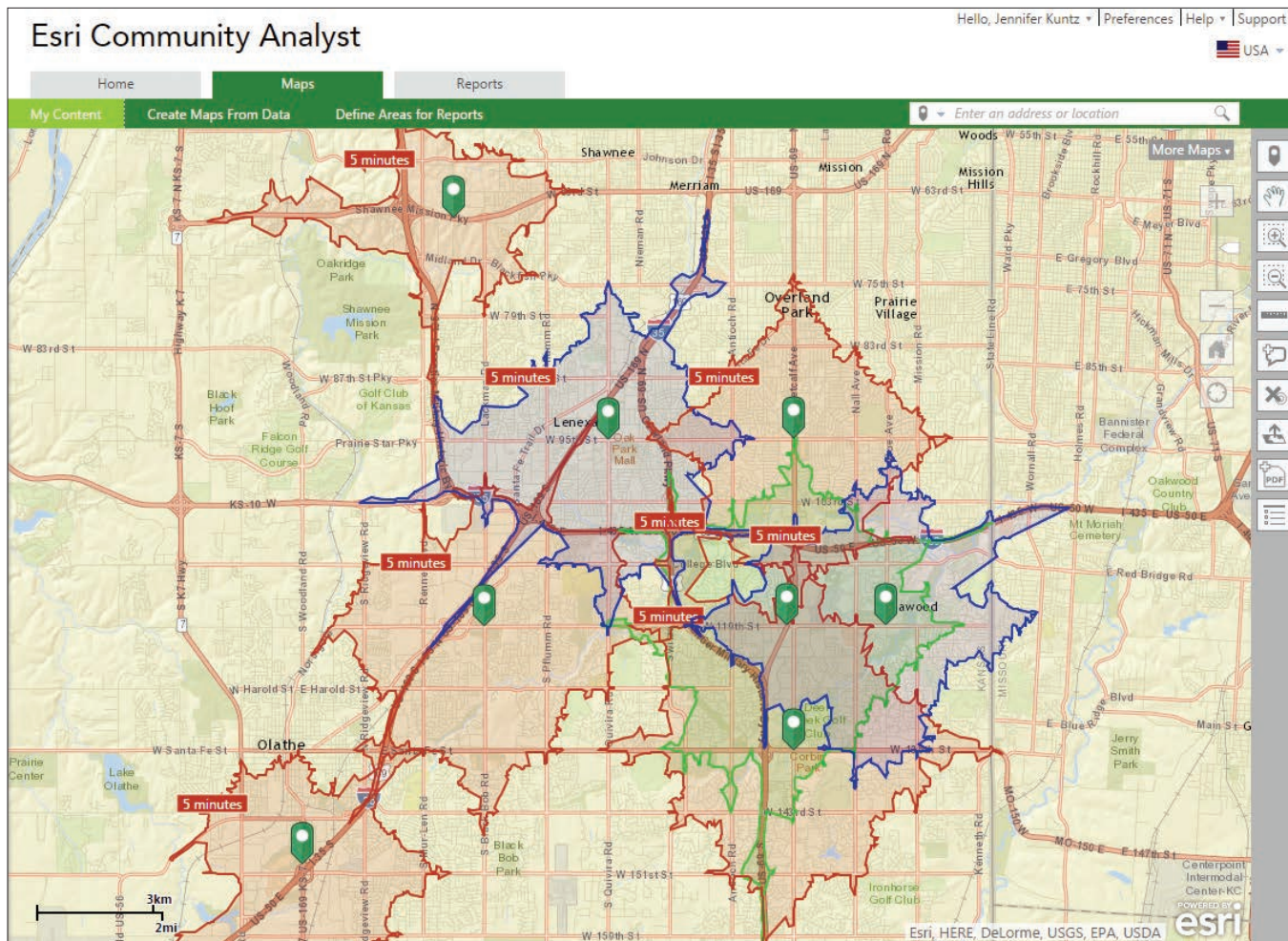
categories such as apparel, financial, food and beverage, entertainment and recreation, and household goods and services. Predictive analysis, which could be added using Esri Market Potential data, compares area demand for products and services to national averages.

Population and lifestyle data in the vicinity of a business can also be useful in defending valuations in an appeals process. This data provides information on ages, marital status, and residency of the people who live, work, and shop near the property being valued. In an independent, blind study by credentialed demographers in 2012, Esri's population data was ranked the most accurate.

Esri's Tapestry Segmentation lifestyle data provides other perspectives on nearby populations. Tapestry data classifies US neighborhoods into 67 unique segments based on demographic and socioeconomic characteristics. Knowing the product, service, and media preferences and favorite activities of residents and consumers can help estimate the revenue generated by a retail property.

To come up with a process for ranking locations for retail businesses in the county, Kevin Skridulis, on the county's GIS team, worked with Scott Porter, manager of commercial real estate valuation, and Welcome. First, the team determined that total retail sales was a good variable to use for ranking as it reflects the number of people in an area, their wealth, and how much they spend.

They decided they would look at spending



↑ Johnson County summarized sales potential within an appropriate drive time of each retail district.

near those locations based on drive time. Realistically capturing the accessibility of a location to nearby consumers required choosing an appropriate drive time. This decision was affected by the county's valuation process, which uses a different price per square foot for big-box retailers than for smaller retail stores.

Because trade areas are complex and cannot be cleanly delineated, Johnson County staff determined that a five-minute drive time provided a realistic measure of the quality of the market around a location for a big-box store. For a smaller retail outlet that might not pull customers from as far away, a three-minute drive time captured the characteristics of the area most likely served by the smaller store.

To capture the estimated total retail expenditures within the drive time for each retail district, Johnson County staff used

the GeoEnrichment functionality in Esri Community Analyst. This software-as-a-service (SaaS) mapping solution hosted by Esri includes both GIS capabilities and access to thousands of demographic, health, economic, education, and business data variables and creates reports using any of the thousands of metrics available.

The county chose Community Analyst for its ease of use. Its ability to easily export variables by census geographies was another factor important for a related project. Community Analyst is just one of several options in the ArcGIS platform for enriching data with up-to-date demographics, consumer spending, lifestyle, and other business data. Other options include the Enrich Layer tools in ArcGIS Pro and ArcGIS Online and the Enrich Data tool in Esri Maps for Office. This functionality can also be accessed through the ArcGIS APIs.

Comparing Assessment Rankings

Johnson County staff compared retail goods spending rankings to their value per square foot rankings to determine if they were accurately capturing the relative desirability of retail property locations. This comparison showed a very strong correlation between the two rankings and was consistent with an earlier study by Bob Gludemans, an assessment consultant hired by the county. The previous study found a statistically significant correlation between wealth corners and the county's value per square foot for retail properties in those locations. These results confirmed that location analytics shows promise for enhancing the appraisal process. Johnson County has continued testing location analytics workflows. Early results show promise for enhancing its business processes.

Engaging with Executives Is Critical to Your Success

By Keith Cooke, Esri State Government Account Executive

When I first started working at Esri nearly a decade ago, my meetings with clients were almost exclusively with GIS managers and GIS technicians. Today, my meetings with many of these same clients are more likely to be with CIOs, agency and department directors, and other executives. That's not because I'm more important than I was a decade ago; it's because GIS is more important than it was a decade ago. And I think two big shifts in the GIS industry have resulted in this change.



First, GIS really started to gain traction in government agencies and the private sector in the 1990s and early 2000s. Organizations wanted it but didn't always put a lot of thought into where it best fit within the organization as a whole. Often, it would fall under whatever department seemed the most able or willing to house it.

Over time, IT professionals saw the value of GIS in terms of how it could benefit the organization, whether it meant geoenabling an existing business system, providing spatial insight to other departments, or as a way to share data with the public. That's when the game changed. GIS evolved from essentially a niche technology to a mission-critical business system. As a result, we've seen IT departments increasingly embrace what was previously seen as an outlier technology.

Second, commercial mapping and mobile devices over the last decade have become pervasive. People expect to be able to get to a map easily now—anytime and anywhere. They don't feel they should have a gatekeeper controlling access to this information. This evolution has increased

dramatically over the last several years with the widespread adoption of web GIS and the availability of focused GIS apps.

As a result of these two big shifts, the role of the GIS professional has forever changed—and for the better! The traditional days of sitting in a corner cubicle and printing out paper maps in a reactive mode are long gone.

Colleagues expect more.

The public expects more.

And executives demand more.

Therefore, being able to engage with executives is a crucial factor in the future of a GIS professional's success.

So how can GIS managers do this? Engaging with executives takes some prep work. Three changes in your approach pave the way for better interactions with executives.

Understand Their Pain and Vision

Before you schedule a meeting, you need to understand two key things about the executives: you need to know their pain and their vision. They have something

that's frustrating them—something that's keeping them up at night and that's putting pressure on them. They probably also have a vision—a specific goal—that they want to achieve.

So what exactly are their pain points and vision? Don't be afraid to ask. I ask executives this question all the time, and you'd be surprised how willingly they'll share this information.

Change Your Terminology

The way you engage executives is not the same way you'd engage your GIS colleagues. The conversation has to be different because it's highly unlikely that executives have the same detailed knowledge of GIS that you possess. In addition, they're generally focused more on the big picture...because they have to be! That's what effective executives do.

Your conversation with the executive should focus on three things: organizational workflows, mapping, and analysis. Typically, I try to avoid all mention of GIS jargon and vendor-specific terminology

when meeting with executives. I've even had very productive conversations where we never even mentioned the term *GIS*. Focus on how mapping and analysis can be integrated into workflows—not just to make a map but to optimize workflows; make better decisions; and enable collaboration, communication, and transparency.

For example, focus on how GIS can be integrated into your organization's business systems. Are you using location analytics to get the most out of your permitting system or asset management system? Are there other business intelligence systems that have a location component that could be mapped and analyzed?

Create Solutions

The most effective way you can become a trusted adviser for an executive is to take the information given to you and map out a solution. I would even submit that this could be the most important role a GIS professional plays in an organization.

To do this, first identify the problem statement, the cause, and the negative impact it creates. The next step is to produce the solution by stating how you plan to solve the problem and what the positive outcome can be. Keep this solution map short and sweet and at a high level. And again, avoid technical terms and jargon. Executives don't care about geodatabase designs, models, or widgets, nor should they. That's what they pay you to do.

This next part is critical: You need to be able to assure the executive that the solution you're implementing is sustainable. Your director isn't just looking at the cost of implementing the solution but also at the cost of maintaining it over many years. Are you offering a solution that is completely customized and constantly relying on either in-house or third-party development? What happens if/when you or the in-house developer leaves? Also, will the solution be able to work on multiple devices?

Embrace Your New Role

Gone are the days when the GIS professional could fly under the radar and work independently of the organization's essential workflows and goals. But have no

fear. There is a very important role for you to play in this new work environment. And to be honest, this evolution of your role is actually a process toward making you indispensable. This is your chance to make executives see both you and GIS for what they really are: mission-critical elements to the success of the organization.

About the Author

Keith Cooke is a state government account executive for Esri. A graduate of Auburn

University, he has been a GIS professional since 1994 and has worked for planning and community development agencies at the regional and local level in Alabama and North Carolina. In addition to his state government duties at Esri, Cooke works with the Elections Solutions Team as well as the Planning and Community Development Team. He is an active participant in the American Planning Association's annual conference, where he has conducted over two dozen hands-on GIS workshops for planners since 2004.

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A Seven-Step Strategy for Managing Technology Change

By David Schneider, Esri Training Services

With the evolution of ArcGIS into a true web GIS, GIS managers now need to motivate people throughout their organizations to adopt geospatial technologies. This challenge is also an opportunity for engaging a new ecosystem of users. Turning opportunity into reality requires a new way of positioning GIS so that it will be adopted by people who would not traditionally be GIS users.

Change is difficult. People tend to resist change. Applying technology change management principles can help overcome this tendency. Dr. John P. Kotter, Harvard University professor and founder of Kotter International, is a noted authority on leadership and change. Kotter's model for facilitating change is an excellent starting point for managers who want to expand GIS-enabled insights and efficiencies across their organizations. This article discusses how to apply Kotter's insights to create an actionable change management strategy that will help you drive adoption of geospatial technology and applications.

First Things First

Going solo is not an option. A team effort is required to spark interest in and adoption of geospatial technologies across your organization. When envisioning your organization's change management approach, start by considering factors that may inhibit or even prohibit change. Common factors that get in the way are organizational culture, complacency, bureaucracy, and a sense of futility.

An **ORGANIZATIONAL CULTURE** that is structured into segmented silos will inhibit the collaboration needed to effect change.

COMPLACENCY is commonly seen with mature teams that have a history of success. A sign of complacency is hearing the response, "The way we do it works fine; we don't need to change."

BUREAUCRACY is a common change inhibitor in large organizations and government. By complicating and slowing change momentum, bureaucracy can stall and ultimately kill change initiatives.

A **SENSE OF FUTILITY** results from the combination of the previous three factors. To teams, the prospect of overcoming these obstacles and effecting change seems overwhelming, and doing nothing is easier.

Identifying change-inhibiting factors you are likely to encounter is a critical part of building your strategy. You will need to develop key value statements to overcome or marginalize each factor as you work through these steps.

STEP 1

Create a Sense of Urgency

To instill motivation, start by creating and clearly communicating a sense of urgency. A sense of urgency is rooted in the “Three Whys.”

- WHY?
- WHY ME?
- WHY NOW?

Because the answers to these three questions may vary significantly throughout your organization, the next step is critically important.

STEP 2

Build a Guiding Coalition

Depending on who you ask, the answers to the Three Whys will vary significantly. With this in mind, it is important to map your organization and identify stakeholder representatives from multiple business units. For example, the guiding coalition for a local government might have representatives from the planning, fire, police, and sanitation departments. The coalition will provide you with the intelligence you need to understand how GIS can help each team improve its business. The coalition is also instrumental in the next step.

STEP 3

Form Strategic Vision and Initiatives

If you understand the motivating factors for the various parts of your organization, this step will be much easier to complete. You will find that as you engage other business units via your guiding coalition, you become an aggregator of information. You can use this information to formulate your vision and strategy.

It is important to distinguish between vision and strategy. The vision is the adoption of geospatial technologies throughout your organization. The strategy outlines the specifics—who, what, when, where, and why—that together form the plan for achieving the vision.

The guiding coalition will help eliminate GIS jargon from your strategy. This is essential for overcoming the factors that inhibit change and winning acceptance from non-GIS teams.

“Organizational change management is a leadership-induced process that involves transformational organizational change that leadership controls and sustains. It requires leadership dedication, involvement of employees at all levels, and constant communication.”

Harry Hertz
NIST Baldrige Performance
Excellence Program

STEP 4

Enlist a Volunteer Army

The volunteer army is an extension of your guiding coalition. The guiding coalition will conduct a stakeholder assessment of its respective teams to classify people into one of four roles, using the stakeholder mapping model from ExperiencePoint, Inc.

CHAMPIONS not only have the vision of how the change will impact the enterprise, they have the leadership capability to initiate change action plans.

HELPERS are your guiding coalition and volunteer army. Helpers are willing and able to move the change initiative forward. They have a complete understanding of the change strategy, are able to communicate it effectively, and can gain buy-in from other team members.

BYSTANDERS will neither help nor inhibit the change initiative. The majority of the people in your organization will be bystanders. Transforming bystanders into helpers is a goal for a successful change strategy.

RESISTERS may inhibit your change initiative. They can be serious obstacles if they have significant influence in your organization. Securing executive buy-in will help minimize resister impact. Ignoring resisters is a critical mistake made by many change champions that gives resisters the opportunity to spread their discontent. Understanding resister concerns will help you to communicate with them and marginalize their resistance. Often, resistance is rooted in perception rather than reality. Transforming resisters into bystanders is a goal for a successful change strategy.



STEP 5

Enable Action by Removing Barriers

After creating your change strategy and identifying your stakeholders, you will address any barriers that may impede the change initiative. One of the most glaring barriers is the need for skills. Will team members be able to immediately use the technology? If not, plan for training to overcome this barrier. Another common barrier is lack of team access to the right technology at the right time. Work with your IT department to ensure the right software is installed on the right systems and that all required permissions are in place.

STEP 6

Generate Short-Term Wins

With barriers removed, execute your strategy. As you begin to see results from your initiatives, it is extremely important to collaborate with the guiding coalition to communicate these wins. By engineering your strategy around initial short-term wins, you will help preserve and increase buy-in across your enterprise. Short-term wins help you build momentum as you work toward your vision. For example, someone creates an Esri Story Map app. Share it with the enterprise and encourage others to participate. With story maps, it is easy to create a high-impact visualization of relevant data.

STEP 7

Sustain Momentum

Continuing to recognize and celebrate wins is key to sustaining the momentum of a change initiative. Earn more wins by continuously building your teams' skills and creating a culture that encourages learning new workflows. As new, more efficient workflows replace old, inefficient workflows, your workforce will be more engaged.

You will need to institutionalize the new workflows your teams have adopted. This is an important step for establishing a long-term strategy for your GIS, and it is often documented in a formal GIS strategic plan. The GIS strategic plan is created using a broader-scale version of Step 3: Form Strategic Vision and Initiatives. This plan will drive the adoption of geospatial workflows and lead to institutionalized utilization of geospatial technologies.

Engaging your human resources team to create GIS training tracks for employees may support institutionalized GIS use. Training plans and workforce development plans that are aligned with your change strategy are a valuable tool to remove skill barriers for those new to the technology. Engage your internal training teams to identify skills gaps that need to be addressed. Esri can also help with this.

Now Get Started!

Embarking on a technology change initiative is challenging. Now that you know the seven steps of the change management process, when will you get started? For more information, please contact David Schneider at dschneider@esri.com.

About the Author

David Schneider, a training consultant in the Esri Washington, DC, office, works closely with large federal civilian agencies to align workforce training and professional development with agencies' strategic missions. He is currently pursuing a master's of science degree in technology management at George Mason University. Schneider regularly gives presentations on the strategic benefits of workforce development planning, change management, and change leadership.

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SUMMIT OFFERS PEER-TO-PEER INSIGHTS

“Embrace your new role,” was the unofficial theme of the 2015 GIS Managers Summit. This “unconference” within the Esri User Conference was held in San Diego on July 21, 2015.



THE SUMMIT BEGAN in 2010 as a way for GIS managers, leaders, and decision makers from public and private organizations to connect, share insights, and discover ways to be more successful. While the user conference focuses on the technical side of implementing GIS, the summit concentrates on the nontechnical aspects of growing GIS in an organization that are just as important.

These include developing a vision for the role of GIS and providing the leadership required to realize that vision. Because GIS has moved from a niche technology to information infrastructure, the role of the GIS manager has changed from a reactive to a proactive one.

The agenda for the GIS Managers Summit is peer driven. For most of the day, presentations by GIS managers and Esri staff alternated with networking sessions. The last hour and a half was devoted to round table discussions and a final panel discussion.

Presenters Wade Kloos, Bryan Zumwalt, and Gary Maguire shared the experience they had accumulated over decades in the field. Kloos, currently the GIS director at the Utah Department of Natural Resources, has worked in GIS since 1990 in various capacities. In his presentation, “Increasing GIS Significance: What GIS Managers Can Do to Maximize GIS Results,” Kloos urged managers to adopt practices that will improve their visibility in the organization by understanding and addressing the mission, priorities, and pain points in their organizations and using spatial solutions to solve the problems their executives face.

Bryan Zumwalt, GISP, is the enterprise GIS manager for Pinellas County, Florida. He has more than 12 years of experience in the field. He talked about the things that have made the GIS program in his county successful and outlined some best practices in “Management Support of GIS.”

Gary Maguire, manager of business and location intelligence services at the South Australia Department for Communities and Social Inclusion (DCSI), is a regular speaker at conferences on leadership, technology, and innovation. His presentation, “Tapping the Strategic Potential of GIS,” focused on strategies for turning the audience’s dreams of changing the world into reality through formulating a business plan and GIS strategy and obtaining executive endorsement.

The last session of the day gave attendees an opportunity to choose the topics they wanted to discuss during the round table groups. Although there were 14 suggested topics for discussion, the findings of the groups returned to these themes:

- Having a vision and having the confidence to pursue it
- Building relationships throughout the organization but especially with the executive level
- Understanding the business processes of the organization
- Identifying the data that is needed, procuring it, and maintaining it
- Using COTS solutions whenever possible
- Educating everyone about the value of GIS
- Realizing that there are no great apps without great data

Join in the Discussion

Whether or not you were able to participate in the 2015 GIS Managers Summit, you can continue to interact with your peers online through the Managers in GIS LinkedIn group. Read discussions and posts on topics related to both technology and management. Send a request to become one of the group’s more than 2,000 members.



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Revealing Hidden Information with Augmented Reality and GIS

While augmented reality (AR) has been around in some fashion for decades, it may be the next big thing in GIS. AR takes a live view of a real-world location and adds contextual information. A familiar example would be the heads-up display in some military aircraft. AR holds the promise of even greater integration of GIS attribute data using mobile devices.

Brady Hustad, director of partner solutions for Esri partner Astadia, Inc., a global business consulting, marketing, and technology services company headquartered in Jacksonville, Florida, spoke with Keith Mann of Esri about the integration of AR with GIS in his firm's AR framework.

Why did you decide to integrate GIS into Argis?

Understanding why GIS is integrated with Argis begins with understanding how AR, and more specifically, how most AR, works today. It breaks into two groups that I have coined as *inside AR* and *outside AR*.

Inside AR is the standard AR you see in most applications today. Any augmented reality has to anchor to the real world in some form or it is no longer augmented reality but something else. In order to augment reality, you have to know where you are in that reality. Inside AR uses markers, or object recognition, to anchor itself to a specific object, not a location. This does have some strong stories to tell, like in maintenance applications and extension to the Internet of Things, but is limited to knowing what object you are attached to and nothing else.

Argis works in what I coined outside AR or augmented reality that is anchored in the real world through standard geospatial sensor technologies. Using GPS, and then the normal AR suite of sensors, we anchor to the real world (instead of a specific object) to allow users to visualize their data wherever they are, impacting whatever they are doing there. The only way to know where data is in the real world is through location, and GIS owns data that has location.

Why did you choose ArcGIS for the geospatial component of Argis?

Ha! That's simple—Esri owns the standards in the geospatial spectrum. Who is going to care about outside AR, or Argis? People and organizations with assets that are either hidden, underground,

complex, or otherwise challenging to a crew on the ground. These people are in utilities, energy, and the public sector, and that's who makes up a large portion of Esri users. Now, these Esri users own most of the data that would need to be seen in Argis, so if we didn't conform to this standard, we would constantly be battling data standards as we tried to roll out the product.

But it also goes even deeper. Esri also is the technical choice. A key factor is ArcGIS Online. When you need data on a mobile platform in the field, you need the data accessible no matter where you are. ArcGIS Online opens this door by creating a secure platform created to specifically manage and distribute spatial data. This platform [*the ArcGIS platform*] allows us to extend its capabilities to make a truly unique visualization of that data.

When you search the web for "augmented reality (AR)," you see a lot of cool demos but not too much in the way of practical applications. Is this one of the reasons Astadia decided to create Argis? What are other reasons that Astadia created Argis?

Developing a practical application for augmented reality was definitely a driving force behind creating Argis. Augmented reality has amazing potential to be truly useful, but the market mostly currently offers applications and solutions that range from toys to marketing gimmicks.

While it's true that we must start somewhere, the current state of AR technology offers real opportunities for paradigm-shifting applications. At Astadia, we saw an opportunity to make a new impact and jumped at it. Beyond this, Astadia is committed to bringing our clients compelling solutions that can directly impact their ROI. As part of my role in R&D, I look for solutions that not only impact the tech ecosphere but also fit our skills and abilities. AR made perfect sense to Astadia because of our mobile, GIS, 3D, and user experience backgrounds. It was a natural progression.

What were some of the issues/concerns/obstacles you were thinking about when you designed Argis?

One of the key challenges is always contextualization. When you give someone a table of numbers, it can take hours—if not days—for them to get the answers they're seeking. Convert this information to graphs and charts and the answers may come faster. But with a map, insight can occur in seconds. You still have to figure out where you are or where the thing you care about is located. With AR, you open up your iPad and see the pipe that runs four feet below the ground in your backyard. You instantly know exactly what you need to know.

Another issue Argis aims to address is making the right data available to users when and where it's needed. With crews working in the field, there may be one guy at an organization who's been there 35 years and has always known that the valve they can't see is hidden in an old shed. But when that guy retires in six months, his replacement simply won't have that institutional knowledge. So how do you reliably transfer that knowledge to a new generation?

Today we can give teams in the field the data they need, where and when it matters. And as an added benefit, new, young crew members can share in real time everything they are seeing in the field with an expert back at the office who can help guide them. With a good system and a wearable device, the supervisor would even be able to communicate back and draw actions on the view-port of the field crew.

How do you think AR and Argis will change your business/operations? Where do you expect to see the most dramatic changes in your business?

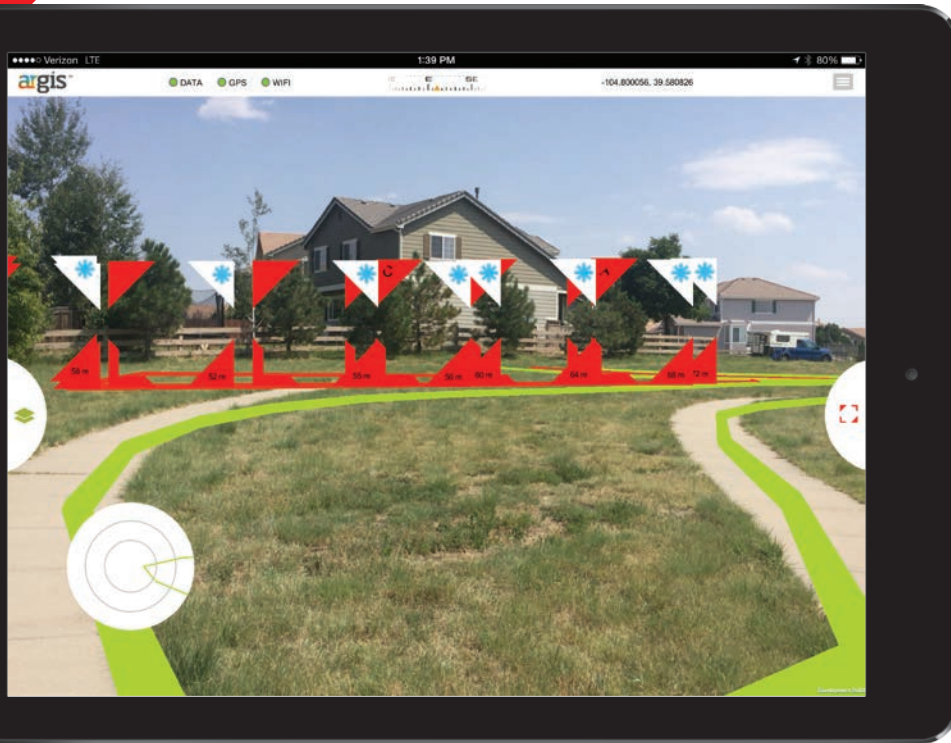
I think people now are only getting a glimpse of the impact augmented reality will have on their world. Concepts being shown today include removing blind spots from cars (by perfectly projecting the outside on the inside) to Argis' ability to offer what some call x-ray vision. This is going to be a new standard in visualizing data. Since Astadia aims to deliver actionable intelligence for our customers who need it, AR and Argis will go a long way to helping our customers use their data in new, more efficient ways.

The most dramatic impact I expect for the near term is the visualization of the unseen or hidden. It is an absolutely simple, but profound, use case—to be able to see what you need to see, even if it is hidden, destroyed, or missing. The ROI is clear: How much do you lose by digging up the wrong asset or wrecking something you didn't know was there? How much time do you lose when you take the wrong tools into the vault?

Please describe the solution in as much detail as you can.

Argis, put simply, translates your spatial data into the real world, for visualization through a mobile device or wearable. In more detail, Argis takes data that has a location, and creates a 3D model of





assets are, you can turn off the GPS and calibrate your data to match exactly to those visible assets, giving you inches of variance. Also, if you want to be able to move and have that level of accuracy or if all your assets are hidden, the system has the ability to link with Bluetooth sensors, including GPS, so you can override with a highly accurate GPS to get the system as accurate as your data can be.

Internally, the real magic occurs. You would be surprised to know that the actual technology to display data in a 3D space isn't that complicated. What is complicated is making sure that data is accurate, smooth, moving correctly, and staying at the correct location. Sensors in commercial devices are not perfect—they drift, they shift, and with them your data will drift and shift.

Astadia spent the time and effort in Argis to smooth the user experience, maintain accurate data, and remove as much sensor error as possible. We have a system that is now ready to truly show you your data in a new story.

the data within a distance from the user, with a default setting to 400 meters. Argis extrapolates elevation if the data doesn't have the elevation data. Argis then displays this data, either overlaying it on a camera display from a mobile device or on the viewport of wearable AR glasses. Argis then integrates with all the sensor systems of the device to allow the user to interact and move among their data.

Then the fun begins. Argis is built as a framework so the workflow can be directly customized to an organization's specific needs or to a specific use case. Astadia will be customizing a few use cases but leaving the door open to more possibilities depending on the customer's needs.

What are the coolest features of Argis?

I will break this into two sections, the first about the visible features, the second about the technical features.

The coolest features that users will see in Argis have to do with immediate integration with their data. With just a few clicks, users will have their data—any data—visible within the solution. This data will have the symbology that they set up using standard tools from Esri. Then they'll have all the standard tools to turn data on and off, connect to the attributes, stuff like that.

What gets awesome from here is the ability to turn off GPS and fine-tune the data. One of the challenges with using GPS as a sensor to anchor you to the world is that most GPS [receivers] are not that accurate. They are accurate enough for most situations (as friends of mine say, "get you within a bucket width" of, say, a meter or so), but what if you need to be more accurate?

Well, Argis gives you that ability. If you know where a few visible

Are there special requirements for using Argis?

I would love to say there are no special requirements for using Argis, but there definitely are. Whatever device you use, it must have sensors that allow you to know where you are and what you are looking at. Necessary sensors include gyroscopes, magnetometers, GPSs, good accelerometers, cameras, or view ports. Not all are needed, but these are what we can use. Luckily, most of these sensors are just part of your smartphone or table.

Additionally, Argis uses your data and can only be as accurate as the data you have. It requires solid, accurate data.

What benefits will your customers realize once they start using Argis?

Time, accuracy, and efficiency.

TIME: Anyone who has worked the field has spent hours searching for what they are working on. This can simply be eliminated. If you can get within one to two meters of what you are looking for, you can usually find it pretty quickly, whether it is covered in snow, dirt, or structures.

ACCURACY: If the asset you are to work on is highlighted in red, and the asset beneath your feet is not red, perhaps you are not at the right location. I know many field crews have found ways to stop from working on the wrong asset, but are any of those ways faster than simply looking at it?

EFFICIENCY: You can send the newer, less experienced crew and can have more cross-trained teams. You can get it done right, faster, the first time.

Describe how what you are doing is unique compared to other AR applications.

Arguably, I have seen a few attempts in the same direction as Argis. I imagine that as time passes and technology improves, more solutions in this vein will appear, as the need is obviously there. Currently, what is unique about our work with Argis is that we are fully autonomous from requiring any visible marker to which to anchor. Argis anchors to a location through GPS, not through object recognition or markers. Additionally, we are a fully outdoor-capable solution. Argis is made to solve the problems of field crews—the teams doing the “last mile” of work.

Are you planning on expanding your use of AR and GIS in the near future? If yes, can you elaborate?

Yes, we are definitely not done yet. We have this ready to be introduced into the industry, but we are continuing to improve and extend the functionality. For example, elevation is a real challenge. It is hard to get accurate elevation data and to accurately model where your data should be in that elevation. I can't go into detail, but we are building a dynamic methodology to create accurate elevation and therefore more accurate data.

Another area we are pushing into is interior dynamic mapping and locating. A large field of interest is the ability to locate people and assets dynamically within a building in real time. We have

much of this in place and are working on how to seamlessly switch from a GPS-based system to a SLAM [*simultaneous localization and mapping*] or other technology-based system and what devices would be able to do this.

Finally, we have the ability to handle Bluetooth sensors and web service sensors in the Internet of Things. Unfortunately, each device and sensor array differs slightly, so we have to code specifically for each one in a small way, at least. So we are working to establish solutions for more and more devices. We started with iDevices [*an informal term referring to mobile or portable devices manufactured by Apple*] as these are ubiquitous in the industry, cost effective, and already have a passable sensor group. We also have the Meta glasses working. We will be working through Android, Windows, and other wearables soon.

Is there anything else you'd like to share?

Currently the researchers are indicating that AR is around a \$250 million industry and expected to grow to \$2.5 billion. This growth is not expected to slow down over the next few years. Every major technology player has jumped into the industry—even Apple with a late play in buying Mateio [*German software company specializing in augmented reality technology*]. This method of visualizing your data and empowering your team will be around for the long haul and will revolutionize how you expect to do your work. I would urge you to look into this technology; this is a game changer and could give you that distinct advantage you need in your business.



Enhancements in the New ArcGIS API for JavaScript

The 3.14 version of the ArcGIS API for JavaScript adds more than 30 new classes, dozens of bug fixes, and other enhancements to the API. Let's take a look at some of these new features.

Renderer Enhancements

Several renderer enhancements were made to the API including scale-driven sizing for polygons and their outlines when calling `smartMapping.createSizeRenderer()`. Also, the new `BlendRenderer` class (beta) was added to the API, providing another option for visualizing complex spatial patterns in your data. `BlendRenderer` allows you to easily identify the predominant attribute among two or more competing attributes of a feature and visualizes the strength of that predominance using blended colors.

In the map in figure 1, blue features represent areas that predominantly contain owner-occupied housing, while the red features are mostly composed of renter-occupied housing units. Areas shaded with a light purple color, however, are composed of a near-even mix of owner-occupied and renter-occupied housing units. Thus, areas with a high occurrence of one attribute will be rendered with strong opposing colors (in this case, blue or red), while areas with nearly equal occurrences of the opposing attributes will blend the opposing colors (in this case, purple). For more information on how `BlendRenderer` works, see this topic in the API reference and explore the new samples that use it.

New Widgets

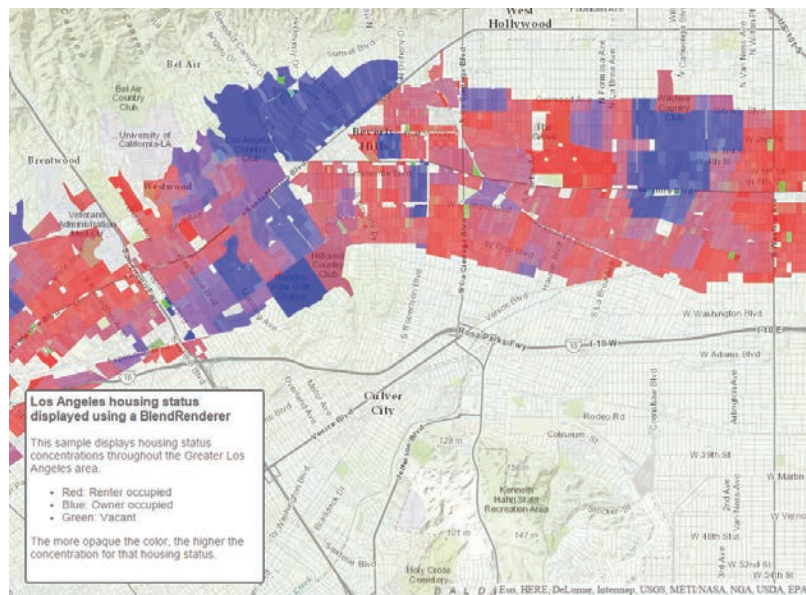
`ElevationProfile` (beta) and `LayerList` (beta) are two of the widgets added in this release. The `ElevationProfile` widget allows you to view the elevation profile along a line feature. The `LayerList` widget provides a convenient way for users to toggle layers on and off.

WFS Layer Support

The Open Geospatial Consortium, Inc. (OGC), Web Feature Service (WFS) interface standard provides an interface allowing requests for geographic features across the web using platform-independent calls. The new `WFSLayer` (beta) adds support for OGC WFS.

API for Image Services Enhancements

New measuring capabilities have been added to the API for Image Services. The `ImageServiceMeasure` widget and `ImageServiceMeasureTool`, for example, allow you to measure areas, perimeters, distances, and angles in image services. The `ObliqueViewer` widget allows you to view image services from oblique views, which minimizes distortion. It also lets you observe the same imagery from different angles. `RasterLayer` and `PixelBlock` are no longer in beta.



↑ Figure 1: `BlendRenderer` allows you to easily identify the predominant attribute among two or more competing attributes of a feature and visualizes the strength of that predominance using blended colors.

Extending Operations Dashboard

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

DataReviewer Classes

The new `DataReviewer` classes allow you to take advantage of ArcGIS Data Reviewer for Server tasks that add data quality control features to your application. Some of these features include automated data validation using rules authored in ArcMap, data quality tracking and reporting, and an iterative correction process.

All the Details

See a complete list of the improvements and bug fixes, as well as additional information about upgrades to other resources, in the What's New in Version 3.14 Guide topic in the online help.

See the Future of Web Mapping

The ArcGIS API 4.0 for JavaScript, the next generation of the API, is already available in beta. This modern API provides an improved developer experience with a lean and simple interface. Beta 4.0 leverages advances in modern browser technology and the ArcGIS platform to create interactive, compelling web mapping applications.

This next-gen API enables smarter data visualizations and analysis. Developers can write both 2D and 3D applications using the same concepts and programming patterns. It has been optimized for use on mobile devices and provides substantial performance improvements, including a full client-side geometry engine for ultrafast geometry operations.

This version of the API will include support for vector tiles. This new representation drives dynamic, interactive cartography in a web browser. Vector tiles eliminate the need to precache styled tiles and provide access to each tile's underlying data. Vector tiles, which use a new open specification that has already been adopted by major consumer devices and other platforms, will be available across the ArcGIS platform but will initially be offered as an ArcGIS Online global basemap tile service for use with the ArcGIS API for JavaScript.

Ongoing beta releases will culminate in a final release in 2016. Learn more about beta 4.0 at developers.arcgis.com/javascript/beta/.

↓ Beta 4.0 will support vector tiles, which drives dynamic, interactive cartography and allows optimal performance.



“We Are Limited Only by Our Collective Imaginations”

By Sarah Wray, TM Forum

Following the release of the recent report *GeoAnalytics: Why location technology is critical to IoT success* by John Williamson of Telecom redux, TM Forum caught up with Esri president Jack Dangermond to get his take on exactly why geanalytics adds so much value in the Internet of Things (IoT).

TM Forum: Esri has been looking at geanalytics data for a long time. Its application is now getting much wider with the growth of the IoT. What does geolocation data bring to the IoT?

Dangermond: Sensor data collected in the IoT ecosystem requires context to understand and make valuable. Geolocation provides that context by transforming the raw data into useful information and, ultimately, actionable intelligence. As an example of how this works, Volvo recently announced a program to build 1,000 smart cars that would share information with other vehicles to warn them about slippery road conditions. Location is not initially important to the car upon sensing the slippery conditions, because it can adjust without this information. However, warning other cars about the hazard requires knowing where the hazard is as well as other vehicles' proximity. Thus, location and geanalytics transform this sensor data into actionable intelligence. Only by understanding the location of the slippery road segment can other vehicles determine the relevance of the warning to their planned routes. Location and geanalytics transform this sensor data into actionable intelligence.

TM Forum: What do you see as some of the most common applications for using GIS and geanalytics in the IoT space?

Dangermond: We are already seeing applications in connected cars, smart homes,

smart cities, and supply chain management, to name just a few. Some of these applications are still in their infancy. GIS will revolutionize that. Many people have a smart thermostat in their homes, for instance. The thermostat monitors temperature and compares temperature with time of day. But let's say you decide to come home early one day. The thermostat typically has no advance warning, so the temperature when you get home could be too cold or too hot.

But now imagine your smart thermostat connects to your smartphone. You can use GIS to erect a geofence around your workplace, so if you leave early, your phone triggers the geofence and alerts your thermostat to change the temperature. That's better. But let's open the scenario a little more. What if a thousand people left work early? It's safe to say the utility company would like advance knowledge of the associated surge in usage. Imagine the efficiencies the company could realize by a very common application.

TM Forum: Are there any surprising/unusual uses you have seen?

Dangermond: One came during Superstorm Sandy [a devastating hurricane that struck the eastern United States in 2012]. Using GIS and Twitter, we were able to collect and analyze geotagged Tweets that referenced the power outages. By normalizing the frequency of Tweets against the population density, we could map power failure across Manhattan. That's pretty huge. So instead of building a system of

dedicated sensors or smart meters, we were able to use common devices like phones, existing communications networks, and GIS to track the outages. This demonstrates the wide potential future of the IoT, which can add location analytics to an existing ecosystem of interconnected devices to create a valuable new solution, with very little incremental investment.

TM Forum: While the opportunities for using location technology and analytics to enhance IoT applications seem to be enormous, service providers face hurdles in harnessing the full potential. What do you see as the main challenges?

Dangermond: Our biggest challenge is determining how to leverage the full capabilities of a location platform. Most applications today merely tap a few spatial tools, like proximity analysis.

As the IoT ecosystem expands, it will create opportunities for integrating data from billions of multipurpose devices through myriad communication technologies, which will support numerous applications. These new applications must tap the full stack of GIS capabilities, including geocoding, routing, geofencing, and spatial analytics, along with a full complement of geoenriched data. We are limited only by our collective imaginations.

TM Forum: What's next for geanalytics, in your opinion?

Dangermond: Geanalytics has the potential to make our lives infinitely simpler and safer. Unfortunately, many of today's GIS uses are reactive. The slippery-road example alerts proximate vehicles after



the fact. Why wait for problems to occur? Once systems like this are deployed, we can leverage GIS for predictive use. For instance, historical data from millions of vehicles collected over time and compared can be integrated with weather data to predict where slippery conditions will occur in advance of the first car skidding. That's the next level of sophisticated GIS modeling, and beyond predictive use is even a further step—prescriptive action. With geoanalytics, we could actually eliminate hazards. Once we enter the prescriptive world, our potential applications of geoanalytics become truly limitless.

TM Forum: You started out as a landscape architect. Does this inform the work you're doing at Esri, and how?

Dangermond: I studied landscape architecture at Harvard University and got exposed to using early computing technology to study the earth's landscape. I had already been doing geographic analysis manually; but at Harvard, I learned that it could be done much more quickly and more accurately with the help of computers. I could see that there was great opportunity to use these new data processing and computing technologies to change the way landscape architecture and environmental planning were done and, as a result, to have a profound impact on the world. Every year, we see more and more users of our software realize tremendous success and drive business value by applying geography to their decision making.

About TM Forum

TM Forum (www.tmforum.org) is a nonprofit global industry association that helps its member community of more than 85,000 experts from more than 900 global enterprises, service providers, and technology suppliers transform and succeed in the digital economy. The association provides members with thought-provoking research and publications, practical guidance, tools, information on best practices, hands-on events, and training for business and IT leaders.

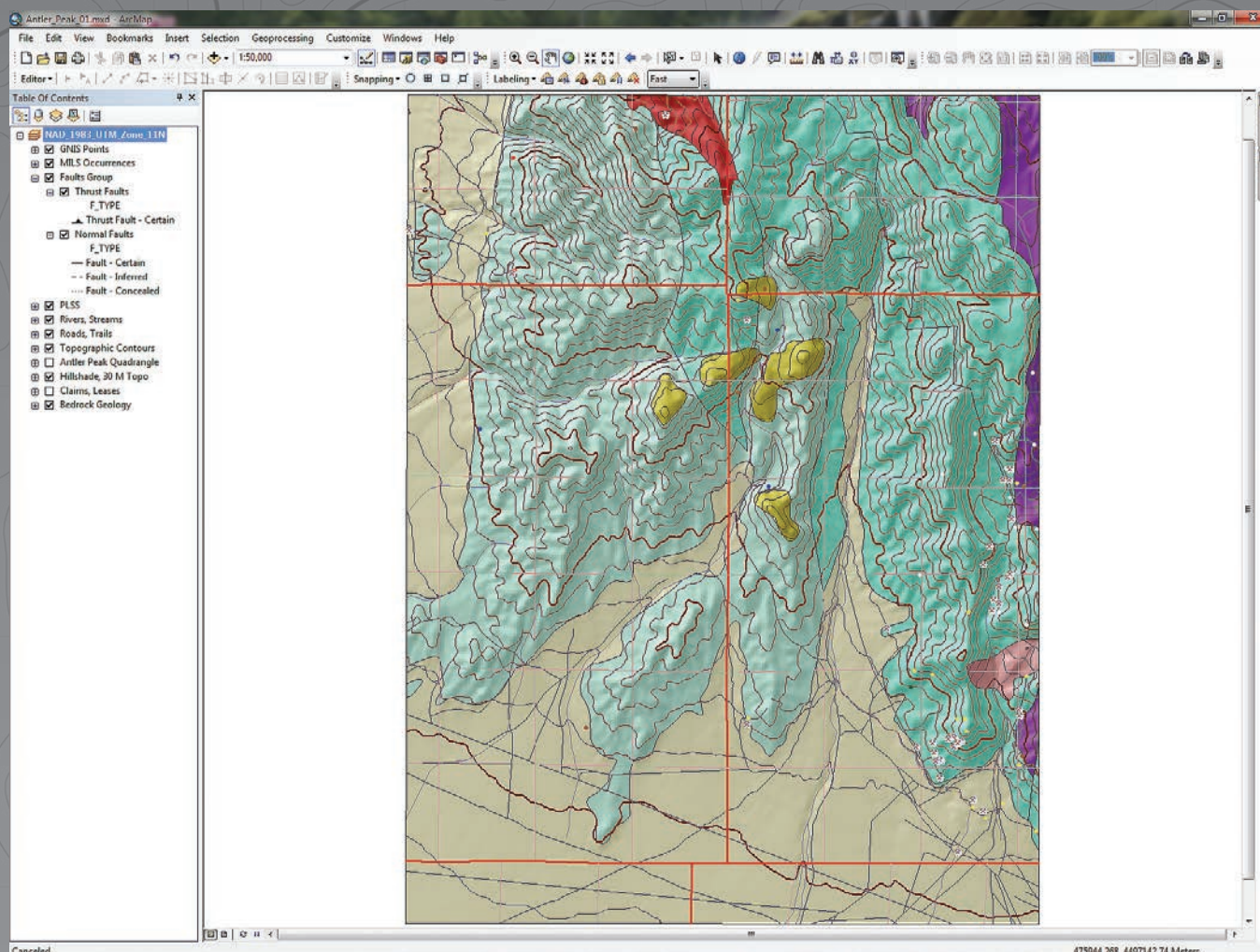
Using Feature Templates for Complex Editing

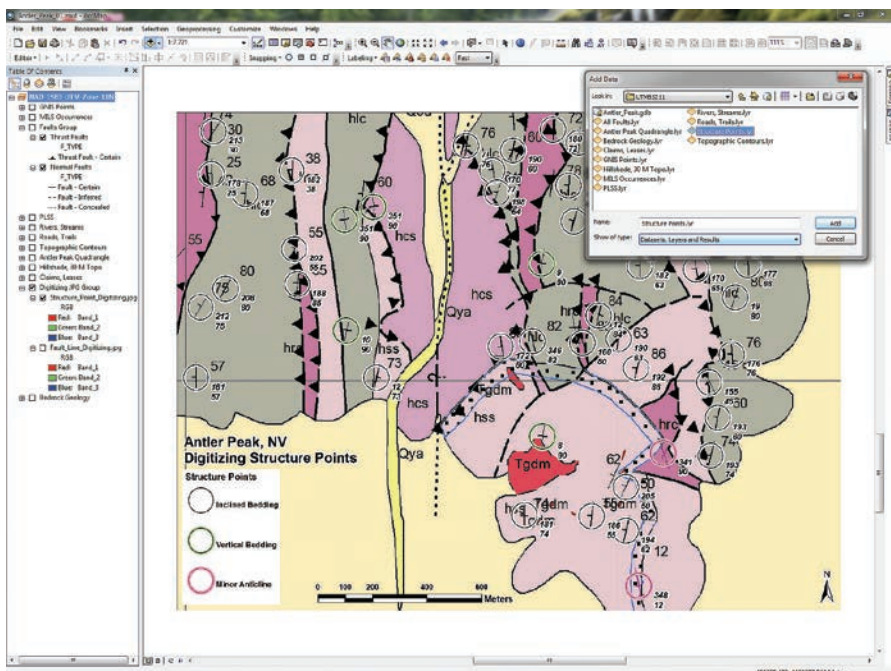
By Mike Price, Entrada/San Juan, Inc.

What You Will Need

- ArcGIS 10.3 for Desktop (Basic, Standard, or Advanced license)
- Sample dataset downloaded from esri.com/arcuser
- Intermediate ArcGIS for Desktop skills

↓ AntlerPeak01.mxd, the map document for this exercise, resembles the end product of the previous exercise and also uses data from Antler Peak, Nevada.





↑ Navigate to \Antler_Peak\GDBFiles\UTM83Z11 and add the Structure Points.lyr.

2. Load the scanned reference maps for digitizing by navigating to \Battle_Mountain09\JPGFiles\UTM83Z11\ and locating Fault_Line_Digitizing.jpg and Structure_Point_Digitizing.jpg. Add them to the map.
3. These rasters are already georeferenced and should appear in the southern portion of the map extent. In the TOC, create a group called Digitizing JPG Group, place Structure_Point_Digitizing.jpg above Fault_Line_Digitizing.jpg, and move the group to the bottom of the TOC, just above Bedrock Geology.
4. Turn off all layers except the Digitizing JPG Group and Faults Group. Leave the Faults Group legends expanded and zoom to the Digitizing JPG Group. The data frame scale should be approximately 1:8,467.
5. To make map symbols easier to see, choose Data Frame Properties > General and set the reference scale for the data frame to 1:16,000. Verify that the Maplex Label Engine is being used for label placement. Close Data Frame Properties and save the map.

“Editing with Feature Templates,” in the summer 2015 issue of *ArcUser*, introduced editing with feature templates and showed how editing templates are created, updated, and applied.

This article will expand your feature template editing skills and teach how to digitize structural geology features from scanned maps. This tutorial will cover symbolizing and labeling geologic points representing the orientation of bedded strata and geologic polylines used for representing simple and complex fault movement.

The previous exercise involved creating simple feature templates and modifying the line direction for existing small-scale faults. Working this exercise will involve digitizing detailed geologic data and creating new points and polylines. The mapped faults in the previous exercise were mapped at 1:100,000 scale, but in this exercise, features will be digitized at a scale of 1:24,000 or larger using a small part of a scanned graphic of the Antler Peak quadrangle.

Getting Started

To get started, download the Battle_Mountain09, Antler Peak training data, from the *ArcUser* website and unzip it on a local drive.

Open ArcCatalog and navigate to \GDBFiles\UTM83Z11\Antler_Peak.gdb.

Expand the geodatabase and preview the table for the faults and GeoPoints layers. Note that these are currently empty but will be populated during this exercise. Close ArcCatalog.

Start ArcMap and open the ArcMap document (MXD) named AntlerPeak01.mxd. It resembles the end product of the previous exercise, which also used data from Antler Peak, Nevada. Note that the frame scale is 1:50,000 and no reference scale has been set. The table of contents (TOC) contains layers in the Faults Group, but these layers are now empty. As part of this exercise, new fault datasets showing much more detail will be created.

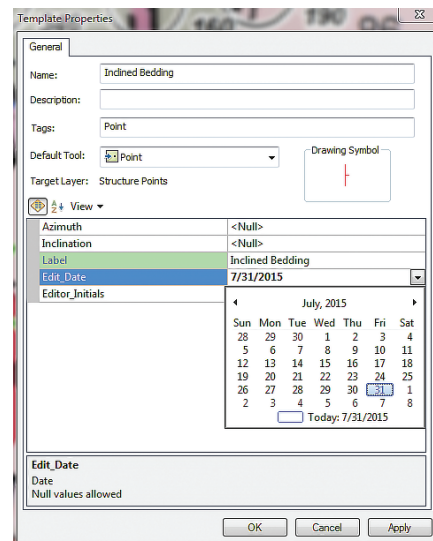
Before adding data and resizing your map, complete the map document properties for this MXD and set a default geodatabase.

1. From the Standard menu, choose File > Map Document Properties. In the Properties dialog box, fill in the text boxes and set the Default Geodatabase to \GDBFiles\UTM83Z11\Antler_Peak.gdb. Save the map. (Because this project resides in a new folder, data and projects from previous Battle Mountain exercises are unaffected).

Understanding Strike and Dip

Study the Structure_Point_Digitizing.jpg graphic. It shows many thrust faults and steeply dipping sedimentary rocks. Since compression occurred from the west, many of the linear thrust boundaries trend north to south. Most tilted sedimentary rocks also

↓ Update the prebuilt Inclined Bedding template with the current date and your initials.



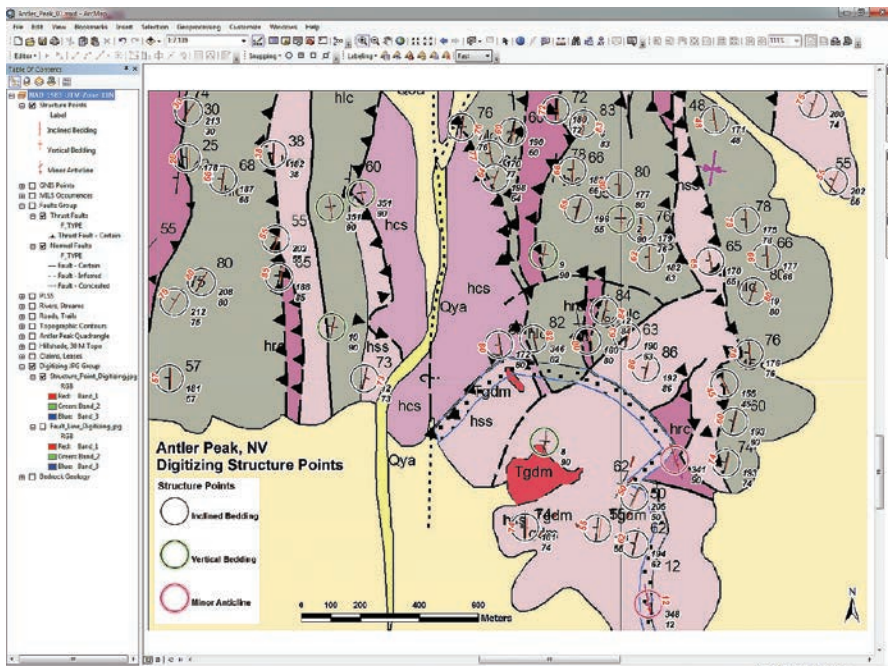
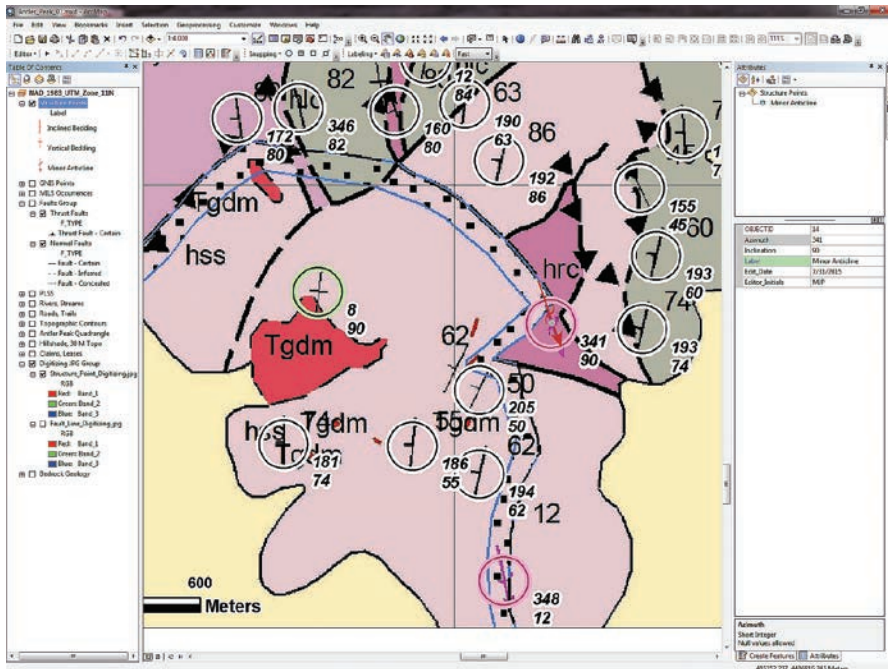
Loading a Structure Point Template

To expedite this lesson, a Layer file template for the structure points was included in the sample dataset.

1. Navigate to `\Antler_Peak\GDBFiles\UTM83Z11` and add the Structure Points.lyr. If the link to the data source is broken, relink it to the GeoPoints feature class in `Antler_Peak.gdb`.
2. In the TOC, open Structure Points properties and click the Symbology tab to study its symbology. The three symbols used match US Geological Survey standards for 24,000-scale geologic mapping and are part of the Esri Geology 24K Style set. Structure Points.lyr already assigned point symbols with preset rotations. Later in the tutorial, you will learn to quickly search for missing fault symbology.
3. Click the Advanced button, then select Rotation... to look at the symbols' rotational properties. Each digitized point will soon display its Dip value to allow data entry to be checked visually. Close the Layer Properties dialog box.
4. Right-click Structure Points.lyr, open its attribute table, and confirm that it is empty. Notice the fields include Azimuth, Inclination, Label, Edit_Date, and Editor_Initials. These fields will be populated as the points are digitized. Close the table and save the map.

Editing the Template

1. This is a good time to open the Editing, Snapping, and Labeling toolbars, so choose `Customize > Toolbars` to open them.
2. To begin editing, right-click Structure Points.lyr in the TOC and choose `Edit Features > Start Editing`.
3. Click the Editing toolbar drop-down and choose `Editing Windows > Create Features`. Dock this pane on the right side of ArcMap.
4. You should see a prebuilt Structure Points template. In the template, right-click Inclined Bedding and choose Properties.
5. Notice that Label is already filled in. Click the blank line next to Edit_Date and select today's date from the calendar. Make sure you update this field to the current date every time this template is edited. Type your initials in Editor_Initials. Click Apply, then OK.



↑↑ Hover your cursor over the most southern of the two magenta arrow symbols inside the magenta circles, click in the center of the circle, and drop the first point.

↑ Input stacked numbers southeast of each point as values for Azimuth and Inclination.

strike north to south, often dipping steeply toward their western source.

Unless the fault has been completely overturned, the triangular symbols on the thrust faults always point in the direction that the rocks came from. Strike and dip symbols show the alignment of tilted beds in the earth's broadly curved plane. The short perpendicular barb shows the

direction of dip perpendicular to strike. The large black numbers show the posted angle of dip, measured from the horizon. The smaller stacked number pair, located southeast of each point, lists the strike azimuth and inclination (or dip) angle. These pairs will be entered as values for Azimuth and Inclination when digitizing the 50 circled symbols included in this training set.

- Repeat this process for Vertical Bedding and Minor Anticline. Since Inclination for Vertical Bedding is always 90, you may enter it too. Save the map to preserve these updates before digitizing.

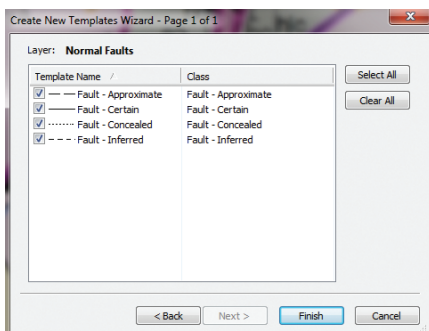
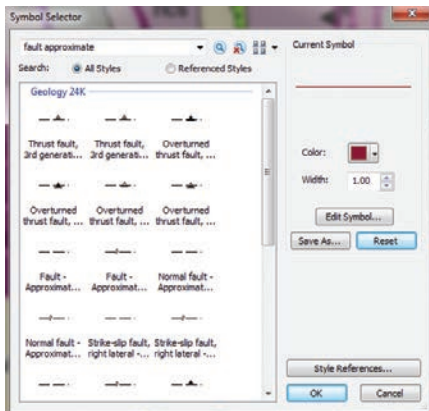
Digitizing Points

To digitize two Minor Anticline points, zoom to the southeast corner of the extent and find two magenta arrow symbols inside two magenta circles. Set the data frame reference scale to 1:16,000.

- In the Create Features window, select Minor Anticline. Under Construction Tools, choose Point. Hover your cursor over the map and watch for the downward pointing symbol.
- Click in the center of the most southern magenta circle to drop the first point. On the Editor toolbar, click the Attributes tool.
- Locate the stacked numbers immediately southeast of the magenta target

↓ Click the Change Symbol button and type fault approximate in the Search window, searching All Styles.

↓↓ In the Create New Template wizard, select Normal Faults and click Next. Select all types and click Finish, then Close. There should be four fault types, including Fault—Approximate.



circle and type the upper number in the Azimuth field and the lower number in the Inclination field. Hit Enter and watch the symbol rotate. The Inclination label will also appear.

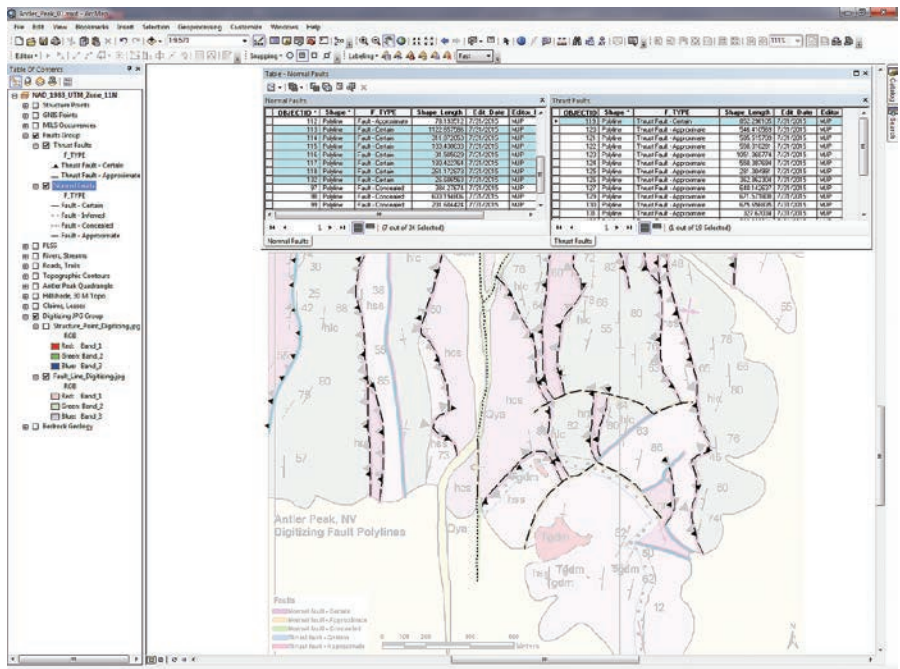
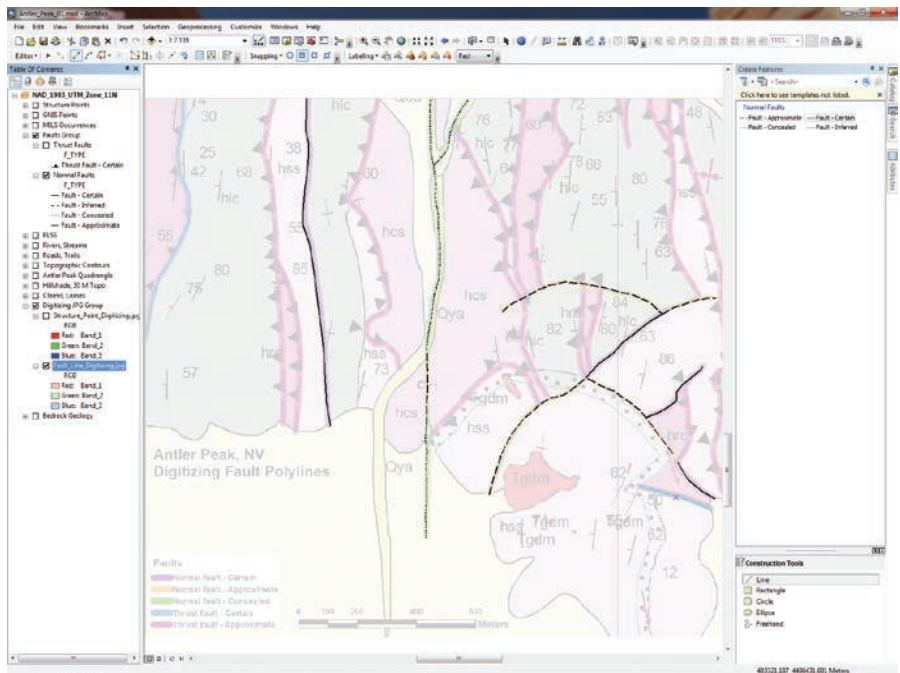
- Repeat the process for the other Minor Anticline point shown inside a magenta circle. Because the Inclination for this point is 90, the label does not appear because vertical dip values are not displayed. Save your edits.
- Close the Minor Anticline template and select Vertical Bedding and the Point construction tool.
- Locate a green circle and click inside it. An inclined bedding symbol has replaced your regular mouse cursor. Use the graphic underneath as a guide to determine where to click and place the symbol.
- In the Attributes window, enter the appropriate azimuth and check the symbol. Pan or zoom around the map, looking for other green circles. Drop points inside each one and enter the appropriate azimuth. (Hint: Hit the Tab key to assign the last field entry.)
- Save the map to save these edits.
- There are 42 Inclined Bedding points. You do not have to enter all of them, but do enough of them to get a feeling for the method. Pan/Zoom to an area with multiple black circles. Select Inclined Bedding, then Point, and click inside any black circle.
- Enter azimuth and inclination values and check that the inclination angle shown in red is correct.
- After editing several points, you will find the sweet spot to drop each new point.
- If you do not like a point's location, rotation, or label, you can edit the point and its attributes or delete it and start over.

Use the stacked numbers to the southeast of each point to enter Azimuth and Inclination. In the real world, you might enter these values directly from your field notes after you place each point. Remember that when looking in the strike direction, the dip direction is always to the right of the strike bar. If the dip appears to be in the wrong direction, add/subtract 180 to/from the azimuth value.

If an Inclination label obscures a new point, you can temporarily turn labels off or change the reference scale. When you have digitized most or all points, save the edits

The Antler Orogeny

More than 300 million years ago, continental tectonics pushed large blocks of the earth's crust eastward across today's Basin and Range [a *physiographic region of the western and southwestern part of the United States that includes portions of California, Arizona, Mexico, and nearly all of Nevada*]. Western rocks were thrust over eastern formations, creating complex geologic relationships. Structural and mineral geologists have mapped the surface trace of many of these overlaps. The two images that are part of the sample dataset—[Fault_Line_Digitizing.jpg](#) and [Structure_Point_Digitizing.jpg](#)—were scanned from a paper copy of a small part of the Antler Peak 1:24,000-scale geologic map.



↑↑ Start digitizing Faults—Certain in the south project area and digitize the single green line. If you come to any highlighted fault junction, finish the current sketch and start a new one.

↑ Remember that thrust fault symbology includes a directional component. Digitize all thrust faults, snapping to previous endpoints wherever possible.

and stop editing. Open the Structure Points attribute table to see the values that have been added. Save the map.

Adding a New Fault Type

The next step will be to digitize five faults: three normal faults and two thrust faults. Fault types are color coded, as shown in

the JPG legend. Since there are only a few normal faults, start with them.

1. In the TOC, turn off Structure_Points_Digitizing.jpg and turn on Fault_Line_Digitizing.jpg. Zoom to the Digitizing JPG Group.
2. Make Faults Group and its Normal Faults layer visible. Notice that the

Normal Faults legend does not include a Fault—Approximate type.

3. To add “Fault—Approximate” type, right-click Normal Faults and select Edit Features > Define New Types of Features.
4. In the Define New Feature Type window, type “Fault—Approximate” in the Name and Description windows. Click the Change Symbol button and type “Fault—Approximate” in the Search window, searching All Styles.
5. Scroll through the results and select the first Normal Fault—Approximate located. Click OK and Next to continue. When prompted, enter today’s date and your initials in the appropriate fields. Click Finish to add the new type. Do not define additional feature types. Confirm that the new type appears in the Normal Faults legend.
6. Right-click Normal Faults and select Edit Features > Start Editing. Reopen the Create Features window if needed. Notice that Normal Faults has an editing template with only one member. Delete it.
7. At the top of the Create Features window, locate and click the Organize Templates button. In the Organize Feature Templates window, highlight Normal Faults and select New Template.
8. In the Create New Template wizard, select Normal Faults and click Next. Select all types and click Finish, then Close.
9. There should be four fault types, including Fault—Approximate. Open Properties for each type and enter today’s date and your initials. Save the map.

Updating Normal Faults

Before digitizing, set the snapping parameters. In the Snapping toolbar, select only End Snapping. Select Fault—Certain type, followed by Point.

1. Start in the south project area and digitize a single green line. Zoom and pan. If you come to any highlighted fault junction, finish the current sketch and start a new one. Continue until you digitize all Fault—Certain lines.
2. If a new fault shares an endpoint with a previous segment, snap to the existing feature’s endpoint. Since there is no directional information on normal fault movement, digitizing direction is not critical, although it might be modified later. However, remember that the symbology for thrust faults is directional!

- Next, digitize all Fault—Approximate (orange) lines and all Fault—Certain (purple) lines. Remember to finish each segment at junctions with Normal and Thrust Faults.
- When you have finished digitizing all normal faults, zoom to the extent and increase the transparency of Fault_Line_Digitizing.jpg. Check the accuracy and symbology of all normal faults. If lines are not as detailed as you want, you may edit them interactively. Be sure to make normal faults selectable.
- When finished, save your edits and the map.

Digitizing Thrust Faults

- Now to digitize thrust faults. In the TOC, make the thrust fault layers visible along with normal faults (that will be used for snapping).
- The Thrust Fault—Approximate type must be added first. Right-click Thrust Faults, select Properties, and open the Symbology tab. Click the Add Values button and type “Thrust Fault—Approximate” in the New Value window. Click Add to List and OK.
- Type “Thrust Fault—Approximate” in the Label field and click the new Symbol patch. In the Symbol Selector, search for thrust fault approximate and select Thrust fault, First generation—Approximately located.
- The next step is to complete the Thrust Fault feature template and begin digitizing. In the TOC, right-click Thrust Faults and select Edit Features > Start Editing.
- Reopen the Create Features window if necessary and make sure it contains the Thrust Faults template. Update the Edit_Date and Editor_Initials field in the template for Thrust Fault—Approximate and Thrust Fault—Certain. If the template is incomplete or missing sections, delete it and create a new template using the same steps used to create the Fault—Approximate template.
- Remember from the previous exercise in the summer 2015 issue of *ArcUser* that thrust fault symbology includes a directional component. Because these rocks moved from the west, the triangles should be pointing toward California. Matching the map, digitize all Thrust Faults—Certain and Thrust Faults—Approximate

in that direction, placing JPG triangles on the left side of the line.

- Continue digitizing all thrust faults, snapping to previous endpoints whenever possible. If you forgot to split an earlier line, you are still editing all faults, so you may split (or join) them as needed.
- When you are finished, save edits and review your work. Make Fault_Line_Digitizing.jpg partially transparent to guide your visual inspection. Open both fault tables and confirm that attributes are properly filled.
- Save the map one final time. The exercise is done.

Summary

Was this quite a task, or was it really not that difficult? Did you find that as you practiced and experimented with templates that snapping, editing tables, changing scale, adjusting labels, and heads-up digitizing became easier? Consistently updating the editing date and editor's initials is an invaluable practice.

Acknowledgments

Thanks to the Battle Mountain data providers and my earth sciences followers. Special thanks to my editor who *still* keeps me heading in the right direction. Happy editing.

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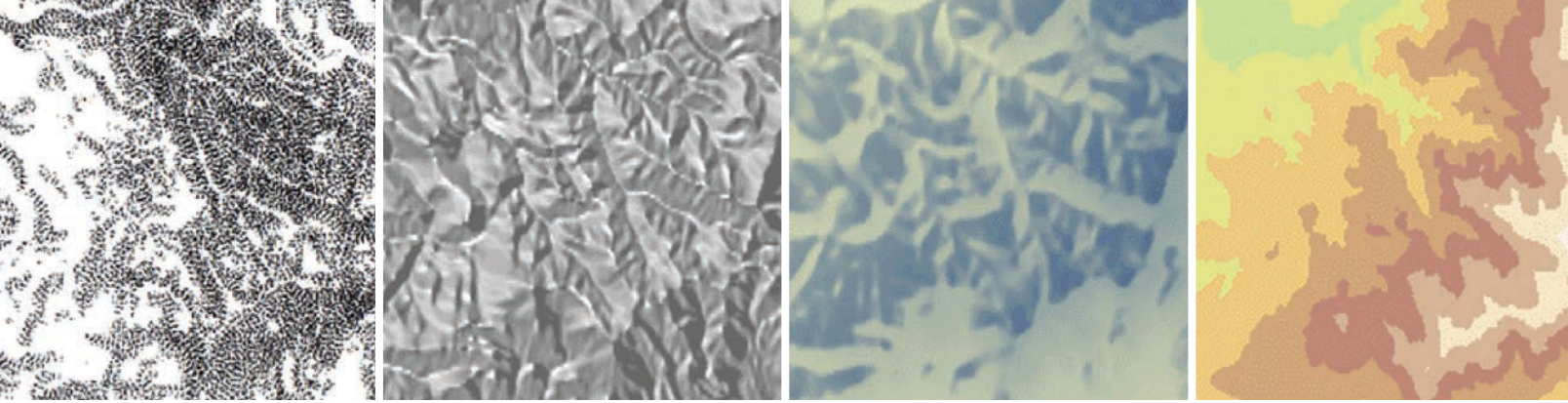
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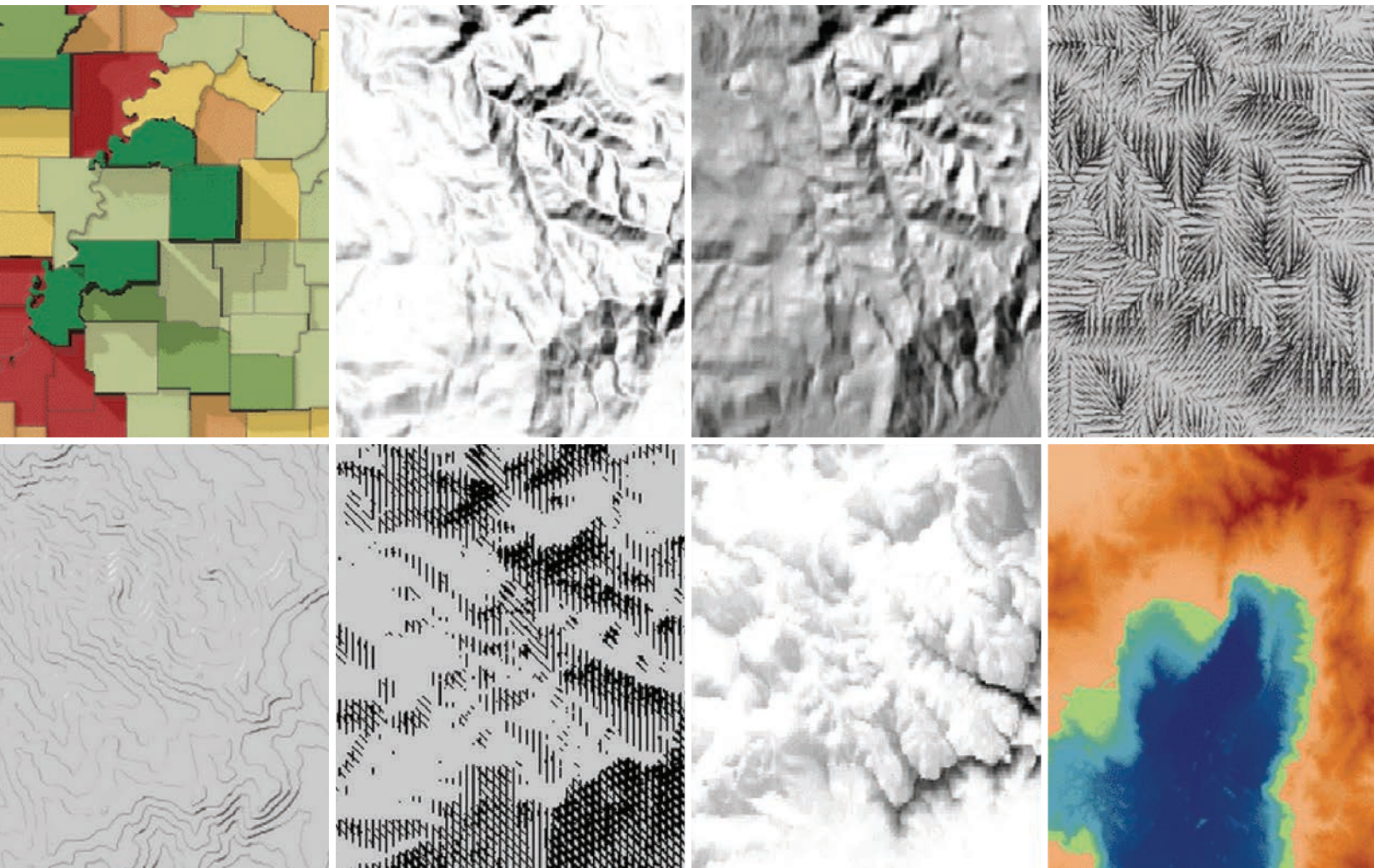


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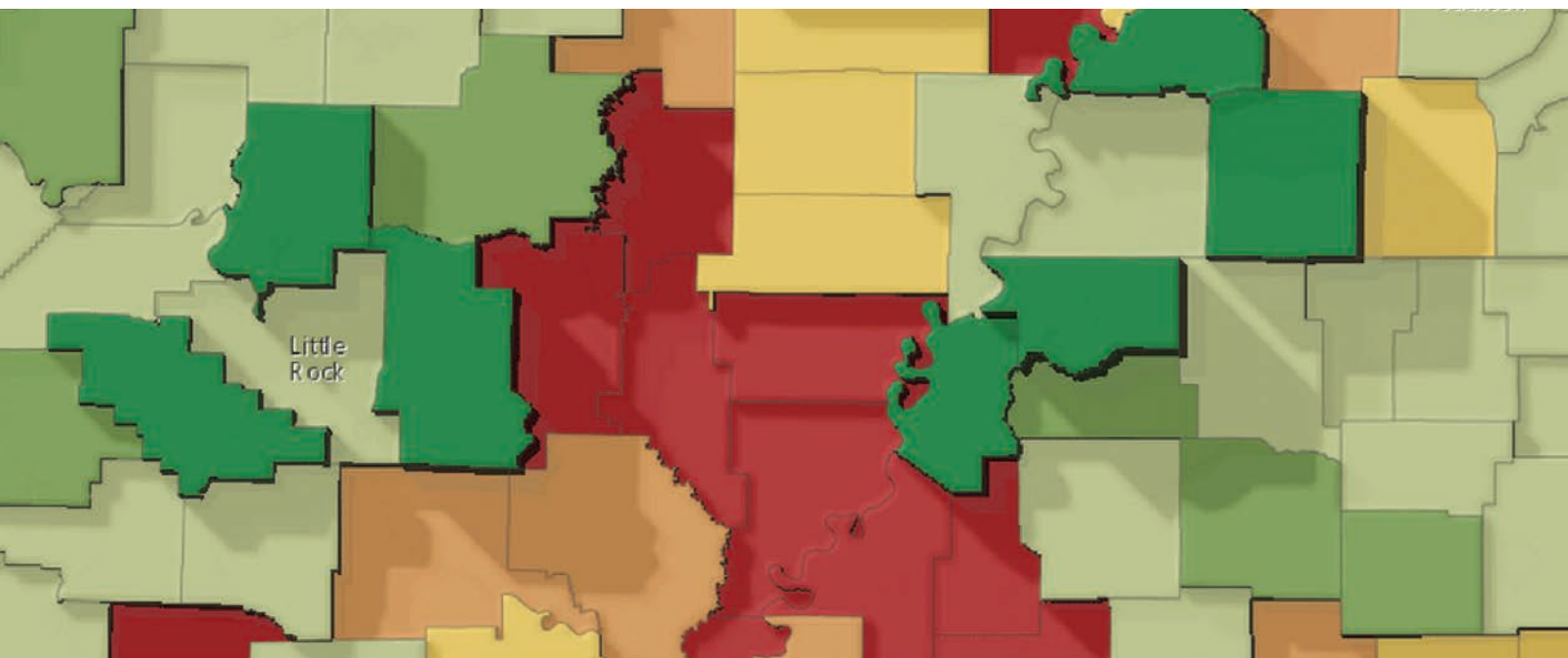


TAKE YOUR TERRAIN MAPPING TO NEW HEIGHTS

By Kenneth Field, Senior Cartographic Product Engineer



↓ The 3D Choropleth tool adds depth to a choropleth map by encoding a second piece of information or as a way of showing variation within a single class interval.



Standard techniques for representing terrain, like a hillshade, are adequate for many applications, but you may want to represent terrain under different lighting conditions or perhaps use more artistic techniques. In these cases, you might need to go a little further than creating a simple hillshade. For this reason (and because we like making tools that extend what we can do!), Esri built a new toolbox called Terrain Tools that helps you take your terrain mapping to new heights.

Cartographic research often develops techniques, models, and tools that supplement or extend what you find in software out of the box. They are often difficult to find, may be hidden in journal articles, or are cumbersome to implement.

We've brought together some of these ideas and workflows in the Terrain Tools toolbox, which provides capabilities for creating alternative terrain representations in both ArcMap and ArcGIS Pro. Terrain Tools encourage you to be more creative by extending your out-of-the-box toolkit for representing terrain in GIS. They will help you think more critically about design choices and how to go beyond the defaults.

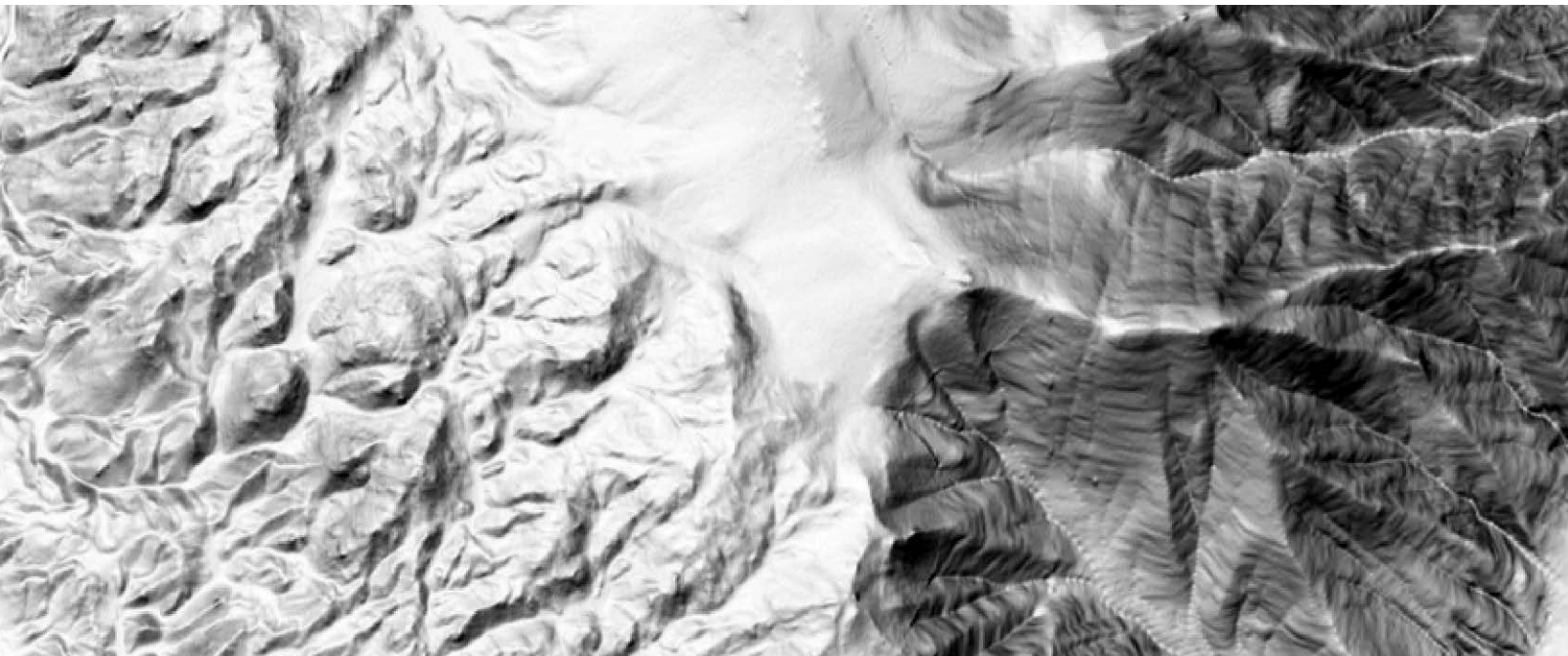
You can download Terrain Tools Sample, a ZIP file that contains the toolbox, sample data, documentation, an ArcMap map document, and an ArcGIS Pro project from ArcGIS Online. The map document and ArcGIS Pro project also include results layers so you can see how the tools work before you use them on your own data.

It's important to note that the sample results use the default output. They are a starting point. Many of the tools give you the flexibility to modify parameters and customize your own output. The documentation is in workshop format that includes a discussion of each tool and instructions for use. Because the tools are written in Python, they can be viewed, modified, and used as a starting point for further development.

The Terrain Tools Sample incorporates a few previously available tools originally built as models using ModelBuilder that have been rewritten and optimized as Python scripts, which improves their stability and processing speed. In addition, new tools have been either written from the original published algorithms or optimized as Python scripts from code samples.

One of the highlights of Terrain Tools is the new Cluster Hillshade, which provides you with the ability to make spectacularly detailed and artistic hillshades with your

↓ Cluster Hillshade produces spectacularly detailed and artistic hillshades.



Multi-Directional Oblique Weighted (MDOW) Hillshade	Produces a hillshade that emphasizes oblique illumination on all surfaces by using more than one illumination azimuth
Swiss Hillshade	Builds and then combines several hillshades resulting in a yellow-blue Swiss hillshade effect
Cluster Hillshades	A suite of three tools that uses k-means clustering to create a seamless change of local lighting conditions throughout the generation of a hillshade to produce stunning results
Sky Models	Builds multiple hillshades with varying azimuth, zenith, and intensity of light source and combines them in a weighted output to create hillshades under different lighting conditions with some dramatic effects
Historic Dots	Creates and symbolizes contours using a historic dotted line symbol and modifies the overall appearance by removing contours for low slope angles
Filled Contours	Creates and symbolizes nested polygons such that the boundary lines demarcate areas of equal elevation value
Illuminated Contours	An analytical version of the Tanaka method of symbolizing contours that includes coloring and varying the thickness of illuminated and nonilluminated contour lines
Hachures	Creates an output that illustrates three-dimensional topography on a two-dimensional map using hachures that symbolize slope and aspect
Shadow Lines	An artistic drawing method in which lines of variable thickness and orientation approximate tonal variations associated with shading and shadowing
Chromastereoscopic Tinting	A technique that encodes depth values by color and which, when viewed through glasses that contain minute prisms, gives a holographic 3D view of the data (Glasses are not included.)
3D Choropleth	Breathes life into the choropleth mapping technique by building multiple hillshades that emphasize differences across the statistical surface

↑ Table 1: Tools in the Terrain Tools Sample

↓ The results of applying the Illuminated Contours and Filled Contours tools, which both use the Tanaka method.



own data. This is just about as close as you can get with an automated process to classic hand-drawn hillshading—and all from just a digital elevation model (DEM) input and a mouse click. One tool lets you use the Tanaka method for creating illuminated contours and filled contours.

Thematic maps haven't been ignored. It's perfectly possible to run the tools for any input raster (e.g., a statistical surface rather than a DEM), but there's also a specific 3D Choropleth tool that is useful for adding depth to a choropleth map by encoding a second piece of information or as a way to see variation within a single class interval.

There are plenty of tools to explore. The scripts are entirely open to being customized further. Table 1 lists what is included in the Terrain Tools sample.

We're indebted to a number of key researchers who assisted in the development of these tools. You'll find references and links to their original work in the

documentation and the tool help.

Get the Terrain Tools Sample 1.0 beta from ArcGIS Online. Enjoy using these tools whether you're looking for a more advanced hillshade or something a little more artistic. Use them as a starting point for inspiration and share your efforts!

About the Author

Dr. Kenneth Field is a self-confessed cartonerd. After 20 years in academia, he now works at Esri in cartographic research and development for the mapping systems team. He writes, teaches, and blogs about map design; is editor of *The Cartographic Journal*, and is on the advisory board of the *International Journal of Cartography*. He is the chairperson of the ICA Map Design Commission, a fellow of both the British Cartographic Society and Royal Geographic Society, and a Chartered Geographer (GIS). You can follow him on Twitter @kennethfield or check his blog.



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ALWAYS & NEVER

When Formatting Excel Tables

By Aileen Buckley and Veronica Rojas, Esri

Microsoft Excel tables are a highly useful data source for ArcGIS. In addition to adding them to ArcMap, previewing them in ArcCatalog, and using them as inputs to geoprocessing tools, you can use the Excel To Table tool in the Conversion toolbox in ArcToolbox (available at all license levels) to convert an Excel table to a geodatabase attribute table. This article describes the things you should always do and the things you should never do when formatting Excel tables for use with the Excel To Table tool.

Understanding Excel and ArcGIS Tables

Here is a quick review of the relationship between Excel tables and ArcGIS attribute tables. A row in an Excel table is a record in an ArcGIS attribute table. All rows in an Excel table have the same columns. A column in an Excel table is a field in ArcGIS.

Fields in an ArcGIS attribute table can store spatial information (i.e., area, length) and nonspatial data (e.g., address, owner) about features. Each row in an ArcGIS attribute table represents the record for one feature. Field names in an ArcGIS table created from an Excel table are derived from the first row in each column of the Excel table. Excel tables are read-only in ArcGIS. If you have an Excel workbook open when you are in ArcGIS, the Excel table is also read-only.

Which version of Excel you use matters. ArcGIS supports several Excel versions: .xls files (Excel 2003 and earlier) and .xlsx files (Excel 2007). The advantage of using Excel 2007 is that it allows much larger worksheets (1,048,576 rows by 16,384 columns) than Excel 2003 (65,536 rows by 256 columns).

If you want to use an .xlsx file but do not have Excel 2007, you will need to install the 2007 Office System Driver. It can be downloaded from the Microsoft Download Center. If you are using Excel 2010, you will have to install the 2007 Office System Driver whether you are working with .xls or .xlsx files.

THINGS YOU SHOULD ALWAYS DO

You can avoid problems by making sure column names and cell formatting in Excel adhere to these guidelines so they will convert correctly. The best strategy is to make changes in Excel before using the Excel To Table tool to convert the table.

Always create unique column names.

Because ArcGIS requires unique field names, no two column names in an Excel table should be the same. If a table with duplicate column names is converted, the resultant field names will be truncated to

10 characters and a version number added (e.g., two fields called Street_Name become Street_Name and Street_Name1). Always rename duplicate columns before conversion.

Always start column names with a letter.

If you start a column name with something other than a letter, ArcGIS will add the letter F in front of the nonalpha character. For example, 2Name becomes F2Name. Avoid this problem by ensuring all column names begin with a letter. If you converted an Excel table with a leading nonalpha character, in ArcGIS change the field names with the Alter Field geoprocessing tool or right-click the table in ArcCatalog, click Properties, click the Fields tab, and type a new field name that starts with a letter.

Ensure that all columns and rows contain values.

Upon conversion, any empty column will be created as a field with a generic name (e.g., field_1) that contains no values. Any empty row will be created with no values. This takes up storage unnecessarily and requires more display area to view the contents of the table. In Excel, delete all empty columns and rows. If you have already converted a table with empty columns, use the Delete Field geoprocessing tool in the Data Management toolbox or open the attribute table in ArcMap, right-click the field heading for the empty column, and click Delete Field. If you have already converted a table with empty rows, delete empty rows with the Delete Rows geoprocessing tool in the Data Management toolbox or open the attribute table in ArcMap, start an editing session, right-click the table, click Open Attribute Table, highlight the empty rows, right-click the far-left box, and click Delete Selected.

Use basic cell formatting in Excel.

Cells in columns should be formatted as text, number, or date in Excel. The cell formatting in a column is used by ArcGIS to set the field type. If no formatting has been specified in Excel (i.e., the default General is used), the field type in ArcGIS is determined by a scan of the values in the first eight rows for that column. If the scan finds mixed data types in those rows, ArcGIS will assign the field type as Text and any values will be converted to strings. Number field types in Excel are converted to Long Integer field types in ArcGIS. Year and Time field types in Excel are converted to the Date field type in ArcGIS. Avoid problems by setting the field types for the columns to Text, Number, or Date in Excel by right-clicking the column, choosing Format Cells,



clicking the Number tab, and setting the field type. If you have already converted an Excel table and you are not sure of the formatting, right-click the table in ArcCatalog, click Properties, click the Fields tab, and check the field type. If it is not the desired field type, add a field of the desired type, use the field calculator to copy the values from the original field to the new field, and delete the field that was converted that contained the incorrect format.

THINGS YOU SHOULD NEVER DO

Just as there are things you should always do, there are things you should never do when formatting Excel tables for use with the Excel To Table tool.

Never use special characters in column names.

Field names should contain only letters, numbers, and underscores—no special characters (e.g., #, !, \$). If you use a column name with a special character, ArcGIS will replace the special characters with an underscore. Avoid this problem by renaming columns before conversion so they contain only letters, numbers, and underscores. If you converted an Excel table with special characters in column names, change field names with the Alter Field geoprocessing tool or right-click the table in ArcCatalog, click Properties, and click the Fields tab. Type a new field name that contains only letters, numbers, and underscores.

Never include spaces in column names.

ArcGIS will replace spaces in column names with underscores. If you converted an Excel table containing column names with spaces, use the Alter Field geoprocessing tool in the Data Management toolbox or right-click the table in ArcCatalog, click Properties, click the Fields tab, and type a new field name without underscores.

Don't use excessively long column names.

Excessively long means column names longer than 64 characters for file geodatabases, 31 characters for Microsoft SQL Server and SQLExpress databases, 30 characters for Oracle and DB2 databases, and 10 characters for dBase databases. Column names longer than the limit for a specific database will be truncated to the maximum length allowed. Rename fields in Excel so they do not exceed the character limit. After conversion, right-click the table in ArcCatalog, click Properties, click the Fields tab, and assign a new field alias for the truncated field.

Never use reserved words in column names.

Do not use ArcGIS reserved words as column names. In particular, do not create column names that use the ArcGIS reserved words ObjectID, OID, FID, Shape_Length, and Shape_Area. Fields with these names are managed by ArcGIS. If you convert an Excel table containing columns with these names, ArcGIS will create fields FID, Shape_Length, Shape_Area and rename the Excel fields with the same names with an underscore and number. For example, ObjectID would become ObjectID_1. If Values or Order are used as column names, those names will be used as field names with a trailing underscore. In some cases, using a reserved word as a column name will cause the field name to be unreadable after conversion and table contents will not be displayed. Using tables containing field names with reserved words may generate error messages when performing tasks such as joins and relates. Before conversion, rename fields so they do not contain ArcGIS reserved words.

Cells should never contain formulas.

Before conversion, replace cells with formulas with cells that have values by copying the cells and pasting them back into their original location using Paste Special > Values. If you converted an Excel table containing cells with formulas, add a field of the desired type, use the field calculator to calculate values for that field equal to the values generated by the formula in those cells and delete the original field containing the formula.

Never use cell values with more than 255 characters.

Only the first 255 characters of a cell are read by ArcGIS. If there are more than 255 characters, the field will be converted to the BLOB type by ArcGIS and the cell value will become <NULL>. You cannot read the contents of a BLOB field. Before conversion, edit the cells so they have no more than 255 characters.

For More Information

For more information on using Excel tables with ArcGIS, visit the ArcGIS Resources website (resources.arcgis.com) and search on the following topics:

- Understanding how to use Microsoft Excel files in ArcGIS
- Formatting a table in Microsoft Excel for use in ArcGIS
- Excel To Table Tool
- Defining fields in tables
- What are the reserved words for Esri's file geodatabase?

Label Like a Pro with ArcGIS Pro

ArcGIS Pro brings labeling tools front and center in the interface. Instead of burrowing through a series of dialog boxes, the Labeling tab on the ArcGIS Pro ribbon lets you immediately change basic type, placement, and scale settings for labels.

Labels are automatically positioned pieces of text that are based on feature attributes. Annotation and graphic text are the other kinds of text you can place on a map. However, labels are the fastest and easiest way to add descriptive text for individual features to a map.

Quickly Style Labels

The Labeling tab on the ArcGIS Pro ribbon gives you direct access to the most commonly used tools for styling labels. Select a feature layer and the Labeling tab becomes active and lets you turn labeling off or select a field for labeling. You can also change font type, size, color, and weight. The font selection drop-down provides an example of each typeface of each font available.

As you set these parameters, ArcGIS Pro immediately updates the display. If you want to suspend label drawing on the map, the Pause button is available.

Choose the scale range at which labels will be visible. The Labeling tab allows you to change the visibility range of labels. You can also view unplaced labels. The Labeling tab lets you access and modify all labels.

By default, ArcGIS Pro uses the Maplex

Labeling Engine with its sophisticated label placement capabilities. However, you can switch to the standard labeling engine if you like. Basic label placement choices are also available from the ribbon.

The ribbon provides direct access to text symbol styles. These are smart defaults for font, size, color, and style that incorporate cartographic conventions for labeling types of features.

Even More Control with the Label Class Pane

Using the basic tools provided on the Labeling tab may be all you need or you can use them to take a first cut at labeling to determine if and where there are positioning issues or conflicts.

If the map is more complex, Label classes will help you resolve conflicts and establish a hierarchy systematically. Label classes restrict labels to certain features or specify the attribute fields used for labels, symbols, scale ranges, label priorities, and placement options for a group of labels. For example, you could use a label class to query out a subset of cities with populations over 100,000 and label only those cities using a

specific font and font style with a text size and color.

You work with label classes using the Label Class pane. Access it by expanding the Text Symbol or Label Placement sections on the Labeling tab or clicking the SQL or Expression buttons in the Label Class pane. The pane has three sections: Class, Symbol, and Position.

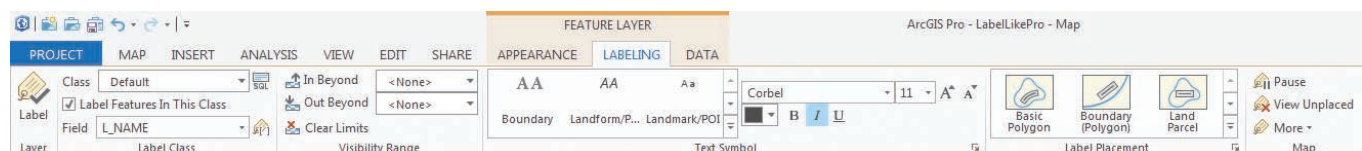
In the Class Section

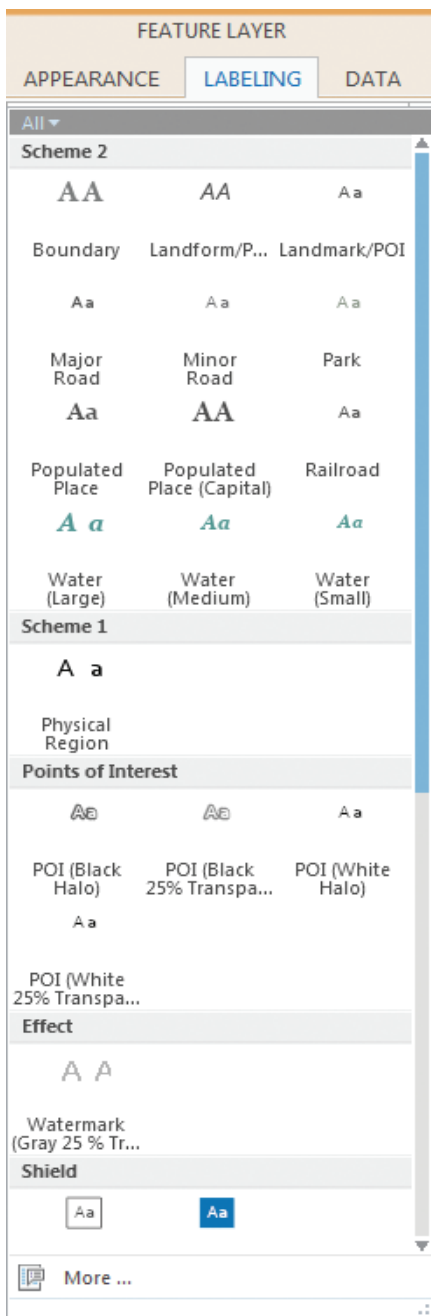
Under the Class section, you have options for filtering the attributes to be displayed by applying a SQL query or creating an expression using Python, VBScript, or JScript so you can create labels that combine text from two fields or insert text you provide.

In the Symbol Section

Under the Symbol section, choices under the General icon include font, size, and style. You can also use the Text Fill Symbol setting so text will be treated as enclosed polygons that can have fills and strokes. Settings for alignment and offsets, as well as rotation, are available. Halos are supported with additional options for masking underlying features (especially when

↓ All the basic tools and controls for labeling are available directly from the ribbon on the Labeling tab.





In the Position Section

Choices available from this section let you exploit the fine control of label placement provided by the Maplex Labeling Engine. Click the Fitting Strategy icon to set preferences for stacking, font size reduction, abbreviations, and key numbers and to choose the strategy used for applying these tools. Handling duplicate and unplaced labels, setting buffers, applying feature weights, and the placement of background labels are set using choices under the Conflict Resolution icon.

And There's More

Go to the Map section of the ribbon. Click More to access additional tools for setting label priorities and weights, as well as

Abbreviation Dictionaries available from the drop-down.

Abbreviation Dictionaries let you tell the Maplex Labeling Engine how you would like to abbreviate text when it needs to shorten long labels to fit within small spaces. Abbreviations are applied to individual label classes and are used on freestanding words or groups of words, not parts of words (except for certain non-English words). Labels containing text formatting tags are not abbreviated.

This overview of the highly available and extensive labeling controls in ArcGIS Pro is a starting point for further exploration of the high-end capabilities now available for producing maps with superior typography and design.

← Use text symbol styles, which provide font, size, color, and style choices for labeling types of features that incorporate cartographic conventions.

↓ Halos are supported and have additional options for masking underlying features including adjusting the width of the halo and using a gradient fill, thin outline, or any color in the palette for the halo.

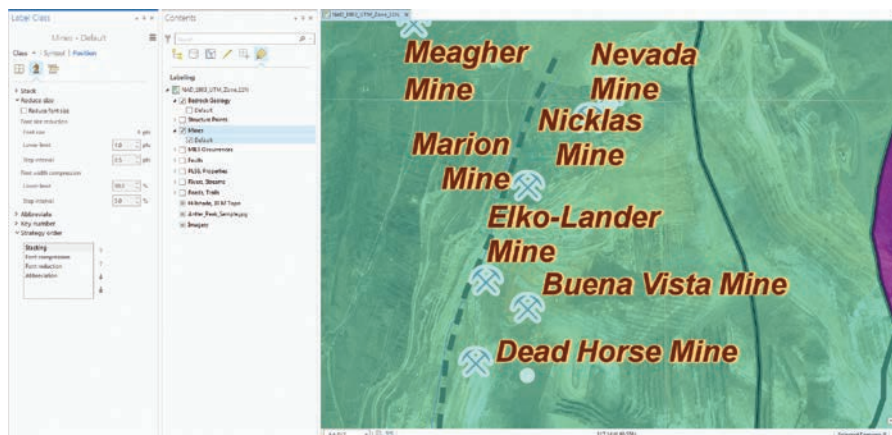
↕ Choices available from this section let you exploit the fine control of label placement provided by the Maplex Labeling Engine.



labeling imagery). These include using a gradient fill, thin gray outline, or any color from the palette for the halo. Callouts and shadows can be manipulated.

Click the Formatting icon, and you have control over the spacing of both words and letters and can adjust letter width, line spacing, ligature, and determine how glyphs are handled.

The same options are available when labeling 3D scenes, although by default labels will billboard and rotate automatically as the viewer moves through the scene.



Use Online Analysis Tools to Gain Location Insights

What you will need

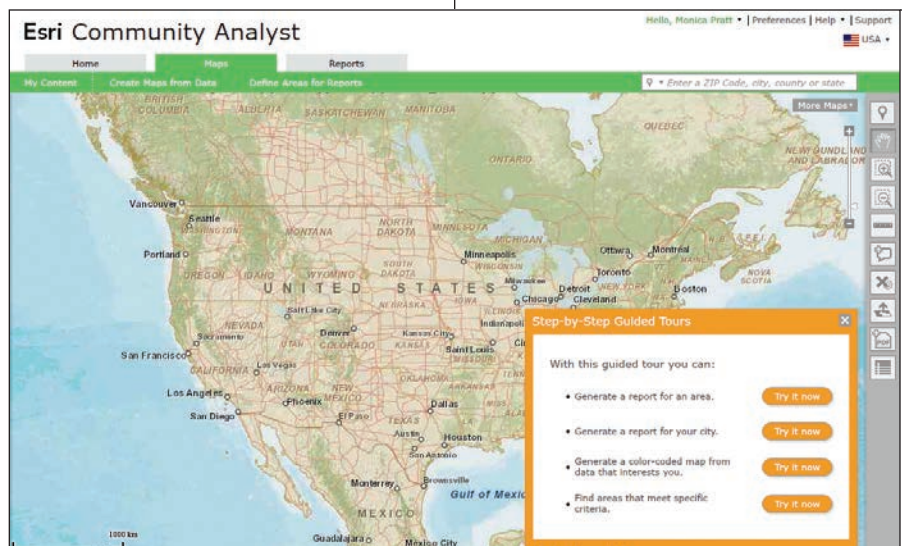
- Internet access and a browser
- Subscription or free trial for ArcGIS Online
- Subscription or free trial for Esri Community Analyst

These two step-by-step tutorials will show you how to compare consumer spending for three locations using two ArcGIS location analysis tools: Esri Community Analyst and ArcGIS Online.

Esri Community Analyst is a software-as-a-service (SaaS) mapping solution hosted by Esri that includes both GIS capabilities and access to thousands of constantly updated demographic, health, economic, education, and business data variables. (Read about how a tax agency in Kansas is using Community Analyst to verify its retail valuations in another article in this issue, “Verifying Valuation Rates Using Location Analytics: Data Enrichment for Better Retail Property Appraisals.”)

ArcGIS Online is a collaborative, cloud-based platform that allows members of an organization to use, create, and share maps, scenes, apps, and data and access authoritative basemaps, geospatial analysis tools, and ready-to-use apps.

Both exercises walk you through the process of generating a table that shows the estimated dollar amount that consumers located within a five-minute drive time of each of the three locations will spend on retail goods for the current year. The table will be saved to a file so that it can be used outside ArcGIS.



↑ Sign in to Esri Community Analyst and click the Maps tab.

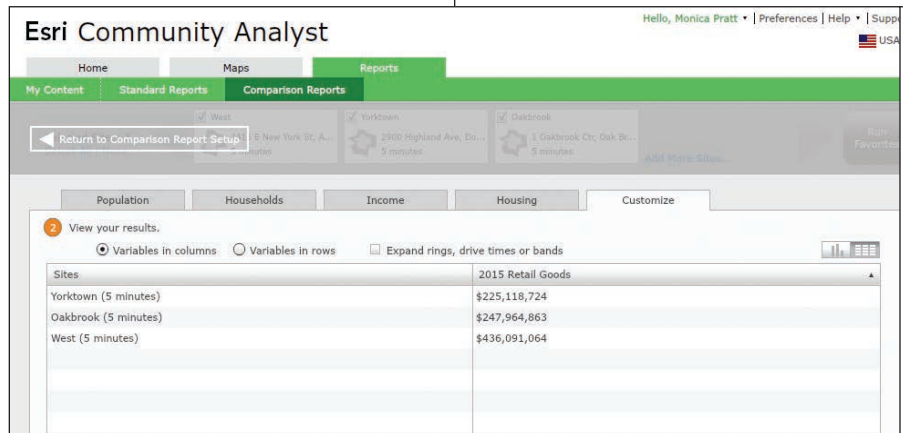
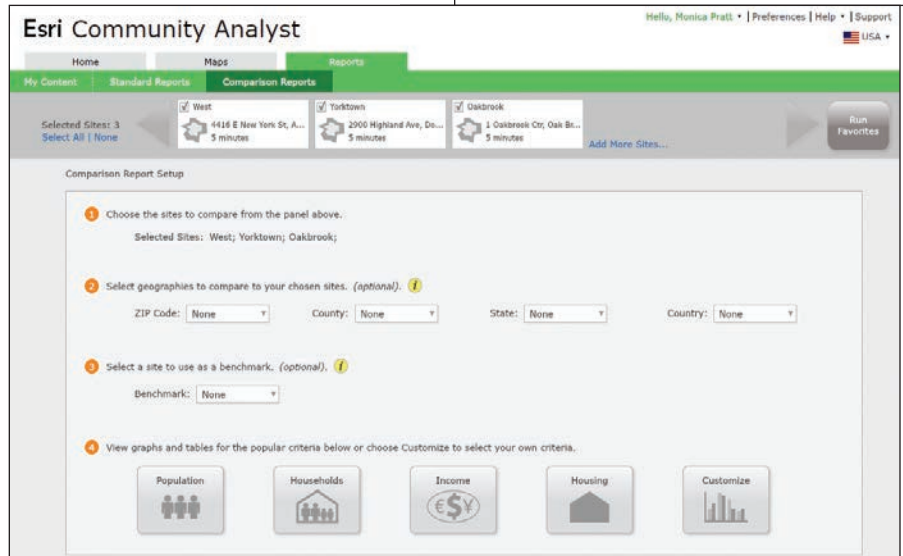
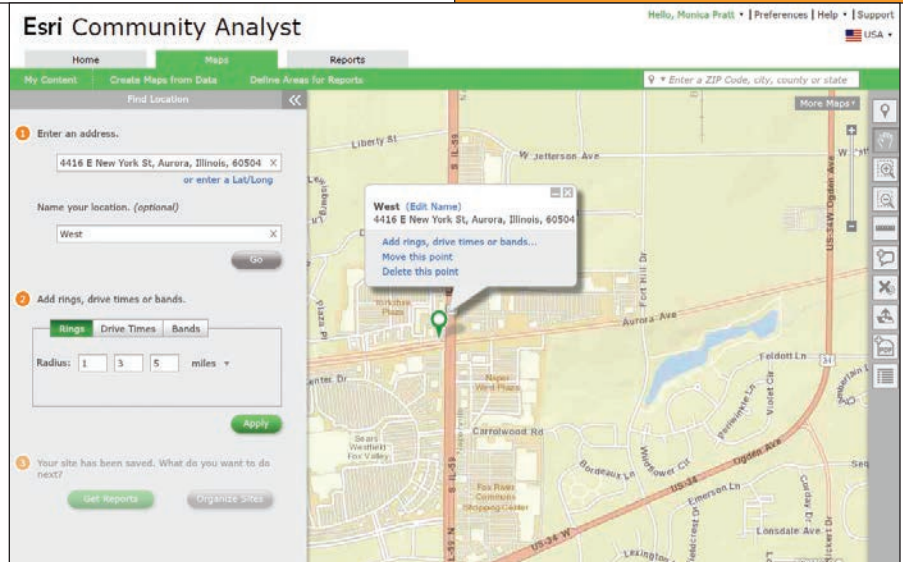
Tutorial 1: Using Esri Community Analyst

If you have a subscription, sign in to Community Analyst. If you do not have one, you must first have an ArcGIS Online subscription. If you have an ArcGIS Online subscription, sign in and obtain a free trial of Esri Community Analyst at esri.com/software/arcgis/community-analyst/free-trial. If you do not have an ArcGIS Online subscription,

get a free trial at esri.com/software/arcgis/arcgisonline/evaluate.

1. Click the Maps tab at the top of the screen and click Define Areas for Reports from the bar below the tab. There are four options. Choose Find Location.
2. On the Find Location pane, enter the address 4416 E New York St, Aurora,

- Illinois, 60504. Name the location West. Click Go.
- Repeat the previous steps to enter the address 2900 Highland Ave, Downers Grove, Illinois, 60515, with the name Yorktown and 1 Oakbrook Ctr, Oak Brook, Illinois, 60523, with the name Oakbrook.
 - Add a five-minute drive time around all three locations at the same time by click the Drive Times button and deleting the 10 and 15 from the second and third boxes. Keep the 5 in the first box and click Apply. On the Apply drive times dialog box that appears, verify that all three locations are checked and then click Apply.
 - Click the Get Reports button on the Find Location pane. On the Reports tab, click Comparison Reports. On the Comparison Report Setup step 1, make sure that the three sites you entered are listed. Only West, Yorktown, and Oakbrook should be checked.
 - Leave defaults for steps 2 and 3 but click the Customize button under step 4. On the Customize tab, click the Get Started button.
 - Explore some of the variable choices (e.g., Population, Health) by clicking the buttons on the Select Your Variables page. Clicking any button will take you to a second Select Your Variables page. When you are finished exploring, click the Categories icon to return to the original page.
 - In the Search for a variable name text box, type retail and click the Search icon. From the list that appears, choose 2015 (or current year) Total Expenditures and Retail Goods to expand it. Check the box next to 2015 Retail Goods.
 - Click the View Table button in the lower-right corner of the screen. On the table that appears, click the 2015 (or current year) Retail Goods column header to sort the results in ascending order.
 - Click Export to Excel and, when prompted, click OK to save the file to your computer.



↑↑↑ In the Find Location pane, enter the first address.

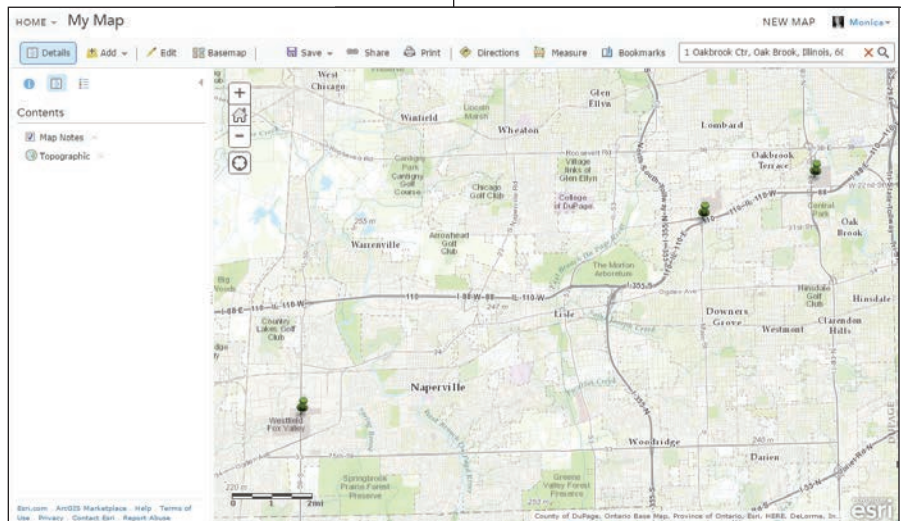
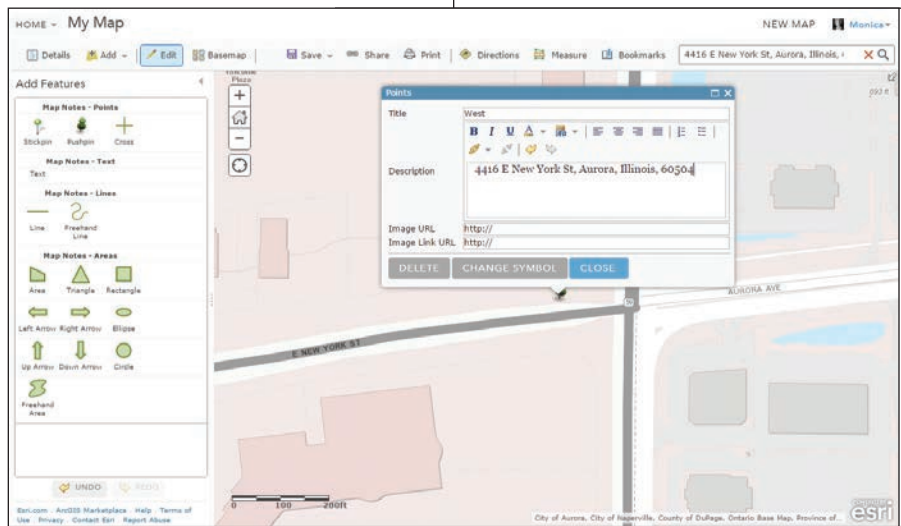
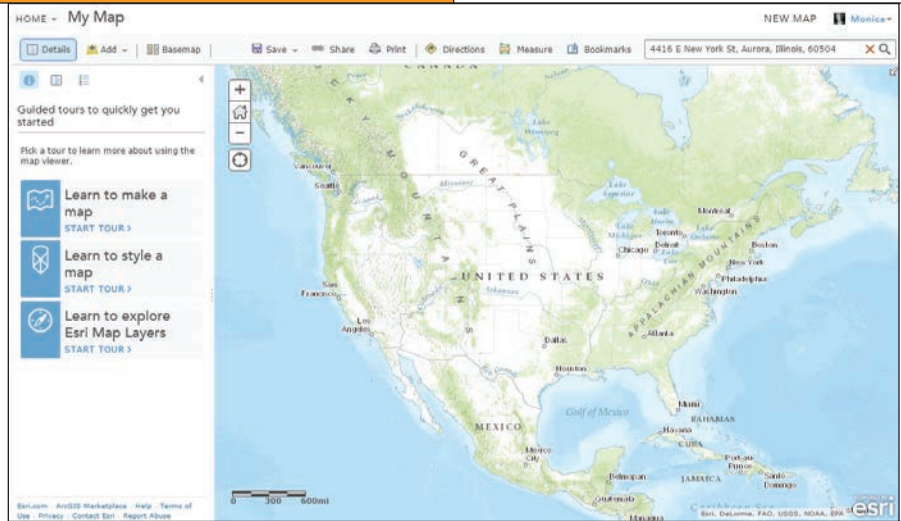
↑↑ On the Reports tab, click Comparison Report and make sure only West, Yorktown, and Oakbrook are checked.

↑ Click the View Table button in the lower right corner of the screen, and the table with the total expenditures and retail goods for drive-time areas around three locations appears.

Tutorial 2: Using ArcGIS Online

In this exercise, you will learn how to use the Enrich Layer tool in ArcGIS Online to rank commercial centers based on retail expenditures from the nearby population and generate a table showing annual estimates for retail goods spending in the five-minute drive time around three major commercial centers in Naperville, Illinois. You will save this table to a file so that it can be used outside ArcGIS Online.

1. Sign in to ArcGIS Online with a login that has either a publisher role or a custom role that has permissions to use the analysis tools in ArcGIS Online. Once signed in, click Map at the top of the page. On the Map Viewer page, click New Map at the top of the page to start a fresh map.
2. Type 4416 E New York St, Aurora, Illinois, 60504, into the search box and click the search icon. Click the Add button and in the drop-down, choose Add Map Notes.
3. Click the Create button to add a Map Notes layer to the map. Map Notes will be used to add point locations representing commercial districts. Click the pushpin icon on the Map Notes palette and then click E New York St to add the first location. Type West for the title, include 4416 E New York St, Aurora, Illinois, 60504, for Description, and close the pop-up.
4. Locate 2900 Highland Ave, Downers Grove, Illinois, 60515, using the search box; add a Map Notes layer; add a pushpin icon near the address and Yorktown as the title and the address as the description; and close the pop-up.
5. Use the same procedure to locate and add a pushpin to the Map Notes layer 1 Oakbrook Ctr, Oak Brook, Illinois, 60523. Use Oakbrook as the pop-up title.
6. At the top of the map, click the Details button, then the Content button, to see the layers in the map. Click the drop-down arrow next to Map Notes and choose Zoom to see all three locations.
7. Click the drop-down arrow next to Map Notes and choose Perform Analysis. In the Perform Analysis pane, click Data Enrichment, then Enrich Layer.

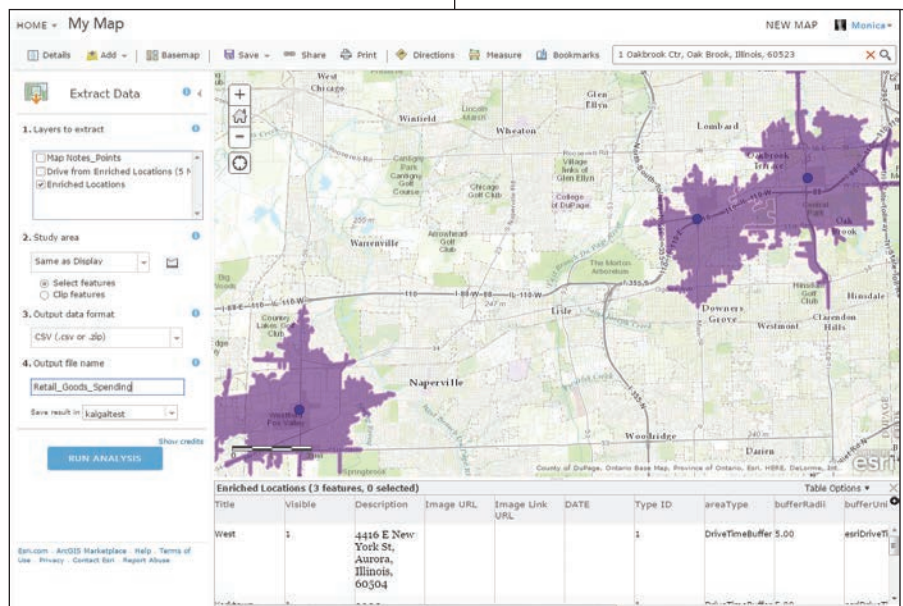
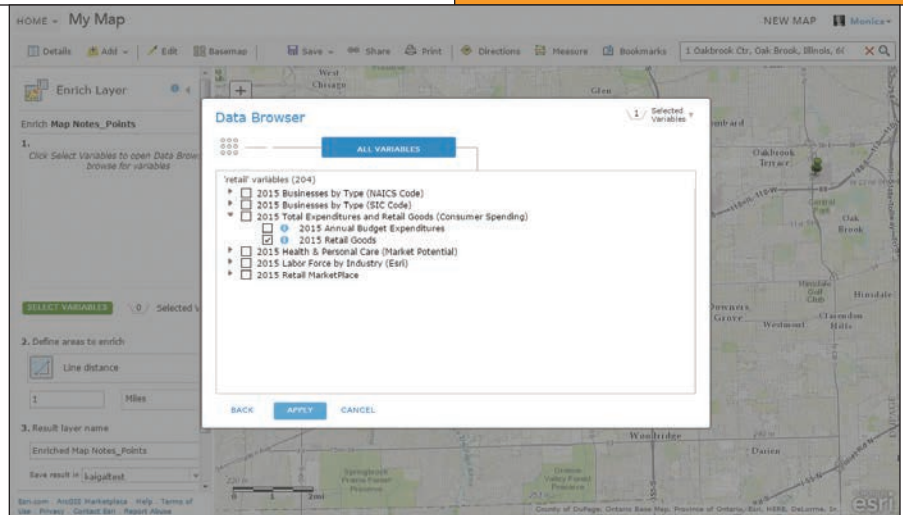


↑↑↑ Once signed in to ArcGIS Online, click Map at the top of the page. On the Map Viewer page, click New Map at the top of the page to start a fresh map.

↑↑ Map Notes will be used to add point locations representing commercial districts.

↑ Once all locations have been added, click the drop-down arrow next to Map Notes and choose Zoom to see all three locations.

8. Click Select Variables, type retail in the search box, and press Enter. Click the arrow next to 2015 (or current year) Total Expenditures and Retail Goods (Consumer Spending) to expand its list. Check the check box next to 2015 Retail Goods. Click the Apply Button.
9. To define areas to enrich, choose Driving Time and type 5 in the text box next to Minutes. Name the result layer Enriched Locations. (If there is already a layer with this name in your organization, choose a different name.) Click Show credits to see how many credits this analysis will consume, then click the Run Analysis button.
10. When the analysis is complete, uncheck Map Notes in the Contents. Click on one of the points and scroll down in the pop-up to see the Retail Goods field, which shows the estimated total of current year retail goods expenditures in the five-minute drive time around the point.
11. Optionally open the table for the Enriched Locations layer by clicking the arrow next to the layer and clicking Show Table. Scroll to the right to see the Retail Goods field. It may be helpful to see the five-minute drive times around the locations. If you would like to add drive-time polygons to your map, click the arrow next to the Enriched Locations layer in the contents and choose Perform Analysis > Use Proximity > Create Drive-Time Areas. Follow the step-by-step instructions on the tool.
12. To create an output table, first click the arrow next to the Enriched Locations layer, click Perform Analysis and then Manage Data, and click Extract Data. On the analysis pane, for layers to extract, verify that Enriched Locations is checked. Verify that all three locations are visible on the map. Use Same as Display for the study area and name the output Retail_Goods_Spending.
13. Click Show credits to see how many credits will be used. Click Run Analysis. Click OK on the dialog box that tells you the data will be available in My Content.



↑↑ Click the arrow next to 2015 (or current year) Total Expenditures and Retail Goods (Consumer Spending) to expand its list and check the check box next to 2015 Retail Goods.

↑ If you would like to add drive-time polygons to your map, click the arrow next to the Enriched Locations layer in the contents and choose Perform Analysis > Use Proximity > Create Drive-Time Areas. Optionally, you can show the table.

14. From the drop-down under Home in the upper left of the interface, choose My Content. If you have a lot of content, sort the list of contents by date modified by clicking Modified at the top of the list. If necessary, click again to get the newest items at the top. You should see an Extract Data layer with the current date. If it is not visible yet, wait several seconds and refresh the browser.
15. To download the extracted comma-separated values (.csv) file, hover over the arrow next to the item name and click Download.

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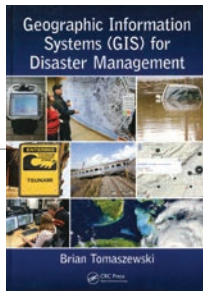
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GIS Bookshelf



Geographic Information Systems (GIS) for Disaster Management

By Brian Tomaszewski

Students who are interested in obtaining a solid understanding of how GIS capabilities can be applied for more effective disaster management are the target audience for this book. In addition to reaching this primary audience, the book's author seeks to raise awareness of and advocate for greater integration of GIS with disaster management practice. No knowledge of GIS or any GIS software is assumed by the text. In addition to introducing GIS, chapters cover the application of GIS to disaster planning and preparedness, disaster response, disaster recovery, and disaster mitigation. The author, Brian Tomaszewski, is a geographic information scientist and assistant professor in the Department of Information Sciences and Technologies at the Rochester Institute of Technology (RIT). His background in disaster management includes work with international organizations that apply GIS to disaster management such as the United Nations ReliefWeb, United Nations Office for Outer Space Affairs Platform for Space-based Information for Disaster Management and Emergency Response (UN-SPIDER) group, and United Nations Global Pulse. He has also mentored students in a National Science Foundation (NSF)-funded Science Master's Program that produces graduates with a systems understanding of the disaster management cycle. A past contributor to *ArcUser*, he most recently coauthored "A Serious Game for Measuring Disaster Response Spatial Thinking" in the Summer 2013 issue. CRC Press, 2014, 295 pp., ISBN-13: 978-1482211689



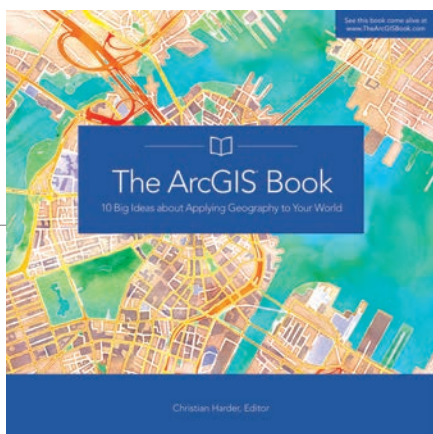
R in Action: Data analysis and graphics with R, Second Edition

By Robert I. Kabacoff

Big data is increasingly a big deal, and R has become the language of choice for many data scientists. R is a well established and widely used open-source language and environment for statistical computing. Thousands of data management, statistical, and graphical functions (known as packages) have been contributed and are available. While ArcGIS users have been using R for some time, the integration of R and ArcGIS has become much tighter with the release of ArcMap 10.3.1 and ArcGIS Pro 1.1. At these releases, native R scripts can be run directly as script tools in ArcGIS, and R can access ArcGIS data and will honor selection and projection parameters.

ArcGIS users who would like to take advantage of the existing functionality in thousands of R packages but are unfamiliar with R may find *R in Action: Data analysis and graphics with R* a good introduction and a useful resource. Written as a "Missing Manual for R," it is not a tome but an introductory text. The general audience for this book is anyone who deals with data. A statistical background is not assumed. Code examples were chosen from a wide range of disciplines. The book's five sections provide an introduction to the R language; basic, intermediate, and advanced methods; and ways to extend newfound R skills. These chapters describe more than 90 of the most useful contributed packages. GIS users may find the chapter on regression analysis, located in the intermediate section, of particular interest. The second edition includes 200 pages of new material dealing with data mining, predictive analytics, and advanced programming. Manning, 2015, 579 pp., ISBN-13: 978-1-617291-38-8

Put 10 Big Web Mapping Ideas into Action



Want to get your feet wet or dive right into web GIS? Visit the website TheArcGISBook.com, where you will find *The ArcGIS Book: 10 Big Ideas about Applying Geography to Your World*.

The ArcGIS Book, new from Esri, outlines 10 big web mapping ideas and how to put them into action using the ArcGIS platform. The website includes accompanying Learn ArcGIS lessons, videos, and other supporting materials.

Edited by Christian Harder of Esri, *The ArcGIS Book* was written for a diverse audience, including GIS professionals just venturing into the new world of web GIS as well as web technologists, information workers, web designers, and others who increasingly recognize how maps play a pivotal role today in clearly communicating information.

The book also serves as a perfect introduction to web GIS for managers and executives interested in understanding how maps can help them make sound business decisions

for their organizations.

The ArcGIS Book was designed to introduce GIS professionals and others to the increasingly powerful capabilities of web GIS, including spatial analysis and 3D mapping. Esri's ArcGIS is a complete system for discovering, creating, consuming, and sharing geographic data, maps, and apps that fully operates on the web and mobile devices.

"At Esri, we recognize that the web, cloud computing, smartphones, and tablets have forever transformed how GIS technology is applied," said Clint Brown, director of product engineering at Esri. "In response, ArcGIS has become a web GIS platform. We wanted to publish a book that not only describes how these trends have transformed GIS but also teaches people how to use the system."

Among the 10 big ideas covered in *The ArcGIS Book* are the online mapping revolution and its role in GIS; storytelling with maps; mapping in 3D; the social implications of web GIS; the power of spatially intelligent apps; and the emergence of mobile GIS on smartphones with, as the book says, "a live data sensor in your pocket."

In an interactive and interesting way, the book takes readers on a journey on how to create and share GIS web maps, use new

smart mapping capabilities in ArcGIS to make beautiful and well-designed maps, do spatial analysis online, make 3D web scenes, and work with mobile GIS.

Each chapter also includes an ArcGIS lesson that helps readers put what they learn to work using a real-world scenario and Esri-provided data and ArcGIS. The lessons give them hands-on experience in all aspects of web GIS, including crafting story maps, solving problems with spatial analysis, editing geographic data, and building 3D models. The book also inspires the enthusiastic and visionary mapper, providing links to hundreds of live examples of web maps and apps and videos of thought leaders describing some of the trends driving the industry.

Interspersed throughout *The ArcGIS Book* are short essays written by thought leaders such as Esri president Jack Dangermond; Allen Carroll, program manager, storytelling, Esri; and the architect and graphic designer Richard Saul Wurman, who co-founded the Technology, Entertainment, and Design (TED) conference.

A print version of *The ArcGIS Book* is available for \$19.99. You also can download a free PDF [70MB] of the book from TheArcGISBook.com.



10 TAKEAWAYS

FROM THE 2015 ESRI USER CONFERENCE

By Carla Wheeler, ArcWatch Editor

You *really* wanted to make it to this year's Esri User Conference (Esri UC), but it just didn't happen.

No worries.

The conference will be back in San Diego, California, in 2016—albeit a little earlier (June 27–July 1) so save those dates.

It's impossible to recapture the excitement of interacting with your peers in person; eyeing hundreds of beautiful, informative maps; watching live tech demos; and trying out GIS apps. But Esri's video team has posted videos of the Keynote Address, plenary talks, technology demonstrations, and other 2015 Esri UC events at video.esri.com. Esri photographers took thousands of pictures of the event that have been posted on Esri's Flickr photo sharing site. However, here is a quick overview of the highlights from this year's conference.

1 Enter the Era of Geographic Enlightenment

Esri president Jack Dangermond introduced the term *geoenlightenment* during introductory remarks at the Esri UC Plenary Session. What is geoenlightenment? Dangermond said it means understanding how things on our planet are interconnected and applying that knowledge to make the world a better place. "What we do here, affects there," he said.

2 Analyze Very Big Data with ArcGIS

Geoenlightenment will get a big boost from Esri's Big Data for GeoAnalytics extension for ArcGIS for Server, which is slated for release next year. Mansour Raad, senior software engineer for Esri, demonstrated how Big Data for GeoAnalytics was used to analyze where to plant 87 varieties of corn hybrids in Indiana based on soil type, a specific time window, and heat and soil moisture. This added up to 300 billion spatial and temporal calculations. "We did these calculations in 10 minutes. Pretty cool," said Raad.

3 R You Ready?

Esri just launched the R–ArcGIS Community on GitHub. The new initiative's goal is to build a collaborative community for R and ArcGIS users. R is an open-source programming language for statistical analysis. "Now R users can directly access all their organization's GIS data, and ArcGIS users can directly integrate R into their geoprocessing workflows," said Esri's Steve Kopp.

4 Buzz Builds for Esri App for Drone Imagery

Esri's Tony Mason previewed Esri's new mapping app for drones, which he said "streamlines the processing of drone data." Within 83 minutes of collecting still imagery of the Oatlands Historic House and Gardens in Leesburg, Virginia, with a drone, the raw data from a Secure Digital (SD) memory card was loaded, verified, processed, turned into a tile cache, and shared via an ArcGIS Online portal. "The app built a stunning mosaic from hundreds of images collected by the drone," Mason said. "The imagery is so detailed, you can even see individual plants."

← 6 Dr. Bruce Aylward from the World Health Organization (WHO) shared stories about his work eradicating Ebola.



5 Get Ready for Vector Tiles

Esri's Nate Bennett got the audience up to speed on the new fast, responsive vector tiles. The audience responded enthusiastically. "Data is prerendered at various map scales, cut into tiles, then cached for quick delivery," he told the crowd at the Esri UC, as he showed an example of vector map tiles on-screen. As the map rotates, the labels dynamically orient.

6 Mission Possible

Dr. Bruce Aylward from the World Health Organization (WHO) described the role GIS plays in the fight against Ebola. He took the audience behind the scenes of the battle to wipe Ebola off the map in West Africa. He credited GIS tools for everything from helping track the chains of virus transmission from one person to another to getting the food and medical support needed to the right locations. "This was a huge logistical effort, much of it guided by the kind of work that you do and by the kind of tools that have been developed through the GIS community," Aylward said.

7 Step into AppStudio for ArcGIS

Esri's Ismael Chivite, Sathya Prasad, and Elvin Slavik demonstrated how to create native apps for multiple platforms in a snap using the configurable application templates and other functionality in the new AppStudio for ArcGIS. Best of all, no coding is required.

8 Swoon over ArcGIS Ready-to-Use Apps

Chivite playfully introduced Esri's many ready-to-use ArcGIS apps during the Plenary Session as potential dates in a speed dating session. "Okay, you see, selecting the right app for the job can be sometimes challenging. You need to know what each of the apps do. Really, finding an app is like finding your best partner. After all, you're going to spend so much time together," said Chivite as he introduced Esri staff who personified the apps.



↑ 8 During the Plenary Session, Esri staff personified ArcGIS ready-to-use apps including this rapping Story Map app.

9 What's Trending in Web GIS

Esri's technology evangelist Bern Szukalski walked the audience through the top trends in web GIS, which included the increase in the number of portals, widely available hosted, easy-to-use analysis tools, introduction of smart mapping technology, and the popularity of Esri Story Maps.

10 Applaud the Winners

Dangermond honored many organizations with awards for their fine work implementing GIS, including Irish Water, which won the Enterprise GIS Award; Abu Dhabi, which received the inaugural Esri Smart Government Award; and the National Audubon Society, which won the Esri President's Award. The International Centre for Integrated Mountain Development (ICIMOD) also was presented the Esri Humanitarian GIS Award for helping to provide Nepal's government with vital information that helped officials better respond to and recover from the devastating earthquakes in that country earlier this year.

A NEW NETWORK FOR BUDDING GIS PROFESSIONALS

By Citabria Stevens, ArcNews Editor

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

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

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

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

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

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

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

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

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

"There's nothing like hearing from your friends," he continued, "because they actually share...experience to experience." By the end of the week, the roots of a durable network were taking hold.

"I think it's a good idea to have this [organization] because it's cooperative," said Maria Pinheiro, a Brazilian GIS analyst for the Instituto Pereira Passos, the research department for Rio de Janeiro's city government. "It's good to know I

have some friends and expectations for my career in GIS."

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

While the directors of the YPN collate ideas for how to best grow the network, they are putting together a packet on how to be a GIS mentor, especially for primary and secondary school students around the globe.

This, along with other materials and information about events, will be posted at esri.com/ypn. To stay up to date with the YPN, register with the network at the website and follow @EsriYPN on Twitter.



↑ One of the Youth Professionals Network social events held during the Esri User Conference.



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Students Find Real-World Answers with Community Analyst

By Camelia-Maria Kantor, Clafin University

Students in a small South Carolina university used Esri Community Analyst to answer an important question: “Where will I look for work after graduation?” These students were enrolled in an elective geography class at Clafin University (CU).

This fairly small university in Orangeburg is located in a predominantly rural area and serves a student population of almost 2,000 that is more than 90 percent African American. In an effort to enhance the technical and analytical abilities of its majors, the Department of Social Sciences has subscribed to Community Analyst for the past three years. The user-friendly mapping tool

was seen as a more appropriate way of gradually integrating spatial concepts into the social sciences. Consequently, Community Analyst was incorporated into several elective geography courses as well as utilized in applications in the fields of sociology, criminal justice, urban planning, and political science as part of senior theses or class research projects.

Community Analyst, a cloud-based mapping solution that provides up-to-date demographic, health, crime, census, business, social, and cultural data available in a “Walmart one-stop shopping” style can help students without any prior mapping experience easily fuse their theoretical, discipline-specific knowledge with real-world applications. It works well with class projects and research papers in various disciplines and does not require substantial technical skills.

One project at CU has been very successful in raising students’ interest and improving their understanding of how mapping can



- employment in an area such as educational attainment or availability of employment pertaining to your career field.
4. Open Esri Community Analyst and select those five variables in Smart Map Search. Select ranges as appropriate (e.g., high educational attainment, high diversity index, low poverty, lower percentage of people in health care/social assistance industries).
 5. After identifying the two top states meeting your five criteria, zoom in to find two counties that most closely match the same criteria in each state. Compare them to your initial options. Are they similar? Are they different?
 6. Start a web search for available employment in selected areas. After finding a job opportunity, start looking for a place to live. To identify the best matching neighborhoods, explore the Esri Tapestry Segmentation data to obtain an in-depth understanding of neighborhoods. Tapestry Segmentation uses 67 unique segments based on demographic and socioeconomic characteristics. Search the online real estate offerings in areas selected based on Tapestry Segmentation and find your new home.

The project takes about two hours to complete. Students found this short project very interesting. It helped them consider the implications of finding and keeping employment in an area that does not meet their demographic and socioeconomic expectations. At this minority-serving institution, the student population mostly comes from rural and socioeconomically challenged communities. Interestingly, variables such as crime index, poverty, and per capita income were found in every individual project.

Crime rate, in particular, became a major decision factor in state selection. This favored states, such as South Dakota, North Dakota, Vermont, New Hampshire, Minnesota, Iowa, and Wyoming, that have low crime rates. To address this limitation, students adjusted other options but still kept crime rates low. After adjustment, students preferred Pennsylvania, Virginia, New Jersey, or Colorado.

Another interesting criterion was diversity, a variable available in Esri Community Analyst. The Diversity Index is part of Esri's

2015 Race and Hispanic Origin demographics database. Most students selected it at first. Then, after realizing that the diversity index relies heavily on the racial composition, students opted for low levels of diversity instead of high diversity, which they originally chose. Some replaced diversity with 2015 Black/African American population.

Overall, the project encouraged students to actively think of their future career in connection to elements, such as demographic and socioeconomic characteristics of an area, in addition to actual employment opportunities. Community Analyst is a great tool for enhancing teaching at all levels. It was easy to use and made GIS capabilities available to every user.

Using Esri Community Analyst increased students' visual-spatial literacy and exposed them to the opportunities spatial analysis can offer in social sciences. By utilizing mapping technology to narrow down their location search according to personal life expectations, these students learned the relevance of place to social life. In addition, it helped students gain a more practical understanding of variable selection and its role in decision making. Esri Community Analyst became an interesting, fun way of conducting spatial analysis to meet the challenges of personal real-life situations.

become useful in real-life career choices. Entitled "Where should I look for a job after graduation?," the project was implemented as part of an elective geography class with mixed student enrollment from education, social sciences, and mass communication.

To complete the project, students followed these steps:

1. Write down the names of two US states where you would be most likely to look for employment after graduation.
2. Pick two favorite counties per selected state.
3. Select five criteria (variables) that matter most to you when looking for

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NEVER STOP EXPLORING

The pursuit of cartographic accuracy

By Jim Baumann, Esri Writer





↑ In pursuit of cartographic accuracy, the Hema Map Patrol teams traverse some of the most remote areas of Australia.

An Australian couple's passion for exploring the Outback eventually led them to develop a multimillion-dollar mapping and publishing company.

← Hema combines ground truthing of thousands of miles of roads with the latest ArcGIS mapping technology.

In 1983, Henry and Margaret Boegheim founded Hema Charts & Laminating, which laminated and sold marine charts in bait and tackle shops throughout Southeast Queensland. The company name combined the first two letters of each of their first names.

The Australian couple's love of the outdoors led them to purchase a four-wheel-drive vehicle a few years later so they could explore the Outback. They discovered that existing off-road maps were of poor quality and limited use, so they began making their own maps for off-roading. This aspect of the business grew so much that the couple changed the company name to Hema Maps

and began using digital data to create maps.

In pursuit of a higher level of cartographic accuracy, Hema Maps has combined ground truthing of thousands of miles of roads and tracks by its Map Patrol teams with the latest mapping technology. Hema Maps significantly increased the size of its ArcGIS-based datasets after it completed the Great Desert Tracks, a two-year-long project to map every Outback road and track in Australia's central region that was completed in 2000.

With increasing demand for quicker updates of its digital and high-quality printed map products, Hema Maps needed a method for automating its workflow. The



↑ A Map Patrol team member captures a waypoint with the HemaExplorer app during an expedition through the Simpson Desert.

company wanted its production processes to be database driven rather than product driven. It wanted to use the same standardized database for all its products. Hema Maps' product line has grown to include atlases; guides; special business-to-business cartographic products; Hema Navigator, its portable navigation device; mobile navigation apps; and Hema cloud services.

This meant completely revising production processes. For data collection, Hema Maps began using a customized version of Esri's ArcPad software on a Tablet PC hooked up to a differential GPS that provides accuracy up to +/- 1 meter. The company will also use a handheld PC running

ArcPad for capturing walking trails and tracks where the fieldwork vehicles cannot go. In addition, Hema Maps is looking into other software, such as Esri Collector for ArcGIS and Geocortex Essentials (from Esri partner Latitude Geographics) for fieldwork data collection, and other hardware options, such as 360-degree cameras mounted on the vehicles, to efficiently capture new media, such as GPS-tagged photos and videos and 360-degree imagery.

Because Hema Maps uses data from a variety of sources, including the Australian government, Geoscience Australia, and the Bureau of Meteorology, as well as the extensive datasets the company collects,

easy integration is key to Hema Maps' new production processes.

"A clean, up-to-date database—one that doesn't have duplicate or extraneous data—is the foundation for creating multiscale digital maps as well as providing a basemap for print products," said Pierre Kurth, the senior cartographer/GIS analyst managing the project at Hema Maps. The company is mainly using Safe Software for data integration and data manipulation so it can create workflows that can be automated and repeated as needed. This saves time, especially when updating third-party datasets from the government or hydrologic systems.

↓ A new style library in ArcGIS provides consistent cartography for both digital and print products.



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↓ Hema has produced a seamless, multi-scale basemap that has revolutionized the company's production processes while maintaining the quality of its cartographic style and readability





↑ Senior cartographer/GIS analyst Pierre Kurth and GIS/fieldwork administrator Micah Brouwer gaze over dunes in the Simpson Desert.

"We used ArcGIS to set up our multi-scale basemap in a special map layer for the composition of all 11 maps of Australia in the different scales that we produce," Kurth continued. A new style library in ArcGIS provides consistent cartography for both digital and print products. ArcGIS also handles the generalization of data and is used to publish the data as a map service.

Data is stored in a Microsoft SQL database as geometry, rather than in a binary format, to allow for the use of third-party tools for simple data manipulation in the future. Hema has also restructured its database so that features are stored in separate feature classes to shorten the time it takes to render features.

With this database, Hema has produced a seamless, multiscale basemap that has revolutionized the company's production processes while maintaining the quality of its cartographic style and readability that Hema customers have come to expect.

"We imagine a digital world without boundaries, with a constant and dynamic connection between our content and our customers," concluded Rob Boegheim, managing director of Hema Maps. "This requires us to create once and publish multiple times across an ever-increasing range of media, and to do this successfully requires our content management and cartographic innovation and intelligence to become deeply embedded in our spatial information system."

"We imagine a digital world without boundaries, with a constant and dynamic connection between our content and our customers."

Rob Boegheim
Managing Director, Hema Maps



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