Esri News
for Facilities
Summer 2012

GIS and The City 2.0

By Jack Dangermond

Seven billion. That number has received a lot of attention recently as the global population has grown past this mark. But lost in the media coverage of this milestone was another, perhaps even more fascinating, global statistic: more than 50 percent of those 7 billion people now live in cities, a number projected to grow to more than 75 percent during this century. In fact, there will be at least 19 cities in the world with a population greater than 20 million people by the end of the twenty-first century. Cities are human destiny.

This growing recognition of cities as the center of the human world was further highlighted when The City 2.0 was awarded the 2012 TED Prize. "For the first time in the history of the prize, it is being awarded not to an individual but to an idea," the Technology/Entertainment/Design (TED) committee stated. "It is an idea upon which our planet's future depends."

Clearly, cities will play an increasingly important role in our survival. Cities offer easier access to services, and urban dwellers are more efficient consumers of limited resources. But as our cities become more populated and more numerous, how do we best manage this complexity?

We need to start thinking about cities in a different way.

Reimagining the Canvas

Fundamental to changing the way we think about cities is a reimagining of the way we abstract them. Maps are abstractions of geography and have proved to be particularly →

↑ Tall structures can have a huge shadow impact on a city, as modeled here in CityEngine.

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useful throughout our history. But traditional maps have limited our ability to manage and design in a holistic, comprehensive manner. GIS technology has given us a powerful new context for extending our traditional methods of abstracting geography—a new canvas that includes everything that lies below, on, above, and around the city, including what exists inside and outside buildings, as well as how things connect to the city and how all these things change through time.

Cities as Ecosystems

Cities are the places where most of us now spend the vast majority of our lives. They have in fact become man-made ecosystems—vast assemblages of interdependent living and nonliving components—the primary habitat for the human species.

The recognition of cities as a habitat for modern man is leading to new approaches to their management and design. GIS technology has long been used to map, study, analyze, and manage natural ecosystems. It only seems logical to manage, model, and design our new man-made ecosystem with the same tried-and-true tools used for traditional ecosystems.

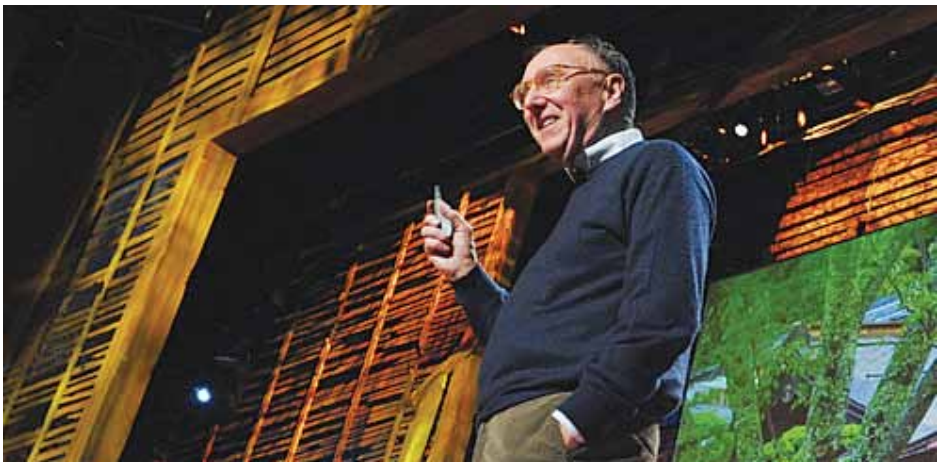
Buildings as Microcities

As our cities are growing in size and complexity, so too are the buildings that compose much of the fabric of the city. In effect, many buildings and facilities are becoming small cities themselves, and they need to be designed and managed as such.

GIS tools, used successfully for many years in fields such as environmental analysis and landscape planning, also support a broad range of applications inside and outside buildings and facilities. In fact, GIS can be used throughout the life cycle of a facility—from siting, design, and construction through ongoing use, maintenance, and adaptation, ultimately through closing, repurposing, and reclamation.

An Engaged Citizenry

Smart cities of the future will be those where the citizenry is engaged in city design and evolution, where we fully leverage the collective intelligence of the masses and allow everyone to actively participate in shaping our communities. Today, social media and mobile citizen engagement applications are enhancing a variety of government-citizen interactions involving public information, requests for service, public reporting, citizens as sensors, unsolicited public comment, and even volunteerism.



↑ Jack Dangermond at TED 2010 in Long Beach, California (Credit: TED/James Duncan Davidson)

Geospatial technologies have already proved to be effective tools in supporting citizen engagement. Intelligent web maps are acknowledged as a catalyst for solving key challenges in creating a dialog with informed citizens. As web- and cloud-based GIS continues to evolve and social media and mobile devices become more pervasive, governments will continue to deliver innovative forums through interactive information and participatory citizen applications.

Designing The City 2.0

Geography is constantly changing—from wind and water erosion, natural climate shifts, tectonic and volcanic activity, and the dominance and extinction of species and ecosystems. But recent changes to geography as a direct result of human activities are threatening the survival of many species, including our own. And while the actions causing these monumental changes are often deliberate, much of the change to geography has been an unintentional by-product of poor planning and unsustainable actions—change that I call "accidental geography."

In my talk at TED 2010, I introduced the idea of geodesign—a concept that enables architects, urban planners, and others, to harness the power of GIS to design with nature and geography in mind. Geodesign results in more open participation through visualization, better evaluation of proposed scenarios, and a deeper understanding of the implications of one design over another. Combining the strengths of data management and analysis with a strong design and automation component is fundamental to designing The City 2.0.

A New Direction

Cities are intricate collections of materials, infrastructure, machinery, and people, with countless spatial and temporal relationships and dependencies, and require progressively more sophisticated tools to help us design and manage them. They are complex systems where we humans spend an increasing amount of our lives.

"This idea is capable of inspiring millions of people around the world to contribute to one of the biggest challenges and opportunities humanity faces," the TED committee stated when announcing the award of the 2012 TED Prize. "The City 2.0 is not a sterile utopian dream but a real-world upgrade tapping into humanity's collective wisdom."

Our challenge is to design our man-made ecosystems to achieve the maximum benefit to society while minimizing short- and long-term impacts on the natural environment. As an integrative platform for management and analysis of all things spatial, I believe that GIS technology can help meet this challenge. Cities are our new man-made ecosystems, and it's time we start to think about them, manage them, and design them as such.

City of Las Vegas Implements ParkPAD for Mobile Asset Management

Founded more than 100 years ago, Las Vegas, Nevada, began as a stopover on the pioneer trails heading west. Soon it evolved into a popular railroad town and staging point for the many mining operations in the area. In 1911, the population was about 800 people. Las Vegas then began to grow in leaps and bounds, with construction of nearby Hoover Dam during the 1930s and the beginning of its now massive casino industry during the 1940s and 1950s. Today, the greater Las Vegas metropolitan area is home to nearly two million residents.

Maintaining the infrastructure necessary to support a population of this size requires carefully coordinated efforts by the city's Department of Operations and Maintenance to minimize redundant work and make the most of shrinking city coffers during difficult economic times. While the department has used ArcGIS software for many years, a different vendor's maintenance management system (MMS) had been implemented to collect and manage the assets within its parks and related facilities. Because the drawbacks of that particular system were substantial, in 2009, the Department of Operations and Maintenance began the development and deployment of its Park Asset Data Collection and Data Conversion Program (ParkPAD) to replace the legacy MMS. Based on ArcPad software, ParkPAD has greatly improved the department's capability to collect and manage park assets, because it is fully compatible with the department's existing ArcGIS enterprise system. Field crews can now view a digitized image of a park or other venue and immediately determine whether the data has already been collected. Getting data in and out of the new system is a quick and easy process, and updates can be performed in near real time.

The Parks and Open Spaces Division is currently working with the Information Technologies Department to complete the digitization of the base layers for all the city's parks, landscaped areas, trails, medians, school landscaping, and sports fields. This new parks inventory database has produced some immediate cost benefits to the city. Since Las Vegas is in the Mojave Desert, water conservation is very important. The vegetation layers in the database are used to determine the square footage of each park so that the necessary amounts of seed, fertilizers, and herbicides can be accurately calculated and purchased. In a related project, the data from an earlier tree study was added to the database so that the parks maintenance staff could determine water usage requirements for each tree based on species, size, location, and so on.

In the next stage of the project, an irrigation layer will be created for the database and will include the locations of irrigation clocks, stations, valves, and controls. This will allow the irrigation system repair crews to quickly locate equipment when there is a break in the water main or if a valve becomes inoperable. In addition, these new base layers will make it easier to collect and track the number, location, and condition of assets, such as playgrounds, shade structures, drinking fountains, picnic areas, and benches.

This new data will be included in the city's enterprise GIS so that it is available to the other departments that rely on it. Currently, these departments maintain their own datasets for park assets, and there are discrepancies between them. Using the same dataset is particularly useful for the Department of Operations and Maintenance, which maintains the parks, and the Department of Parks, Recreation and Neighborhood Services, which schedules outdoor events, maintains sports fields, and manages the use of picnic and other recreation areas.

"Our use of GIS continues to grow," says Joel Hillhouse, GIS analyst at the City of Las Vegas. "In the near future, we will be posting our parks data on the city website for residents and visitors so that they can find information and make reservations for a specific site using an interactive park finder."

↑ All American Park showing the base layers and assets added over the aerial image, which helps those using the map understand what they are looking at.

For more information, contact Joel Hillhouse, GIS analyst, City of Las Vegas (e-mail: jhillhouse@lasvegasnevada.gov).

Building a University of the Future

The University of Calgary in Alberta is considered one of the top research universities in Canada. It has more than 29,000 students and more than 4,000 academic and support staff. The university began using GIS for academic research 20 years ago and has now standardized the management of its geographic information with Esri technology. Realizing the value of geographic analysis for informed decision making, it has expanded the use of GIS to manage not only academic data but also institutional and administrative data.

Running a Smart Campus

The main campus has more than 20 academic buildings occupying more than 200 hectares, which is larger than Calgary's entire downtown core. In 2008, the university embarked on a $1.5 billion campus expansion, the largest in its history. Knowing that implementing a project of this size and continuing to maintain so many buildings would require a comprehensive understanding of every aspect of the campus—its landscape, people, buildings, and infrastructure—university planners relied heavily on ArcGIS and geodesign principles to help analyze and evaluate the impacts of design alternatives early in the development process.

The university maintains institutional data used for facilities management in a central data warehouse. Esri's ArcGIS for Server serves as the front-end technology that pulls data from ARCHIBUS, Esri partner (Boston, Massachusetts) and creator of a solution used to manage spatial data and real estate, infrastructure, and facilities information. These recently integrated systems enable users to visualize and analyze both interior and exterior building data that's important to understanding how the campus currently works. Defining how the landscape works and evaluating whether it is working well are key tenets of the geodesign framework for landscape change. Evaluation of current processes allows proper "baselining" and the identification of key metrics against which design alternatives can be measured. The result is improved site planning and facilities design optimized for cost-efficient management and sustainability well after the initial project work is complete.

Understanding the physical constraints of a property is equally important. During site assessments, planners and landscape architects alike need to know how water flows across a property. This question came up early in the design phase, before construction, when the facilities management team approached the university's GIS team to create a campus drainage basin model. While there are no drastic slopes on the campus, there are low spots. Coupled with Calgary's high water tables, understanding these environmental issues was an important design constraint. If a basement is built in a particular location, the probability of flooding may be higher. Knowing where rainwater would drain allowed the team to see where flash floods might occur and then mitigate any potential dangers.

Understanding the terrain—the physical lay of the land—and how it affects drainage across this particular landscape has proved to be invaluable. The drainage basin model has been leveraged in planning new building sites and the expansion of the storm sewer →

Cornerstone

Shelli Stockton
Global Facilities Industry Manager, Esri

As a reader of *Esri News for Facilities,* we hope you will come to this year's Esri User Conference (Esri UC), where we will be addressing some of the biggest advances and trends that are changing the way facility professionals use geospatial technology.

Of the 14,000 attendees at the Esri UC, you'll find representatives from nearly every industry. This is where you learn about what your peers are doing and how you can apply those best practices to your own work. It's where you get technical training, contacts, and exposure to the best geospatial products and services available. Esri even offers personalized tech support, so you can discuss your biggest challenges with our experts.

Facilities-focused sessions will take place on July 24 and 25, 2012, at the Esri UC. Sessions include the following:

- Facilities Sustainability: Planning, Carbon Footprint, and LEED Compliance
- Enterprise Facilities GIS for Asset Management and Routing
- Data for Facilities and Floor Plans: CAD, BIM, and Lidar
- Interior Space Mapping and Assessment
- Interior Space Data Collection and Management for a Facilities Basemap and Planning

Don't miss the technical workshop Implementing ArcGIS for Facilities with Intelligent Maps & Apps or the lunchtime Facilities/AEC Special Interest Group (SIG) meeting and the FM Evening SIG meeting on Wednesday, July 25.

You can't get this combination of practical insight and technological inspiration anywhere else. I hope you can join me this July in San Diego.

Building a University of the Future

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system, including an innovative research project for filtering surface water before it enters the sewer system.

3D Data to the Rescue

The team combined light detection and ranging (lidar) data with high-resolution, orthorectified aerial photographs to create the drainage model data. ArcScene allowed decision makers to view and process the data in 3D while analyzing the effects of new construction sites on the existing grounds.

Using lidar to map the campus allowed the team members to look not only on the ground but in the trees, as well. They recorded and processed the height of every tree on campus to provide even more information necessary for relandscaping after the expansion project, as well as to understand the position of shadows on potential buildings. Armed with this information, the team was able to optimize the planting of five trees for every tree removed during construction, along with native, low-water vegetation, helping the team achieve greenhouse gas and water use reduction goals.

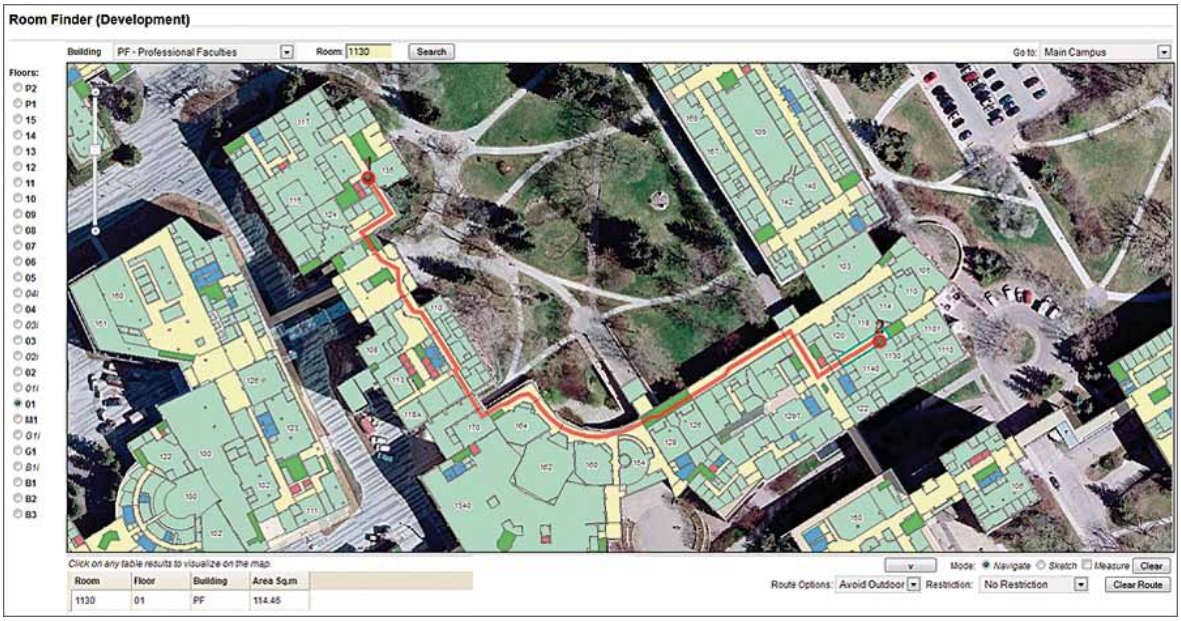
Once the surface models were completed, the team generated 3D building models to use for shadow simulations during the next construction phase. Traditionally, the models have been leveraged to ensure that new buildings do not obstruct the views of existing buildings. In this case, the shadow models were used to track the sun's effect on a glass exterior compared to a solid wall structure. This method of optimizing the heating mechanics of buildings is an important consideration in an area as far north as Calgary, where sun angles change drastically depending on the season. In the summer, the sun is high, creating narrower shadows; in the winter, the reverse is true. Simulating 3D shadow effects based on sun angle allowed team members to calculate just how long a building would sit in shade at any time of year, enabling decisions to be made on the heating needs and estimated costs to maintain the comfort level of that specific building.

As with many GIS projects, the development of one application often generates additional benefits. With the surface models in place and the building sites located, there was an urgent need to model the campus irrigation system. An application was developed to help map the changes caused by the construction. The irrigation model also provided the ability to monitor water usage and maintain asset inventories. This innovative application created a model for managing 8,500 sprinkler heads across campus and has helped grounds personnel better understand and manage the system. Knowing the flow rate and tilt angle of each sprinkler, the university is now able to calculate the volume of water it sprays, as well as the area it covers. The application can be used for the life of the campus and allows it to conserve water by reducing overlap and avoiding spraying water on roads and pedestrian walkways.

Coordinating Solutions

The geodesign process opened many new avenues to explore to increase efficiency around campus, even in areas where it wasn't expected. In a synergistic move with the new construction, the information technologies (IT) department also used ArcGIS to consolidate several computer centers where remote computer systems were once maintained. The consolidation freed up new space for faculty to use and has led to better communication and system coordination across campus. It also allowed a reduction in utilities costs for electrical and cooling systems.

"Using GIS as a decision-making tool is a smart way of gathering all the things you already know and placing them in a single spot so you can see the entire picture," says Tom McCaffrey, GIS coordinator, University of



→ The interactive room finder provides the ability to determine the user's current location and find the best path to a new destination.

← The University of Calgary uses ArcGIS to manage a $1.5 billion expansion and maintain the facilities on its 200-hectare campus.

Calgary. "Understanding each layer of data as a separate entity is one thing; combining several layers together to get a coordinated solution to a complex problem is a completely different scenario. It's the difference between thinking in two dimensions versus thinking in three or four."

This understanding of how ArcGIS can be applied to different problems led the IT telecom group to reach out to the GIS team for help creating an application that would track telecom network lines, utility corridors, wiring closets, and utility shafts throughout the campus. While general maintenance for utilities and computer networking systems can be overwhelming if left unchecked, the ArcGIS for Server web-based application, when completed, will serve up 3D diagrams of the networks that administrators can edit and analyze at any time. Service technicians will also be able to trace, track, and repair faulty wires and equipment as these tasks are necessary. The system will enable them to monitor real-time data, plan networks, and prevent costly technical problems.

Improving Asset Management and Reducing Risk

The university currently needs to renew and maintain the exterior roofs of more than 90 buildings on several different campus sites. To make this process more efficient, the GIS team created a web mapping application that allows editing, updating, measuring, and reporting on government funding spent on reroofing the campus. Using ArcGIS, the team is now able to more effectively track life cycles and warranties of the roofing materials, which can potentially lead to thousands of dollars in savings on roofing jobs. Data on structures reported to the government is now documented using an accurate spatial and temporal method that provides strong accountability for how government money is spent. GIS has virtually eliminated the need for manual roof measurements that cost both time and money, as well as pose a potential safety risk.

From a risk management perspective, the university has also used ArcGIS to enhance public safety. Using a current model of the campus and incorporating up-to-date floor plans, emergency preparedness and evacuation plans were developed. Models and processes were discussed with local authorities and emergency responders to generate a map standard that was distributed to these stakeholders. The safety team created different scenarios and determined several possible routes for building evacuations. These plans were posted on a central website to help fire wardens understand the proper evacuation protocols. Future plans to integrate live security camera feeds into a secure campus web dashboard would allow the creation of a mobile command and control center. ArcGIS was even used to design external lighting models for the university's safety walk programs. These models estimated ground illumination based on the type of light fixtures and any interference caused by vegetation or building shadows. Maps were then generated and given to grounds personnel to take corrective measures in illuminating unsafe areas.

Enhancing the Campus Experience

To help students and visitors easily find their way around campus, the university developed an interactive room-finder application using institutional data. Users can input the building name and room number they wish to find, and the application generates a detailed map showing the floor plan with the desired room highlighted. Visitors can look up their destination using the online tool and determine the nearest parking area before arriving on campus. This enhances visitors' experience and helps them save time.

The interactive room finder will soon become available on mobile devices. Users will be able to take a picture of a wall marker to determine their current location and then enter their new destination. The map will show several route options—shortest path, indoor or outdoor routing, elevator access for the handicapped, or stair access for those who want more exercise.

Another future project will use administrative data to help students select classes based on spatial proximity. An application is being developed that will allow students to enter their ID numbers and generate maps that show their classroom locations, as well as the proximity to the next class, based on a specific time and day. This will help students familiarize themselves with the campus and select a schedule that offers reasonable travel times between classes.

"GIS technology offers endless opportunities for our processes to grow," says McCaffrey. "Processes that used to take weeks can now be done in minutes. Being able to see the entire picture at once is an option we've never had before. GIS allows us to plan at a much higher level than we could have ever imagined. Now, we look for new ways to view scenarios and come up with better ideas to manage them."

With all the efficiencies gained in their research, institutional, and administrative processes using Esri technology, the University of Calgary earns an A for geodesign and is well on its way to becoming a university of the future.

For more information, contact Tom McCaffrey, GIS coordinator, University of Calgary (e-mail: tmmccaff@ucalgary.ca). For more information on how you can put geodesign into practice, contact Mr. Shannon McElvaney, Esri (e-mail: smcelvaney@esri.com), or visit esri.com/geodesign.

Smartphone Application Aids District's Facilities Maintenance

By Jim Baumann, Esri Writer

Students and faculty in the Los Angeles Unified School District (LAUSD) can report graffiti, broken benches, or other repair issues using a smartphone application that is integrated with the district's GIS.

LAUSD is responsible for educating more than 675,000 K–12 students annually and is the second-largest public school district in the United States. The district manages facilities that include 1,065 K–12 schools; more than 200 education centers, adult schools, and occupational skill and learning centers; and dozens of warehouses and storage yards within the district's 710 square miles.

The district has used Esri's GIS software since 1990 for administrative tasks including student enrollment forecasting and analysis, school boundary maintenance, student safety, disaster planning, and facilities operations and management. As additional applications were added, the GIS gradually evolved into an enterprise system.

"GIS has played a big role on the administrative side of our operations," said Danny Lu, business analyst for LAUSD. "As we continued to expand our use of the technology, we realized that there were some commercial applications that could be easily integrated with ArcGIS and would fit into our existing workflow."

Upkeep of the numerous LAUSD facilities requires an army of administrative, maintenance, and technical staff members, who are continually evaluating and processing the many service requests submitted each day. The district implemented a data collection system that allows campus staff to easily report nonemergency issues. This relieves the operations department from some inspection and reporting responsibilities and lets it concentrate on the repair and maintenance of the school district's assets.

In 2010, the district contracted with Esri partner CitySourced to implement LAUSD Service Calls, a smartphone application permitting LAUSD students and faculty to report issues related to the repair and maintenance of school facilities, such as graffiti, broken benches, or damaged sprinkler systems.

"We wanted to take advantage of today's technology and provide our community with an intuitive tool that allows them to easily document maintenance issues and send those reports directly to us so that we can resolve them," said Lu. "As an added benefit, by using the application, students and faculty members of LAUSD are provided with a sense of ownership while building community pride."

CitySourced uses Esri's ArcGIS application programming interface (API) for smartphones in the LAUSD Service Calls application so that the school district can integrate the volunteered data from the incident reports with its authoritative ArcGIS database. This helps the school district keep the GIS database up-to-date for its IBM Maximo asset management system.

Kurt Daradics, director of business development at CitySourced, said, "The LAUSD Service Calls implementation at LAUSD is an end-to-end solution. Incidents are recorded on the mobile devices and sent to the CitySourced servers hosted by Microsoft Azure. Our servers route the issues directly into LAUSD's IBM Maximo asset management system as service requests, where they are reviewed and subsequently resolved by the district's maintenance department."

Daradics indicated that the LAUSD Service Calls application will eventually be able to automatically query the operational asset layers in the ArcGIS database so that the asset ID can be determined. The ID will then be attached to the asset specified in the incident report submitted by the LAUSD community member. This will allow all information related to the asset (maintenance history, age, and replacement costs) in the GIS database to be automatically retrieved so the school district can use its GIS to better manage and maintain its assets.

The LAUSD Service Calls application can be downloaded for free to the user's smartphone. When reporting an incident, the user is prompted through a series of drop-down lists to specify the incident location, type, required maintenance, and description. This report and accompanying photograph is sent to LAUSD's asset management system, where it is reviewed by a moderator to determine the required course of action. If maintenance is required, a work order will be generated, prioritized, and routed to the appropriate department for action.

↑ A smartphone application integrated with the Los Angeles Unified School District GIS lets students and faculty members report graffiti or other repair issues.

According to Lu, the system also provides feedback to the person or persons reporting the complaint. When a work order is generated as a result of a service call, the asset management system automatically sends a response to the sender, indicating the incident report has been received and assigned. Students and faculty can use the CitySourced application to search for the calls they have placed. Under My Reports, they can view the status of an incident. This feedback loop demonstrates to the community that LAUSD is aware of and is working to resolve its concerns.

What's Ahead for Mobile GIS in 2012 and Beyond?

A Conversation with David Cardella, Product Manager for Mobile Technologies at Esri

Esri's ArcGIS for smartphones and tablets, including the new Android application, are proving popular with both GIS and non-GIS professionals. Esri writer Leslie Roundy spent a few minutes talking with David Cardella, product manager for mobile technologies, about how mobile applications, including ArcGIS for Android, will be used by Esri customers and what lies ahead for mobile development at Esri.

Roundy: What does the ArcGIS for Android application mean to Esri software users?

Cardella: All our mobile solutions, not just those specific to Android, are essentially a window into our users' GIS. This allows them to extend the reach of their GIS out into the field or even down the hall, outside their office space. Having ArcGIS on mobile devices means it's much easier to do this, especially on smartphones and tablets. These devices are pervasive and prevalent in the consumer industry, but we're seeing organizations implement and integrate them as well.

Roundy: Is there a typical user for these applications?

Cardella: Since ArcGIS for smartphones and tablets was launched, we're finding that non-GIS professionals are downloading it. While we intended it for GIS users as a more convenient way to get their data on these devices, we're finding that because of the accessibility of the various marketplaces and application stores, it's really reaching a large number of people outside our traditional customer base.

Roundy: Was that unexpected?

Cardella: In a sense, it was. I expected some non-GIS professionals to download the application because it's in the Android Market, but not in the numbers that we've seen. Our primary focus was to allow our existing customers to get their data on the device. But non-GIS professionals are using it to discover all the maps we host on ArcGIS Online. Our customers like that they can get their data on their devices. And the application's users like both the data and maps that Esri hosts plus the authoritative maps and data our customers provide. They like to be able to get at different types of data. The application allows them to access the ecosystem of maps that we have online, as well as any data that our customers want to share.

Roundy: What's in store for mobile development at Esri?

Cardella: We're finding that these mobile platforms, iOS and Android especially, are becoming much more pervasive in enterprises as well as with consumers. Consumers are using these devices to access maps and location-based services. In terms of how Esri wants to move forward, we want to support ArcGIS and GIS capabilities on the most popular mobile platforms. So as new platforms appear and become popular, we'll build on them as well. Until then, we'll continue to build more and more functionality into existing platforms.

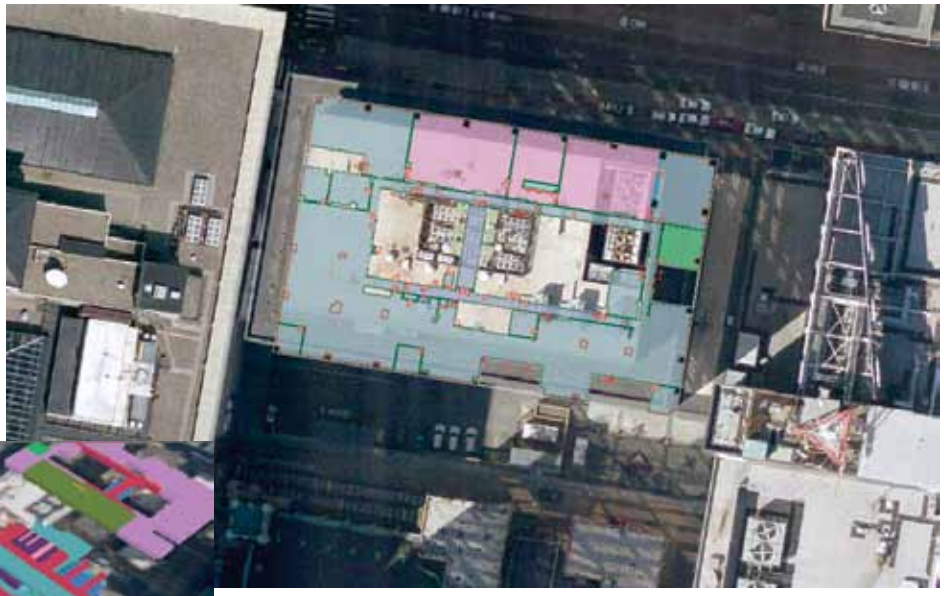
Roundy: Where do you think mobile technology will be five years from now?

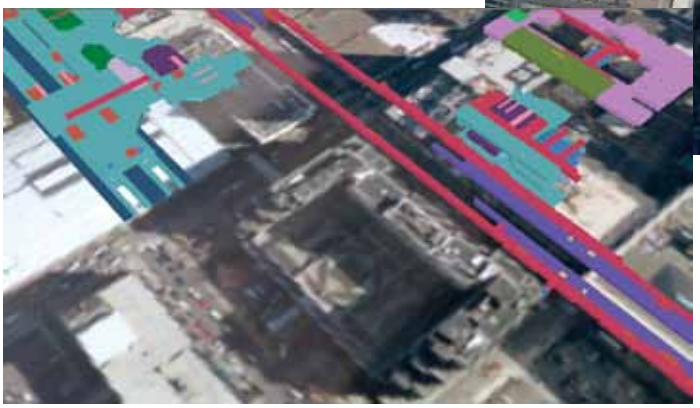
Cardella: When I look back five years ago, where we were with mobile, both within the consumer market and within GIS, I never would have thought we'd be where we are now. Over the next several years, I see a few pervasive platforms emerging. In North America, I see Android and iOS gaining traction among consumers and in the enterprise. I believe Windows Phone 7 will start to increase in usage as well, especially in European markets. There might be one or two emerging mobile platforms that share the limelight with iOS and Android. I certainly see the movement to tablet devices replacing desktops in homes. I don't think we're there yet, but we're moving in that direction. With smartphones being so conducive to browsing the web, there are some households that already use their smartphone as their primary means to connect to the Internet. As a company, we're going to closely track mobile technology trends, study what this means to our users, and determine where they're going to demand their GIS be in the next few years. Our job will then be to develop the best technology to suit their organization's needs.

Lidar Speeds Up Mapping of Bustling Center City

The City Uses a Blend of Robotics and GIS for an Innovative Project below Market Street

Center City in Philadelphia is a confluence of transportation, shopping, business, and government agency activity, with several multilevel spaces (including underground) within a few blocks. The fifth biggest city in the nation, Philadelphia also boasts the third-largest downtown population. The City of Philadelphia is committed to encouraging business and real estate development and has embarked on an innovative project to build up the area while at the same time making certain the downtown remains ready for business every day.





PenBay Solutions, an Esri partner headquartered in Brunswick, Maine, was contracted by the city to provide facility management mapping services for a pilot project aimed at testing the effectiveness of a total 3D GIS solution. This service included interior data collection using an innovative robotic platform employing 3D lidar. The robotic platform collected thousands of data samples as it was guided by a surveyor through the buildings. The data was precisely geolocated to a point on a high-resolution map of the interior space. This allowed PenBay staff to develop spatially accurate floor map data of the underground infrastructure that connects several notable buildings along Market Street in Philadelphia.

To effectively serve the city, including this bustling area, municipal government staff rely on their GIS, which is based on ArcGIS. Like most traditional GIS installations, however, theirs did not include data for the insides of the Center City buildings or the vast infrastructure under the streets. To maintain and expand the city effectively, staff need a complete view of the infrastructure—both inside and out—of buildings, railways, and surrounding areas for their facilities management, public transit, public safety, space planning, and real property departments.

Understanding from the Inside Out

The city wanted to understand its building infrastructure better. It was interested in seeing the relationship between pedestrian concourses with platforms, corridors, stair locations, and ramps; ingress and egress points; emergency access and air vent facilities; and connections between levels. To effectively analyze and manage this critical public infrastructure, it needed access to accurate and comprehensive spatial data information. This included data about space, like rooms and how they are being used, as well as data about assets, such as fire extinguishers and other components found within the rooms. Images had to be collected to guide anyone who needs to access a space, such as public safety officials, so they can get a real sense of what the space looks like.

A site assessment and requirements validation was conducted at the client site to plan for collecting the data necessary to help the city. The goals of this activity were to validate deliverable requirements and define data collection specifications; identify project logistical support requirements; discuss and validate project staging, access, and scheduling dependencies; and visually inspect project areas of interest.

Upon completion of the site assessment, a detailed list was generated of priorities, points of contact, access dependencies, and geographic proximity that allowed the creation of a project plan and schedule to capture the data. Center City facilities are complex and have a high volume of pedestrian traffic. Minimal survey time and disruption were of high importance to the city. The decision was made to operate a two-person crew on-site under the control of a project manager. This plan optimized the use of PenBay and client staff so that there would be minimal impact on building occupants and client resources.

Open during Construction

Once the dates for the survey visit were determined (the survey itself took place in fall 2010), PenBay started the logistics necessary to mobilize the equipment and staff

needed to execute the data collection phase of the project. Upon arrival at the site, the survey team closely coordinated its collection activities with the client.

The robot PenBay surveyors used was pushed through each hall and room at a normal walking pace. Lidar was used by the robot to measure the distance to each object by illuminating the target with light from a pulsating laser. Data points were collected illustrating where every object in the space is located, from walls and doors to desks and chairs. The robot also took spherical images with a camera that takes 360-degree pictures inside the building and then georeferences them. This provides a continuous image of the space that can give a more accurate representation of the real buildings.

Since data collection happened mostly at night to keep with Center City's mission of not impacting the community, security escorts were provided by the city's public transit agency, SEPTA, for safety as well as to provide unencumbered access to all areas, such as the subway system and secure buildings. In total, PenBay collected 340,000

square feet of designated infrastructure. The survey provided the city with a clear and accurate view of how underground infrastructure links to the aboveground buildings and roads. The combination of GIS and robotics provided the ability to measure pertinent space in a fraction of the time it takes with traditional collection methods. Staff took only 20 hours to collect all the data necessary for the pilot project.

One Cloud—Many Datasets

PenBay provided this data to the city in a building information system data model (BISDM)-compliant dataset that included CAD (AutoCAD) and 3D BIM (Revit) files of the area of interest and a primary deliverable of an ArcGIS geodatabase. Using ArcGIS for Server and the geodatabase, city staff have access to the data files easily over the web.

A 3D video dataset was also collected for the entire captured area. This is of particular interest to public transit and the public safety community for planning and preparedness workflows, which provide assistance to facilities managers in condition assessment and asset inventory.

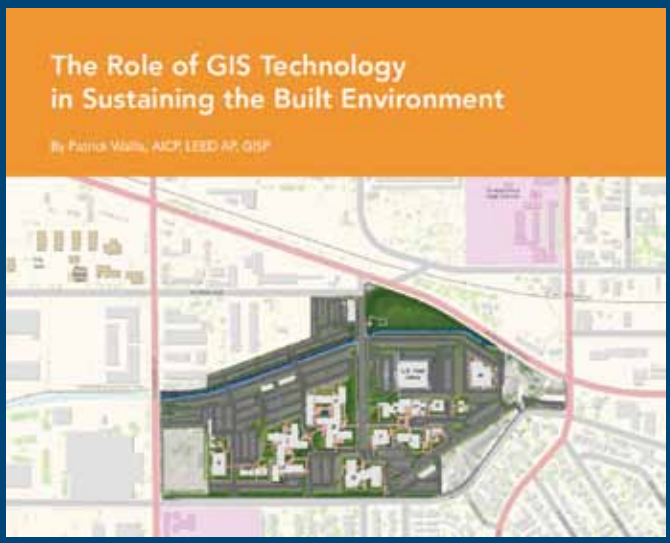
Through this pilot, PenBay was able to demonstrate how critical deliverables can be created to support the city facilities management initiative using GIS and lidar. Space definitions were defined, including where boundaries such as hallways and rooms begin and end, accurately on maps; floor plan data was captured to represent interior space and structure accurately; and facility surveys were performed quickly, safely, and cost-effectively. For more information, contact Stu Rich at SRich@penbaysolutions.com.

New E-book for Facilities Managers

The Role of GIS Technology in Sustaining the Built Environment

A new e-book is available for anyone responsible for the form and condition of the built environment—regulators, policy makers, facility designers, owners, and managers. The e-book was produced to help connect the dots between the number of reports published over the past 14 years on the state of the capital and residential facilities industry in the United States, as well as between everyone's experiences working for and with the industry. The e-book also provides a cogent and compelling argument for using GIS as the enabling technology for better communication and data interoperability. Trends over the past 30 years have not been favorable for the long-term sustainability of the built and natural environments. This book proposes the use of GIS as a means to achieve required stewardship, sustainability, and savings for the built environment.

The e-book is authored by Patrick Wallis, a project manager with Esri who provides technical expertise in support of facilities management, master planning, ports, and maritime projects. He is an architect and designer by training (M.Arch,



LEED AP), as well as a certified planner (AICP) and GIS Professional (GISP), with nearly 14 years' project experience shaping and managing the built and natural environments. His technical expertise is in facilities acquisition, real estate management, municipal and master planning, economic analysis, and GIS.

Read an excerpt of the e-book, which is available on the Esri Facilities industry page at esri.com/facilities.

ArcGIS for Facilities

By Shelli Stockton, Esri Global Facilities Industry Manager

Do you know what you don't know about your building, campus, or base? If you're looking at your building or campus as a group of disparate objects as opposed to seeing it as an integrated, functional system of interdependent parts, you don't.

BIM and specific facilities technologies like enterprise asset management (EAM), building automation systems, computer-aided facility management (CAFM), and integrated workspace management systems (IWMS) provide great amounts of detailed data on a myriad of items, from the smallest screw to the largest HVAC system, yet have no ability to tell you if they are located within the same proximity so that it would make sense to have the maintenance worker you send out handle the reported problems with both. Or that incidences of crime have spiked in an area where outdoor lighting fixtures are old and blocked by overgrown bushes. Or that, over time, your CPR-certified employees have all ended up on one floor, leaving three others without access to that resource. Smarter facilities—those that are safe, secure, energy efficient, and optimally operated and utilized—result from the convergence and interoperability of BIM, these specific FM technologies, and GIS.

The key to developing true insight into our complex and dynamic world is creating a framework of understanding. We need to take many different pieces of past, present, and future data from a variety of sources and merge them into a single system. GIS is uniquely positioned to do this. Already widely used by planners, engineers, and facility managers, GIS helps you capture, store, analyze, and use all forms of location-referenced data about where people live and work.

GIS enables a framework for smart design and management. Users can inventory and display large, complex spatial datasets and use them to analyze and manage issues. Whether at a single campus or base or across an entire organization, the effect of various factors on each other can be studied, monitored, and measured.

With GIS, you can do the following:

- Streamline asset information: collection, dissemination, maintenance, and use
- Facilitate better planning and analysis
- Allow efficient sharing of information in and out of the field, providing a comprehensive view of operations

Smarter facilities will result from the convergence of BIM, GIS, and the additional FM system technologies mentioned above. These tools and technologies will help primary facility stakeholders and users improve decision-making capabilities, the time it takes to make these decisions, and the reliability of the results. These benefits will translate into recognizable and, in many cases, dramatic increases in cost efficiencies, reductions of risk, and increased facility sustainability and longevity.

To make this even easier, the ArcGIS for Facilities system includes a series of templates for facilities and a data model so facility managers can integrate their facilities data into one standard format, apply cartographic rules to the data so it is easy to view and understand, and make the data easily accessible to others in their organizations. For more information on these concepts and how GIS helps facility managers, visit esri.com/fm.

Private Clouds: Moving from Hype to Reality (Really!)

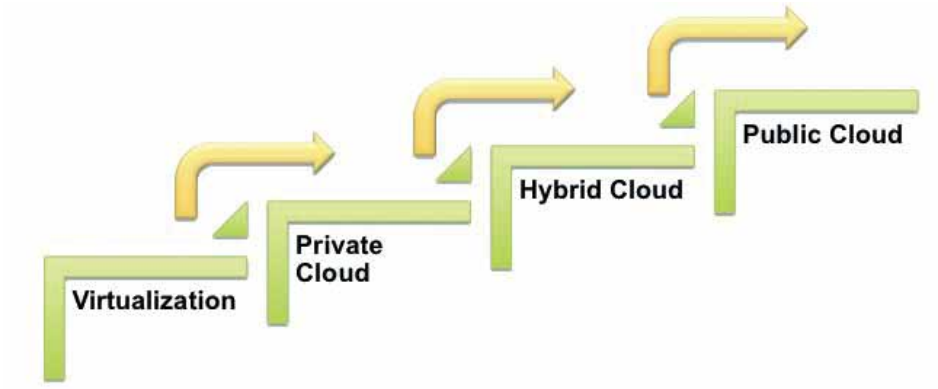
by Victoria Kouyoumjian, Esri Business and Technologies Strategist

Back in 2008, the term *cloud computing* was barely a glint in the eye of most technology companies. Perhaps they used SalesForce.com and Gmail, but tossing around the *cloud* terminology wasn't really de rigueur. Now it's hard to imagine tech discussions without some reference to it at least once in the conversation. Seems like it's everywhere—or at least the terminology is.

In 2009, Esri hitched its geowagon to Amazon Web Services (AWS) as its primary cloud provider. But the general consumer audience was much more familiar with shopping experiences through Amazon.com rather than cloud hosted services off of AWS. Fast-forward less than three years, and things certainly have changed. AWS has established itself as separate and different from Amazon.com, with a brand synonymous with cloud as a globally known public cloud infrastructure service provider. And in 2010, Esri announced the availability of ArcGIS Online, initially supported by AWS infrastructure under the hood, to bring the ubiquity of a public cloud platform to the geospatial community.

At the same time that public clouds were moving into mainstream business, a parallel current of a cloud trend was emerging: private clouds. Initially, there was (and still is) a lot of back-and-forthing on the definition of *private cloud,* and arguments around the private cloud notion as simply a rebranding of an organization's existing data center—infrastructure hosted on premises behind the firewall. But with the advent of cloud computing, organizations are now exposed to some of the technologies that enable the core characteristics and benefits of cloud computing: the idea of a self-service portal for their customers or staff and the virtualization of servers—that is, the ability to create multiple "virtual machines" from one physical server—affording increased optimization of underutilized infrastructure, ratcheting up server optimization to 75 percent or more, from an average of 25 percent.

In fact, for many businesses and agencies, the private cloud may be the only choice when attempting to leverage at least some of the benefits of the cloud computing "skyscape." Hosting data and applications off premises in a cloud provider's data center, potentially out of the country or in a seemingly unknown location, might be legally prohibited or verboten by organization requirements and politics. This growing interest in leveraging the private cloud has not gone unnoticed by Esri, and it's moving quickly to provide solutions for this demand.



↑ The Cloud Adoption Trend

Portal for ArcGIS allows any organization to stand up its own customized ArcGIS Online, to create a unique geographic content system; the system may be on premises, within privately owned data centers, or managed by Esri, behind configured firewalls, to provide more control over security or meet regulated restrictions.

Available in Q2 2012, ArcGIS Online for organizations carves out a private community cloud for any company, business, group, organization, or agency. Although hosted in public off-premises infrastructure, the services and data are specific, secure, and isolated to only the members of the organizational account, but with access to public services, hybridizing the public and private cloud seamlessly.

Most recently, Esri paired up with VCE—a coalition of EMC, Cisco, and VMware—to successfully test and certify ArcGIS on its private cloud infrastructure appliance. Vblock, as it is known, provides the storage, network switches, virtualization layer, and compute capacity that many organizations will find attractive as a bundled private cloud platform, in a nearly plug-and-play capacity.

Esri is dedicating significant investment, research, and development into public and private cloud offerings and providers and will continue to do so, going forward. It is without question that cloud computing has the potential to be a disrupting trend, upsetting traditional technology models, and yet simultaneously demonstrating the potential for a promising boon. And what about you? Where do you and your organization stand "in the cloud"? Private, public, hybrid, or none of the above?

Geodesign Gathers Momentum

Two-Day GeoDesign Summit Focuses on Geodesign Technologies and Practices

By Carla Wheeler, Esri Writer

The term *geodesign,* once hard to define, is becoming part of the vernacular in the design field. That astute observation opened this year's GeoDesign Summit, a gathering of professionals interested in using geospatial technologies to arrive at the best and most sustainable design solutions.

The theme of the summit, Geodesign in Practice, went to the heart of geodesign's ultimate goal: finding innovative solutions to the most pressing challenges by fusing design processes with geospatial technologies. In other words, geospatial technologies will provide the analytic capabilities necessary to evaluate different options and the tools to collaborate as these alternatives are weighed.

"This is not just the classic design field," Esri president Jack Dangermond said during a talk that welcomed to the summit geodesign practitioners from a diverse range of fields and industries including urban planning, architecture, transportation, utilities, and telecommunications. "This mixing of science and design goes right across all of society."

Dangermond underscored the importance of putting geodesign to work on pressing issues such as climate change, energy needs, health, poverty, and biodiversity loss. In hearing former US president Bill Clinton speak at the recent Eye on Earth Summit, Dangermond said that he was struck by Clinton's words about taking action. "He talked about all the policies and discussion about climate change and population, and he said, 'I'm not really sure all these discussions are going to matter.' There was silence in the room. He said, 'What I actually have faith in are real projects. I'm dedicating my life to doing projects in [places like] Africa, Latin America, and India.' He said where the rubber hits the road is doing real project work. Isn't that really what geodesign is about?"

↑ The audience at the GeoDesign Summit heard from more than 30 speakers.

Geospatial Systems Essential to Understanding

Geospatial systems are critical to understanding the problems society and organizations face, according to Dangermond. "They are converting data into maps [or] information," he said. "They are integrating mapped datasets through map overlays and integration and modeling to create knowledge of how things are working. One of the great contributions that the web is making is the collaborative sharing environments that are allowing us to bring our knowledge together over the web to create better understanding. These trends are half of the story. The thing we need to do is link all that information/knowledge with the design process [using] tools and methods that allow us to create sustainable designs and environments in the future."

Geodesign Framework and Technologies

At this year's summit, the conversation among the 200 attendees focused on the emerging technologies for geodesign, geodesign in education, and geodesign case studies. Here are some highlights:

- Technological advances that support geodesign, including demonstrations of new sketching, design, and scenario management tools in ArcGIS 10, along with Esri CityEngine generation of 3D content, such as buildings, trees, and roads, from GIS data.
- How elements of geodesign are being put into practice by urban planners, architects, landscape architects, design and GIS professionals, and even marine scientists. Speakers delivered a wide range of Lightning Talks, including Red Fields to Green Fields—Los Angeles, a project where geodesign was used as part of the process to create a plan to transform rundown, vacant land into parks and green, open space.
- The growing number of higher education institutions that are launching geodesign programs or curriculums. These include Penn State University, which is developing a master's program in geodesign, and Northern Arizona University, which has already launched a bachelor's degree in geographic science and community planning.

Speaking at this year's conference was Carl Steinitz, Alexander and Victoria Wiley Professor of Landscape Architecture and Planning Emeritus, Graduate School of Design, Harvard University. He just finished writing the book *A Framework for Geodesign,* which will be published by Esri Press this summer. Bill Miller, the director of GeoDesign Services at Esri, wrote a working paper in which he says that the book will likely become

an important resource for geodesign practitioners and academics.

This complete framework includes the following:

- Representation models: How should the landscape be described?
- Process models: How does the landscape operate?
- Evaluation models: Is the landscape working well?
- Change models: How might the landscape be altered?
- Impact models: What differences might the changes cause?
- Decision models: Should the landscape be changed?

"In Carl's book that's forthcoming, we now begin to realize that geodesign is not just a concept," said Dangermond. "It can be thought of as a systematic process of measuring and modeling and interpreting and designing and evaluating and making decisions. And articulating that well and embedding that into the workflows of how we create the future is the real plot of discussion here."

Years from now, Dangermond said, people will look back at geodesign as "an evolutionary step for humans. It's going to be, 'Ah, finally we connected the dots. Finally we began to realize the implications or the consequences of our actions.'"

During the summit, product engineer Matthew Baker from the Software Development team and solutions engineer Eric Wittner from GeoDesign Services at Esri demonstrated some work the company is doing to develop GIS software that supports geodesign. Steinitz's geodesign framework remains the key model for the workflows and tools developed by Esri to support geodesign with ArcGIS, Baker said. "We know that geodesign is software independent, so our challenge is, how does our software fit in with this framework?" he asked.

With the framework from Steinitz in mind, tool development efforts focused on studying the workflows of several design firms that have geodesign projects in the works. One such firm is O2 Planning + Design, based in Calgary, Alberta, which is working on a transit-oriented development north of the city.

Geodesign workflows involve creating suitability and sensitivity layers that will inform design, such as a layer that depicts the vulnerable habitats in a proposed development study area.

After studying the workflows of several other design firms, Esri developed a set of tools that would facilitate sketching and design. This new geodesign window for ArcMap, which will be in the upcoming ArcGIS 10.1 release, lets people easily search for and download design templates from ArcGIS Online that include tools for creating, manipulating, and interacting with a design.

The window also brings together several core tools into one centralized window, with easy access to the tools that facilitate sketching and design.

One key aspect of the window is scenario management. The ability to create and manage multiple scenarios is something that has not previously existed in a GIS. With the design in place, said Baker, the next step is to visualize what a design might look like if built. This can be done with Esri CityEngine software. CityEngine allows an urban form to be rapidly created on top of GIS data by procedurally creating features such as streets, parcels, blocks, buildings, houses, open spaces, and vegetation based on sets of rules. In the case of O2 Planning + Design, the rules looked at the underlying data to visualize the density and arrangement of buildings as described in the foundational land-use and intensity plans.

High-intensity areas, with mixed-use zoning, drove denser street network creation, smaller lot sizes, with taller buildings. Likewise, residential zoning in low-intensity areas automatically creates less dense streets, larger lot sizes, and houses rather than multistory buildings. The buildings and houses can be rendered as simple massing models; color coded by zoning type; or developed into geometrically complex, fully textured buildings with step backs, balconies, windows, and terraces. Wittner demonstrated how spatial analysis inside Esri's 3D City template can be used to drive site analysis and selection; CityEngine is then used to do advanced plan visualization, and the results are pulled back into the template for use in analysis. CityEngine, when paired with ArcGIS, provides a powerful tool for understanding and visualizing what could be, in the context of what is.

Geodesign in Action

Besides watching technology demonstrations, which included a presentation about ArcGIS Online, the audience also heard talks from more than a dozen professionals who incorporate geodesign in their work.

They included Stuart Rich from PenBay Solutions LLC, who spoke about how geodesign is helping Kuwait University plan construction of a new, multibillion-dollar campus; Lilian Pintea from the Jane Goodall Institute, who described how geodesign is being used to protect chimpanzees through community-centered conservation; and Abby Jones from the Anthro/Ecological Design Collective, who talked about the role of geodesign in a project to turn distressed land into parks in Los Angeles.

Jones spoke about geodesign at a small scale—a neighborhood park or community garden, for example.

Keynote speaker Braden Allenby stressed the importance of thinking about geodesign at a greater, global scale to deal with complex issues such as climate change, water resources, biodiversity, and the economy. Allenby, Lincoln Professor of Engineering and Ethics and professor of civil and environmental engineering at Arizona State University, also talked about designing for complex adaptive systems such as the Florida Everglades. "You never go backwards in a complex adaptive system. You may go to someplace new, but you are not going to get the world that you had. You want to restore the Everglades? It will never happen," he said. "What you will get is something that is new and maybe pristine and maybe very biodiverse, but you will not get the old Everglades back. . . . What we need to do is learn how to design in the context of complex adaptive systems."

The GeoDesign Summit ended with a thought-provoking talk on the future of geodesign by Stephen Ervin, assistant dean for information technology at the Harvard University Graduate School of Design and a lecturer in the department of landscape architecture. He looked ahead to what's possible, probable, certain, likely, unlikely, and inevitable in a world with geodesign.

While Ervin said he thinks that it's highly unlikely any agreed-upon definition of geodesign will ever emerge, one certainty will be a planet of 10 billion people. "It is for these people that we do geodesign," he said. "It's not for the trees or the hydrological systems or the atmosphere. It's for the 10 billion people that are our inheritors of what we do."

The next GeoDesign Summit will be held January 24–25, 2013, at Esri in Redlands. For more information, visit geodesignsummit.com.

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