Enterprise Edition

Smart Facilities

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GIS for Facilities Management

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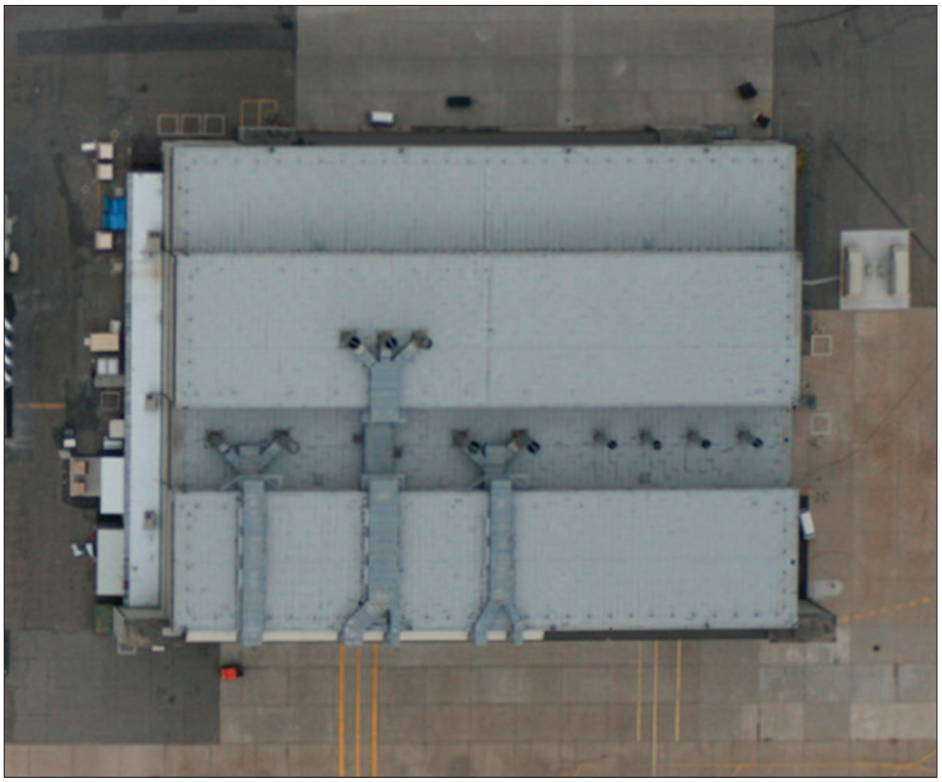
ArcGIS and Thermal Infrared Imagery Provide a Cost-Effective Means to Identify Failing Roofing and Utilities

Hill Air Force Base (AFB), part of the Air Force Materiel Command (AFMC), is located in northern Utah near the city of Ogden. Many operational and support missions are located here, including maintenance of the F-16 Fighting Falcon, the A-10 Thunderbolt II, and the C-130 Hercules aircraft.

The main base covers 10.2 square miles. Buildings are used for aircraft maintenance and upgrades, as well as for technical and training facilities for flight staff on the base. This critical infrastructure is worth hundreds of millions of dollars in assets, services, and personnel.

Many of the 1,300 buildings located on the base are original, dating back to the 1940s. Due to normal wear and tear, the 70-year-old infrastructure, including the maturing utility system, was deteriorating. There was little data—some of it unreliable—kept on facility conditions, including roofing. Failing roofs were often discovered when personnel were directly affected or the damage was extensive enough that it could be seen. Limited information on the facilities made identifying and fixing the issues expensive and time-consuming.



Hill AFB mapped 12,000,000 square feet of roofing to see where infrastructure was located.

Historically, Hill AFB personnel manually inspected roof conditions, but the manpower and monetary requirements to conduct physical roof inspections building by building were cost prohibitive. Additionally, the price tag attached to replacing all the roofs was unrealistic.

Discovering Roof Failure with Thermal Imagery

To find a solution that would help them work smarter and more efficiently, Hill AFB personnel turned to ArcGIS. Most air bases are standardized on Esri geographic information system (GIS) technology. Hill AFB has been a longtime user of the technology, with a site license for ArcGIS that allows it to use the software throughout the base for everything from topographic mapping to flight chart-

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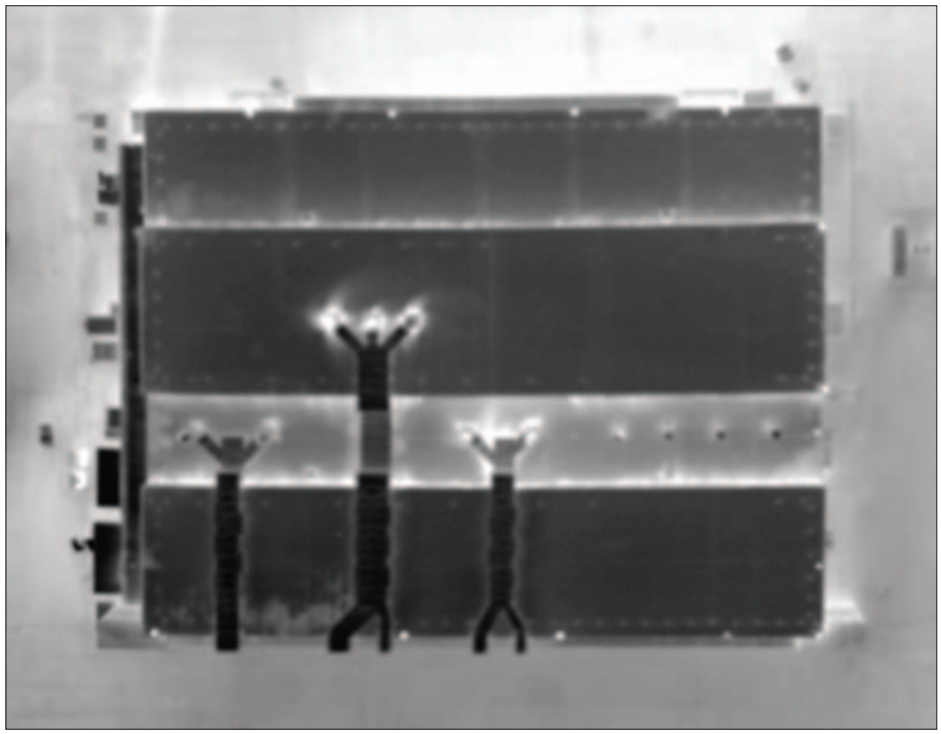
Innovative Facility Upgrading at Hill Air Force Base

ing. With their extensive knowledge of the software, staff turned to ArcGIS to help them with their challenge of building maintenance. Working with Esri partner Woolpert, Inc., based in Dayton, Ohio, members of the GIS department took existing topographic maps and overlaid them with aerial photographs of the buildings to map the facilities, including 12,000,000 square feet of roofing. This gave them a visual representation of where the infrastructure was located, but the issue of cost-effectively finding failing roofs and pipes was still unresolved.

"We thought incorporating thermal infrared [IR] imagery into our facilities maintenance would be an efficient solution to identifying our failing infrastructure," says James Wright, IGI&S (GeoBase) manager, 75 CEG/CEAO at Hill AFB.



Using thermal IR imagery, unique heat signatures are registered, and areas with wet roofing material can be easily discovered.

Thermal IR is imagery that shows heat. It is often presented in the form of a grayscale picture with shades of gray indicating the differences in temperature and emissivity, or ability to emit energy by radiation, of objects in the image. Typically, objects in a thermal IR image that look lighter are warmer, and those that look darker are cooler. Bright white objects are the warmest in the images, and black objects are the coolest. For example, in looking at the thermal imagery, it is possible to see how buried chilled-water lines cool the surface above the line while steam supply lines heat the surface above the line.

> "We like to use imagery because it isn't reinterpreted, and so it retains all the original information, making it a perfect choice for analysis such as feature extraction, classification, suitability, and measurement."
>
> Daniel Michalec, Application Specialist, Woolpert

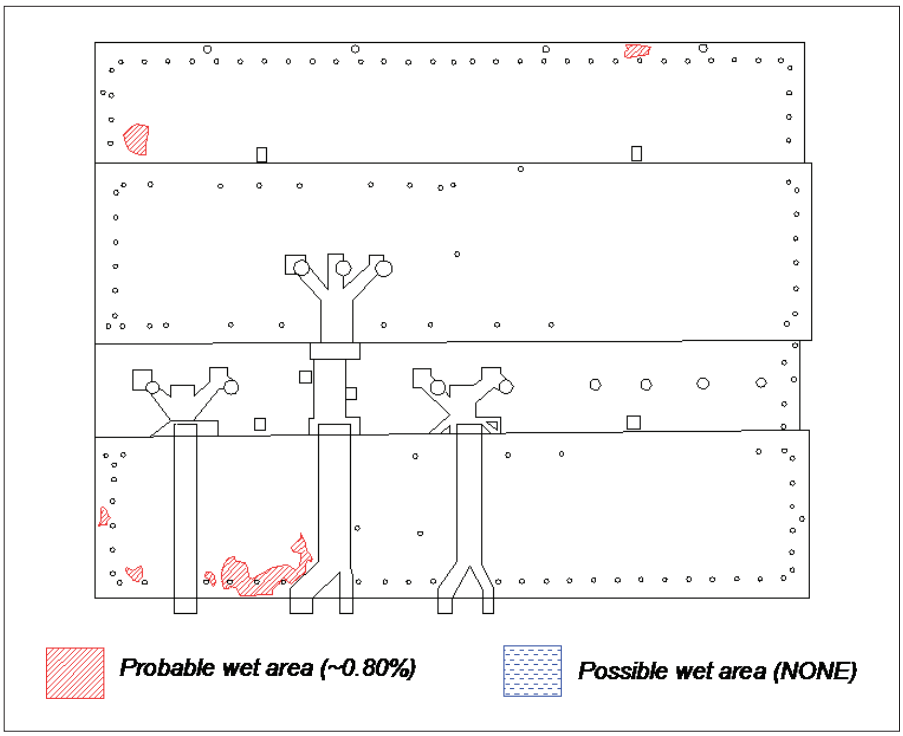
Thermographic imagery shows the unique heat signatures that are produced by different environmental conditions on physical materials. The wet areas of roof materials have different thermal characteristics because the latent heat from daylight sun, which is trapped in the water mass, is greater than in the dry, functioning insulation or roof substrate. After sunset, when the roof structure cools down, wet areas of the roof insulation and other materials continue to radiate heat that can then be detected and captured with thermal equipment.

ArcGIS for Efficient Image Processing

"Thermal IR promised significant potential cost savings, since it is much cheaper to fix a roof before it fails," explains Wright. One reason for this is manpower. Data for the entire installation can be collected in one night rather than performing individual inspection visits to 1,300 buildings. Another reason is the fact that even buildings with rooflines on multiple levels can be collected easily, unlike a ground-based survey that would require staff access to each individual roof level.

Woolpert staff flew the base with a fixed-wing aircraft and captured nadir images, which are images taken pointing straight down toward earth. Since thermal IR is stored and used in the same manner as other types of raster data, no special requirements are needed to view, analyze, and store them in ArcGIS. Once collected, the raster imagery is processed with ArcGIS and delivered in georeferenced vector and raster datasets that seamlessly integrate with existing GIS data used at the base. ArcGIS allows staff to manage different image resources such as thermal IR and aerial photos, since the software supports most existing raster and imagery formats. This simplifies image management and workflows.

Another plus for Hill AFB is the fact that



Images are converted to vector files, and the data is analyzed for the probability of water infiltration or leakage and the amount of square footage affected.

imagery does not have to be reprocessed, as the existing datasets are referenced and can be analyzed on the fly when the imagery is accessed by the user. This cuts down on the need to store multiple versions of the imagery. This is an advantage when dealing with large files like the thermal IR, which was captured at the base at eight-inch resolution. Once collected, thermal IR imagery was analyzed with ArcGIS for the probability of water infiltration or leakage and the amount of square footage affected. More than just a picture of roof damage, the imagery provided real knowledge for analysis. "We like to use imagery because it isn't reinterpreted, and so it retains all the original information, making it a perfect choice for analysis such as feature extraction, classification, suitability, and measurement," says Daniel Michalec, application specialist, Woolpert.

Data and reports generated from this analysis allowed staff to determine the roofing needs and priority for each building. Work orders were then created based on the analysis and entered into the work order system used throughout the Air Force, the Automated Civil Engineer System (ACES).

Cost Savings and Discovery

Besides the deteriorating roofs, using the thermal IR found older areas of the base with utility systems that are becoming increasingly volatile. Leaking steam lines are easily identified in the images as white lines. Since the raster is geospatially accurate, these utility locations can be identified, surveyed or digitized, and then loaded into ArcGIS. This eliminates the need for costly, ground-based detection to seek malfunctioning lines. "Thermal IR roof inventory saved us money compared to traditional, manual roof assessment," states Wright.

For more information on how GIS is used in facilities management, visit esri.com/fm.

Cornerstone

By Shelli Stockton, Facilities Industry Solutions Manager, Esri

The primary theme for the next release of Esri's ArcGIS software, ArcGIS 10.1—which is expected to be released in early 2012—is sharing/collaboration. FM users of ArcGIS 10.1 will find that this release, along with the resources Esri is making available right now, will make it simpler to apply mapping and geospatial analytics to all your facilities needs. The recently released Campus Basemap and Campus Editing templates are two examples and will help you deliver GIS throughout your enterprise more easily and readily than ever before.

The next release of ArcGIS and resources like these templates make cloud computing an increasingly critical player in how you and your users get work accomplished. ArcGIS software will take advantage of the powerful, scalable, and ubiquitous nature of cloud infrastructures to store and distribute geospatial content. You will be able to easily package maps and layers and make that content available to staff, stakeholders, partners, and the public via online groups while maintaining complete control and ownership of your content. Additionally, you will be able to quickly deploy GIS servers in the cloud when you need them as fully functional production systems for publishing services and supporting desktop, mobile, and web applications.

I invite your questions and ideas. E-mail me at sstockton@esri.com.

Building a University of the Future

High-Level Planning Bolsters Performance and Processes

The University of Calgary in Alberta is considered one of the top research universities in Canada. It has more than 29,000 students and over 4,000 academic and support staff. The university began using GIS for academic research 20 years ago and has now standardized on Esri technology as its geographic information management platform. Realizing the value of geographic analysis for informed decision making, it has expanded the use of its 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 capital expansion project in its history. The university maintains institutional data used for facilities management in a central data warehouse. ArcGIS for Server serves as the front-end technology that pulls data from ARCHIBUS, an Esri partner that provides solutions used to manage spatial data and real estate, infrastructure, and facilities information. These recently integrated systems enable users to visualize and analyze interior and exterior building data, which allow more cost-efficient facilities management, as well as improved site planning and operations.

"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," said Tom McCaffrey, GIS coordinator, University of Calgary.

In the early stages of construction, the facilities management team approached the university's GIS team to create a campus drainage basin model. The model has since been leveraged in several projects including planning of new building sites, sewer expansion, and a research project that filters surface water before it enters the sewer systems. The drainage model was created using light detection and ranging (lidar) data combined with high-resolution orthorectified aerial photographs. Esri's ArcScene application allowed decision makers to view and process the data in 3D while effectively analyzing the effects of new construction sites on the existing grounds.

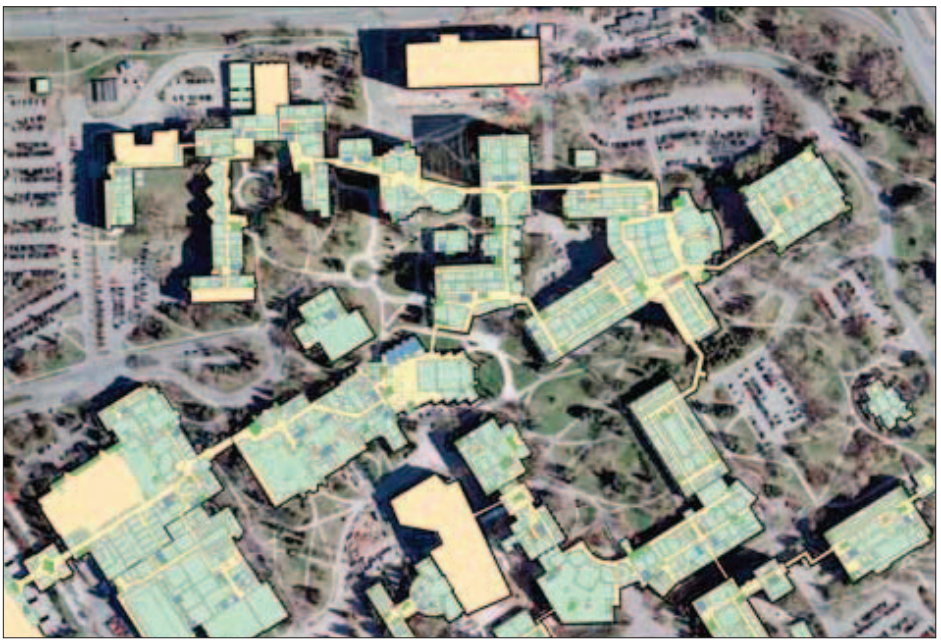
> "Esri technology offers endless opportunities for our processes to grow," said McCaffrey. "Processes that used to take weeks can now be done in minutes. Being able to see the entire picture at once is an option we've never had before. GIS allows us to plan at a much higher level than we could have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

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 as compared to a solid wall structure—a method used to optimize the heating mechanics of the building.

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. In many GIS projects, the development of one application often generates additional benefits. In this case, 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 each one sprays, as well as the area it covers. The application allows the university to conserve water by reducing overlap and avoiding spraying water on roads and pedestrian walkways.

"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," said McCaffrey. "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."

In conjunction with the construction, the information technologies (IT) department also used GIS 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 reduced utility costs for electrical and cooling systems.



Data on more than 200 hectares containing 20 academic buildings is stored within a data warehouse managed by ArcGIS for Server.

General maintenance for utilities and computer networking systems can be overwhelming if left unchecked. The IT telecom group reached out to the GIS team to create an application that would track telecom network lines, utility corridors, wiring closets, and utility shafts throughout the campus. The web-based application, when completed, will serve 3D diagrams of the networks that administrators can edit and analyze. The application will also allow service technicians to trace, track, and repair faulty wires and equipment in a more timely fashion. The system will enable them to monitor real-time data, plan networks, and prevent technical issues, thus saving costs in the future.

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. Using ArcGIS, it is now able to track life cycles and warranties of the roofing materials, which can potentially lead to thousands of dollars in savings on roofing jobs. GIS has virtually eliminated the need for manual roof measurements that cost both time and money, as well as pose a potential safety risk. The GIS team created a web mapping application that allows editing, updating, measuring, and reporting on government funding spent on reroofing the campus. Reporting structures to the government via documentation using an accurate spatial and temporal method provides strong accountability for how government money is spent.

From a risk management perspective, the university has also used GIS to enhance public safety. Using a current model of the campus and 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 facilitate a mobile command and control center.

To support the university's safety walk programs, ArcGIS was used to build external lighting models. These models estimated ground illumination based on the type of light fixture 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 find their way around campus easily, 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—by 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 number and generate a map that shows 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.

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

Esri Acquires 3D Software Company Procedural

3D GIS to Provide Instant Visual Feedback in City Planning

Esri has acquired Procedural, one of the world's leading software companies for creating stunning 3D urban environments from typical 2D data. Urban planners, architects, video game developers, and movie studios around the world use Procedural's CityEngine product to create 3D cities at any resolution.

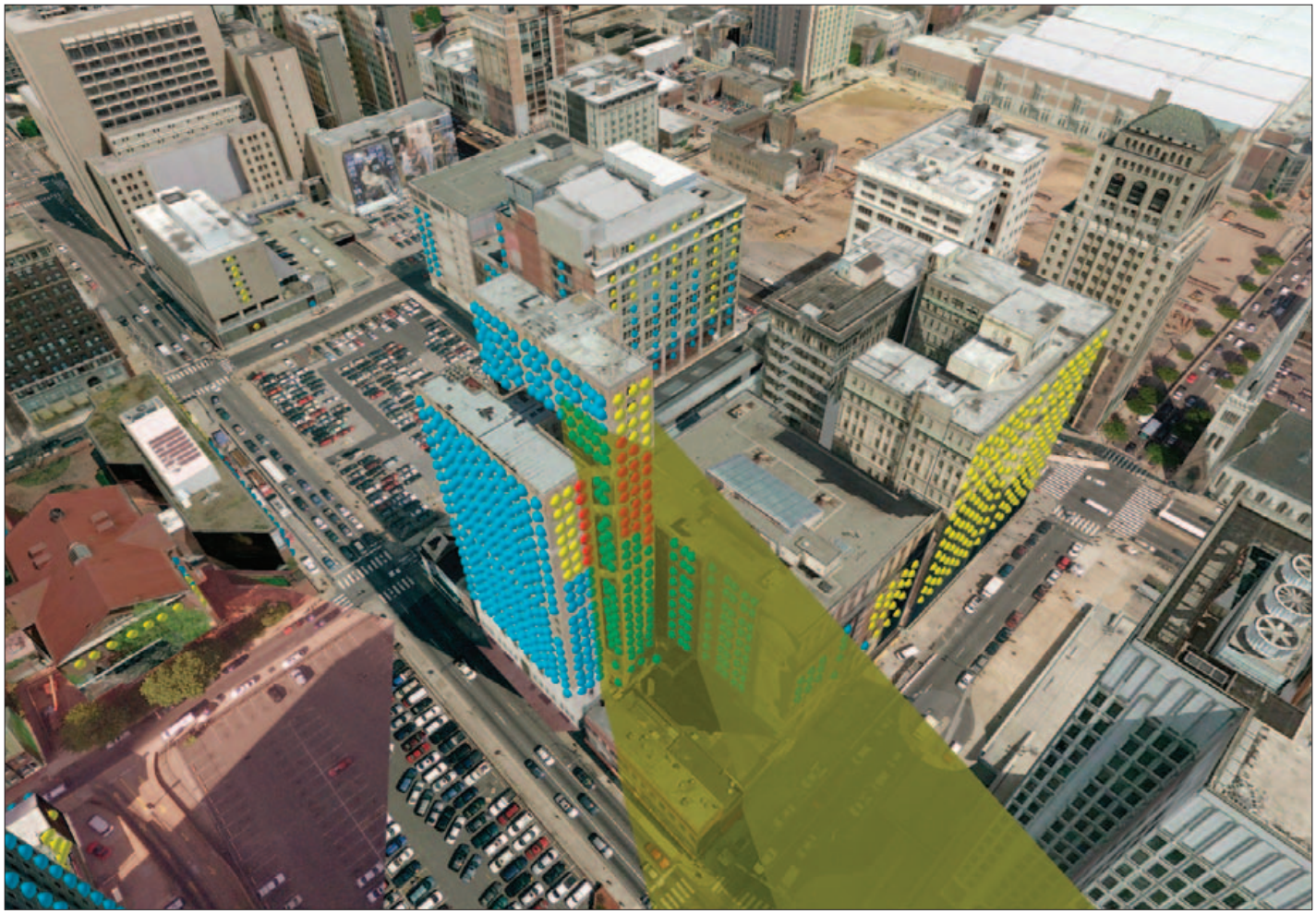
Esri will integrate CityEngine into ArcGIS, allowing ArcGIS users to create and design 3D urban environments leveraging their existing GIS data, such as parcels and street centerlines. CityEngine's rule-driven approach will allow users to undertake large-scale civic planning efforts and will provide immediate visual feedback on the impact of planning decisions, such as setbacks and floor-specific zoning changes. Users will also be able to interactively design and analyze urban growth with intuitive sketching tools.

"Many GIS problems can only be solved in 3D, particularly in the area of urban development," said Jack Dangermond, Esri president, making the announcement at Esri's 2011 International User Conference. "Procedural's unique capabilities for generating high-quality 3D data, using the same GIS data our users already have, makes it a perfect match for Esri."

CityEngine will continue to evolve and expand as a stand-alone product. The founders and employees of Procedural will be employed by Esri, and Procedural's offices in Zurich will be extended to a leading-edge R&D center in the field of urban design and 3D content creation. Procedural will continue to meet the needs of its large community of CityEngine users in the simulation and entertainment industries.

"We are very excited to join forces with Esri," said Dr. Pascal Mueller, CEO of Procedural Inc. "Many of our existing clients already use ArcGIS, and a closer integration between our complementary technologies presents obvious benefits. We're looking forward to fully leveraging our R&D capabilities, growing the CityEngine business, and bringing many of the innovations we've developed at Procedural to the leading GIS solution of ArcGIS."

For more information, visit esri.com/cityengine.



The integration of CityEngine into ArcGIS will provide immediate visual feedback on impacts of planning decisions, such as line of sight.

Esri Offers New ArcGIS Online Templates for Facilities

By Karen Richardson, Esri Writer

A Scanned Paper Floor Plan Being Used in the Campus Editing Template

Two templates called Campus Basemap and Campus Editing were just released on ArcGIS Online. These templates will help facility managers 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.

Users can also visit a new, online Facilities Group, where they can find maps, applications, and best practices created by Esri to help with facilities projects.

ArcGIS Online is a cloud-based system for creating and sharing maps and geographic information. Anyone can use it to create, view, and use intelligent maps as well as upload and style geographic data, create web maps, interact with maps on any device, and embed maps into websites and web-based applications. ArcGIS Online also provides a wealth of information and resources for users who can benefit from additional assistance with their GIS projects.

Campus Templates for ArcGIS 10

The Campus Basemap template is an ArcMap document that can be used to create a detailed, multiscale basemap for a university or business campus. Government agencies can also use the template to produce a detailed basemap for a downtown area, government complex, or military base.

The Campus Basemap template is designed to help organizations publish high-quality basemaps using their own authoritative content. The template provides a consistent geographic context so organizations and agencies can share data and provide applications and services to their users. The template supplies important reference information such as buildings, parking areas, sidewalks, and fences.

The Campus Editing template includes an ArcMap document, an add-in for the Editing Toolbar, and a set of editing workflows for managing building, interior space, and related exterior campus data. Mapping technicians at a school campus, government agency, military installation, or private business can use this data editor to streamline the collection, maintenance, and use of asset information.

The editing template includes workflows that can be customized to support the format of facilities source data. It can also be used to create and import both interior and exterior features. Adding interior and exterior facilities and assets to a campus map can be completed expediently by using imagery as a guide. High-resolution imagery can assist with inputting exterior facilities and other data, such as roads and parking lots, to the map. Buildings, floors, and interior spaces can be added by using a georeferenced scan of a building floor plan. Also included is an add-in called the Attribute Assistant, which uses a series of predefined methods that automatically populate attributes for updates or additions of new features to the campus map.

For more information on how GIS is used for facilities management, visit esri.com/fm.

Data Is King

By Stu Rich, PenBay Solutions LLC

This article is the second in a series that will discuss the value that GIS can offer to each stage of the facility management life cycle.

Everyone has had the "garbage in, garbage out" experience and knows that it can really impede your success in data-related decisions, since you can't trust the information you are using. In the built environment, data is critical for many tasks, from site selection and design/construction to work order or asset management and portfolio assessment. Without good data, it is difficult to make good decisions.

While managing data in a GIS is not a new concept at the landscape level, it has the potential to revolutionize facility management when applied to building interiors. Just as there are landscape feature classes, such as roads, parcels, or pipelines, there can be facility feature classes, such as walls, doors, and emergency exits, to which the same principles can be applied. GIS, the same technology that has already proved invaluable to so many organizations around the world, is now being applied to its last frontier: building interiors. GIS has the potential to help even more by making facilities run more safely and efficiently while saving money and energy in the process.

There are many data sources already available that are focused on the built environment—CAD, IWMS, CAFM, BIM, and CMMS, to name a few. Most of these datasets are more valuable when they are put on a map. Geospatial information is intuitive, and access to data in that form is an extremely powerful tool, but only if the data is properly maintained.

Then the question becomes, Who will maintain the data? Someone must be responsible for keeping datasets updated and organized so that they can be used effectively. This has been a daunting challenge given the wide range of data tools, types, and formats that are currently available. Often, the tools facility managers and executives use to collect, store, and update data are different from the tools they use to analyze and report on them. CAD, for example, is an excellent tool for maintaining floor plan data but cannot provide the analytic power of GIS. But how can GIS be kept updated with the latest floor plan data?

One answer is to regularly move the data from one or more sources to populate a more robust system for analysis or reporting.

The "Harvest, Convert, Create, Maintain" Workflow

Depending on the situation, you may need to regularly harvest from a parallel system, convert from point-in-time documents, and create new information to maintain an overall facilities information system. The goal is to make this workflow as simple as possible

Building Information Spreadsheet Example

RoomID	Space type	Occupancy	Floor type	Ceiling height ft.	Windows	square feet
BldgX001	office	1	carpet	9.36	2	123
BldgX002	office	1	carpet	9.36	2	112
BldgX003	office	1	carpet	9.36	2	123
BldgX004	conference	n/a	carpet	9.36	4	123
BldgX005	office	2	carpet	9.36	4	123
BldgX006	closet	n/a	carpet	9.36	0	123
BldgX007	maintenance	n/a	cement	10.12	0	132
BldgX008	office	1	carpet	9.36		
BldgX009	office	1	carpet	9.36		
BldgX010	office	2	carpet	9.36		
BldgX011	office	2	carpet	9.36		
BldgX012	kitchen/break	n/a	tile	9.36		
BldgX013	conference	n/a	carpet	9.36		
BldgX014	restroom	n/a	tile	9.36	1	123
BldgX015	restroom	n/a	tile	9.36	1	123
BldgX016	office	1	carpet	9.36	2	123
BldgX017	office	1	carpet	9.36	2	123
BldgX018	office/cube	1	carpet	9.36	0	123
BldgX019	office/cube	1	carpet	9.36	0	123
BldgX020	office/cube	1	carpet	9.36	0	132
BldgX021	office/cube	1	carpet	9.36	0	123
BldgX022	office/cube	1	carpet	9.36	0	123
BldgX023	office/cube	1	carpet	9.36	0	123
BldgX024	copy	n/a	carpet	9.36	0	123
BldgX025	closet/janitorial	n/a	cement	9.36	0	123

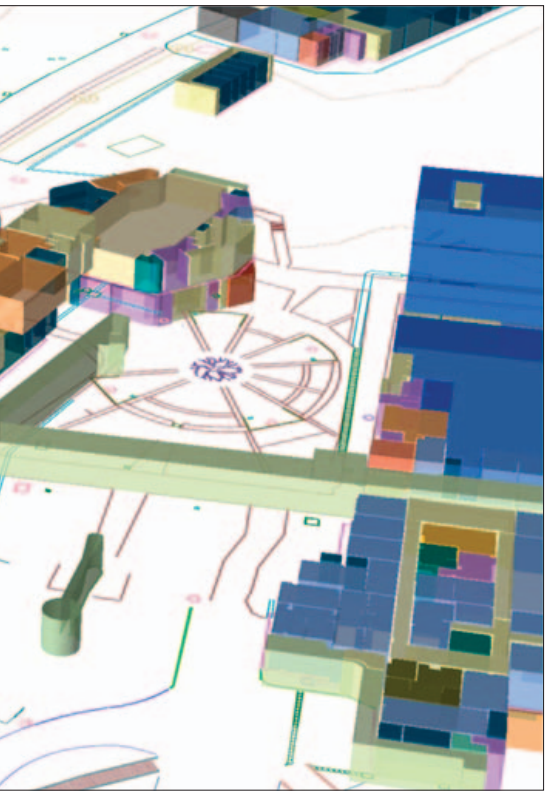
GIS takes valuable datasets and puts them on a map for intuitive decision making.

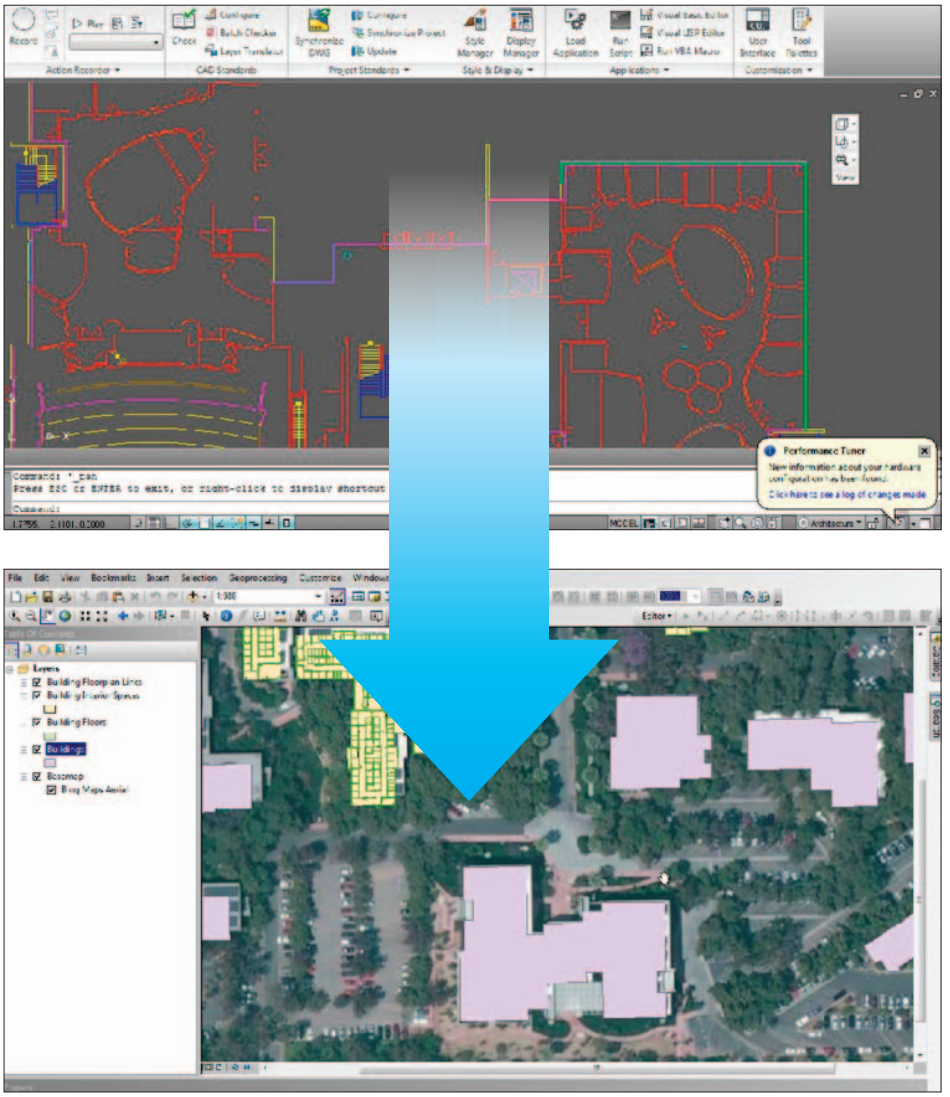
while maintaining the accuracy and completeness of the data throughout the process. If, at any point, these systems fall out of sync or data becomes out of date, it becomes useless, and all faith in the system is lost. This is why data is king.

Harvest

There are many different data types and formats, with new ones being continually developed. Each data type has a specific purpose, and while the technology is there to support a wide range of functions, the challenge of interoperability often arises. For example, facility maintenance requires CAD and/or building information modeling (BIM) construction documents to design and build the maintenance record system along with a workflow system to manage the maintenance work orders.

Harvesting data involves identifying appropriate data types and formats and then inventorying and organizing existing data sources to prepare them to be moved into the work order management system. Understanding the depth of your data—its accuracy or completeness—is critical before you can harness it.





Conversion of CAD files into a GIS provides interoperability between facility management systems, streamlining processes.

Convert

Data conversion can be an enormous undertaking. Fortunately, tools such as Safe Software's FME are available to support data conversion of almost any type or format. Additionally, processing models have recently been developed to streamline the conversion process with specific attention to facility data. InVision Toolkit, developed by PenBay Solutions, offers automated conversion of multiple CAD files into the Building Interior Space Data Model (BISDM), complete with error checking. BISDM is a GIS data model for buildings, meaning that InVision Toolkit can convert CAD quickly, easily, and inexpensively into an enterprise GIS. By converting whole sets of CAD files, this tool can cut considerable amounts of time out of data management workflows.

Data conversion allows more interoperability between facility management systems. Having various data formats consolidated into the same GIS database greatly simplifies the data management tasks, streamlining facility management processes.

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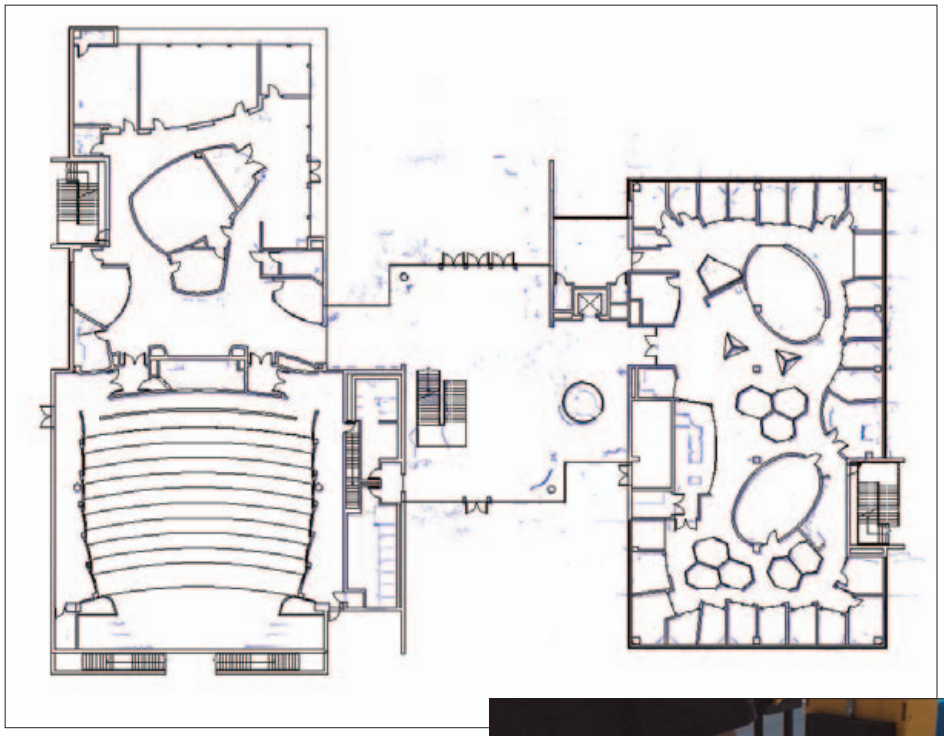
Data Is King



AutoCAD Floor Plan Drawing Created Using a Lidar Point Cloud

Create

The biggest problem with existing facility data sources is that they are often out of date or incomplete. A building's CAD files, for example, may have been accurate when it was built but are outdated as a result of renovation, additions, or damage repairs. Sometimes data is in the form of paper blueprints. Sometimes it is missing or just doesn't exist. In these situations, it becomes necessary to collect and create data.

Traditional building surveying techniques are expensive and time-consuming, as they are conducted by hand with tape measures and clipboards. But new technology and techniques have been developed in recent years that have drastically reduced the time required to create accurate as-built models of buildings. Lidar is now being used in buildings to create 3D point clouds that can then be converted into CAD, BIM, and GIS. Lidar data collection platforms (DCP) can be fitted with different sensors to collect supplementary data such as air quality and temperature. Additionally, surveyors can add attribute data, such as space use, occupancy, and asset location, during the scan. The DCP automatically georeferences the data within the building and produces a precise, attributed floor plan after only a few minutes of postprocessing. With this technology, it has become easier and more affordable than ever to collect and maintain rich, current, and accurate floor plan data for facilities.

Lidar Interior Space Data Collection Platforms (DCPs)

Maintain

Data, unlike wine, does not get better with time. In fact, unless it is properly maintained, data quickly becomes obsolete. This is especially true of facility data, with grave consequences if you are using multiple systems of records to manage data. Keeping these systems in sync can be a big challenge and a critical one.

GIS makes maintaining data easier by adding spatial elements. If viewing facility data on a map is a more intuitive way to access it, the same logic can be applied to creating, editing, and attributing it. When a building is renovated or departments are moved, for example, floor plans and attributes can easily be edited on the map to reflect the changes. Furthermore, since a GIS can be an integration point for other data systems, this may be the only edit you have to make.

Esri GIS software makes it possible to maintain your data through desktop, web, or mobile clients so that data maintenance is a natural part of your daily workflow. Systems that make data maintenance a seamless part of any given task are most likely to ensure high-quality data. Esri's sophisticated software and partner solutions make achieving this ideal more practical than ever before.

To keep data viable, it is necessary to continuously harvest, convert, create, and maintain that data for access to robust information on demand. The power of GIS lies in the accuracy and integrity of its data. Thanks to new technology and the innovation of industry leaders, data management is getting easier, and facility data is getting better. This means the power of GIS is growing. Long live the king!

For more information, contact Esri partner PenBay Solutions LLC at www.penbaysolutions.com or 207-230-0182.

BIM for Facilities Management and 3D GIS

By John M. Przybyla, Woolpert

Building information modeling (BIM) is replacing computer-aided drafting (CAD) as the environment in which building designs are created. BIM is a graphic and data model of a building prepared by designers and enhanced by builders and can be used by owners. BIM enables all parties involved in a project to communicate in a more collaborative manner, develop useful information sooner about a project, reduce errors, and shorten project delivery times.

The Value of BIM

BIM creates 3D models of a building in a computer before construction begins, and the visualization capability alone is a huge improvement over the 2D design methods of the past. BIM is becoming widely adopted within the design and construction communities and is providing huge benefits to the industry. However, it has the potential to do much more. The greatest potential benefits of BIM—those associated with the operation of the building over its life cycle—have yet to be realized by owners.

In a typical construction project today, the owner receives the BIM when the building is handed over, but it has limited information about the operation of the building. The information the owner really needs comes in paper form (or as PDFs on a CD) in the way of catalog cut sheets, written operation and maintenance (O&M) manuals, warranties, etc. The relevant data then has to be manually extracted from these sources, formatted, and typed into the owner's facility management system (FMS) so that the information about the equipment, spare parts, and tasks needed to maintain the building can begin. In some cases, this process takes so long that necessary preventive maintenance tasks are not performed, equipment fails prematurely, and warranties are voided.

BIM is important technology and plays the critical role as the essential tool during the design and construction phases of a facility. However, it is not intended to be the software tool to manage a facility over its life cycle. Tools such as FMS and GIS are the tools of choice to manage facilities once they are operational.

The Value of COBie for Tabular Data

The US Army Corps of Engineers has developed a technical approach to attempt to address the tabular data transfer from BIM to FMS. This approach, named Construction Operations Building Information Exchange (COBie), simplifies the work required to capture and record tabular hand-over data from the design and construction processes and prepare it for importing into a FMS.

The COBie approach is to have each party enter the data as it is created during design, construction, and commissioning. Designers provide floor, space, and equipment layouts and equipment lists. Contractors provide the make, model, and serial numbers of installed equipment. Much of the data provided by contractors comes directly from product manufacturers, who also participate in COBie, and directly from the BIM. The developers of FM software then import the tabular COBie data into their FMS or computer-aided facility management (CAFM) systems. This can result

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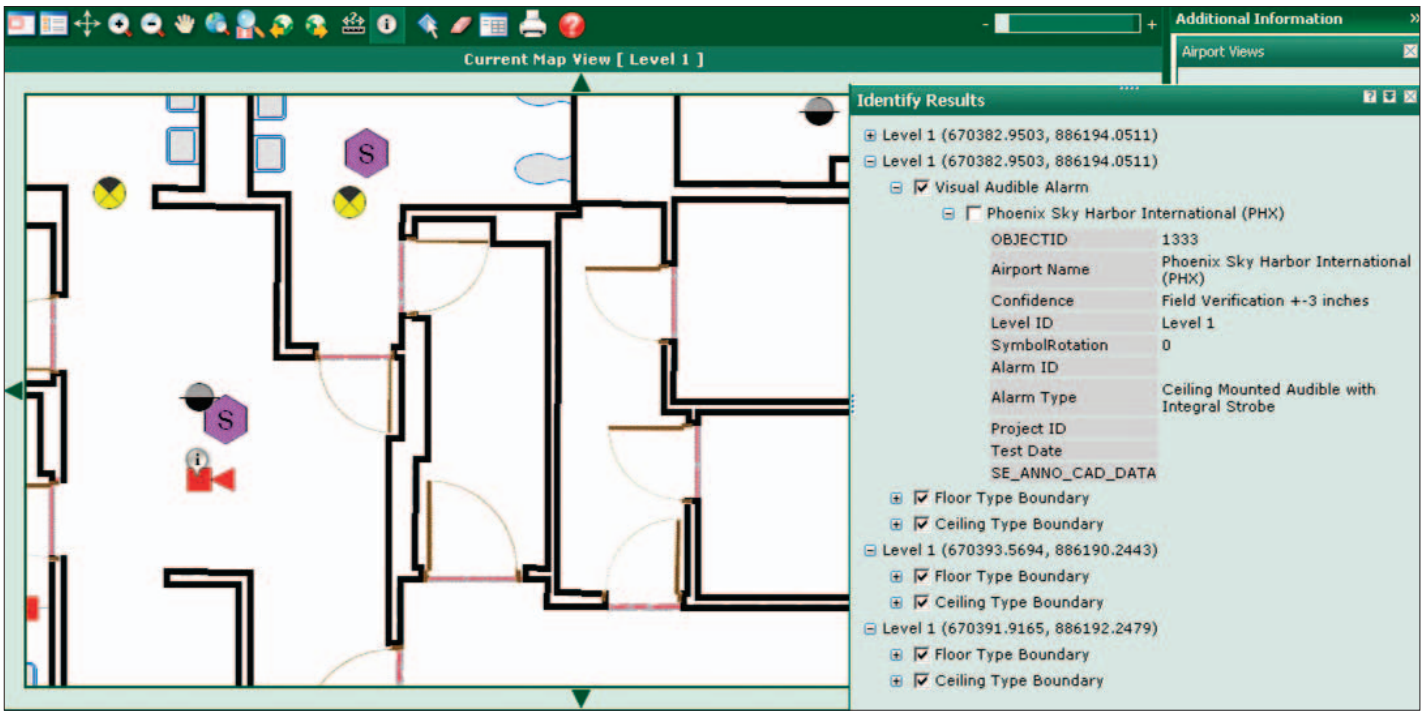

2D GIS representation of a building floor plan—everything is a GIS feature with intelligence.

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in more effective operation of facilities, more efficient use of energy, and longer life span for the facilities.

COBie has been adopted as an international standard, and many of the major FMS products can directly import COBie data. But COBie only addresses the tabular data from BIM.

The Value of GIS for Spatial Data

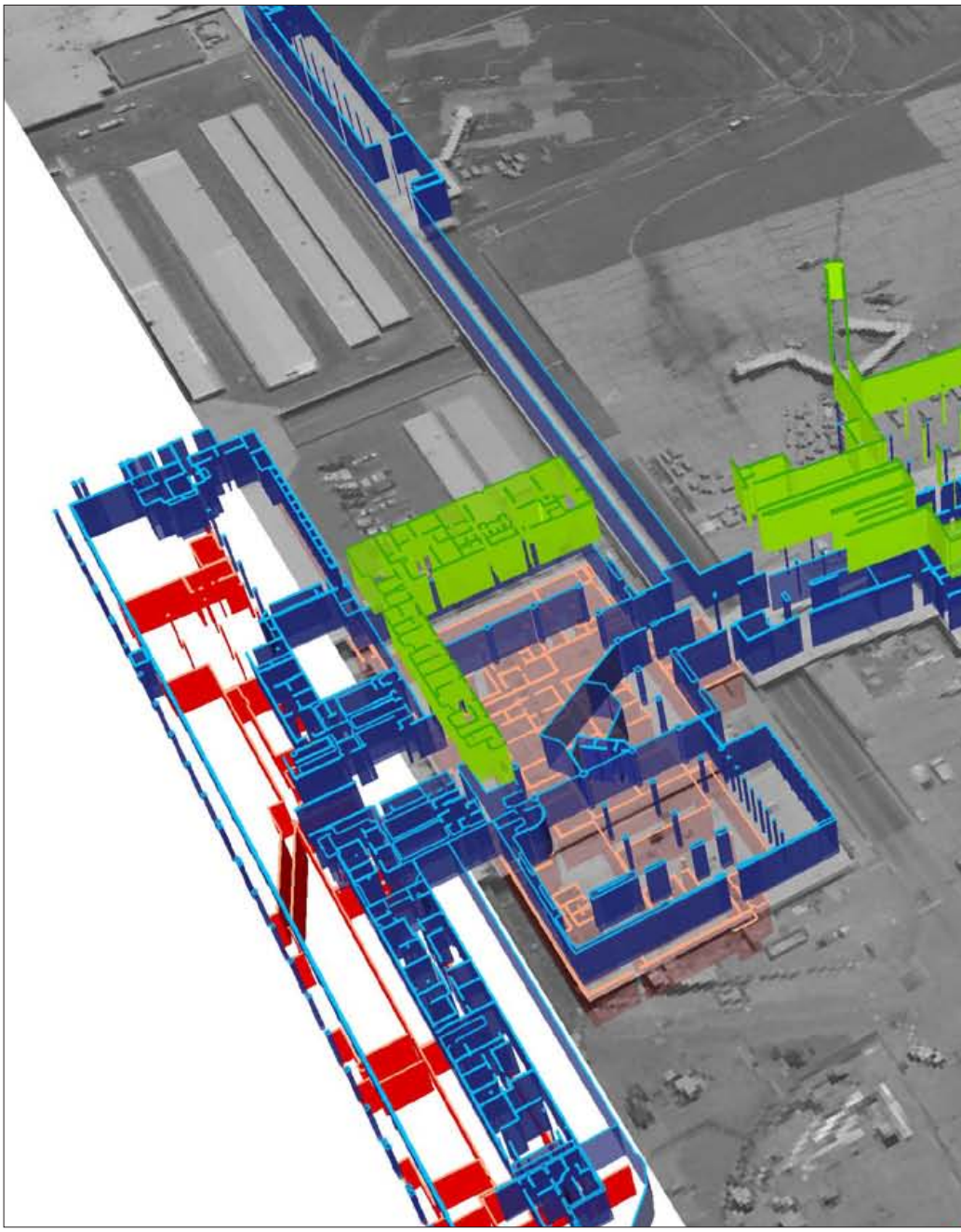
Mainstream GIS products employ server-based relational database architecture, making them incredibly versatile and powerful. In the context of facility management, GIS is being used today by building owners and managers to manage multiple facilities spread out across a campus or even around the globe. Here GIS data can be used to answer a wide variety of questions that involve location, time, and tabular information, such as

- What is my average number of square feet per employee by department?
- How many fire extinguishers do we have to inspect in the next month, and where are they?
- How many ADA-compliant toilet stalls do we have, and what is the maximum distance someone has to travel to get to one?
- What spaces do we have that will be available in the next six months that could support a new office?
- Which valves do I have to close to isolate a main break, and which buildings/rooms are impacted?

The only way any tools can be developed to answer these questions is to capture all the natural and man-made features—including what is on the ground, under the ground, and inside the buildings—in the same seamless database: a GIS.

In the future, the full value of BIM will be realized by incorporating 3D spatial data from the BIM to facility management systems, building management controls, and information systems using 3D GIS technology. Once built, a 3D GIS model can be accessible at regional and corporate levels via web deployment as both a portfolio visualization tool and a dashboard presentation environment. Utility consumption, resource and energy use, operational statistics, building and space utilization data, facility and component condition, emergency system diagnostics, remote system management, and many other datasets can be integrated into a 3D GIS-based solution.

Of course, most owners have only a fraction of their portfolios in BIM. However, with only a modest amount of effort, 3D facilities can be created in GIS by converting existing 2D CAD drawings and extruding them into basic 3D representations. And as each of these technology pieces matures, owners will begin building intelligent virtual 3D campuses that encompass everything on the ground, under



the ground, and inside the buildings into a single GIS database. And that will transform everything about how those campuses are managed and maintained.

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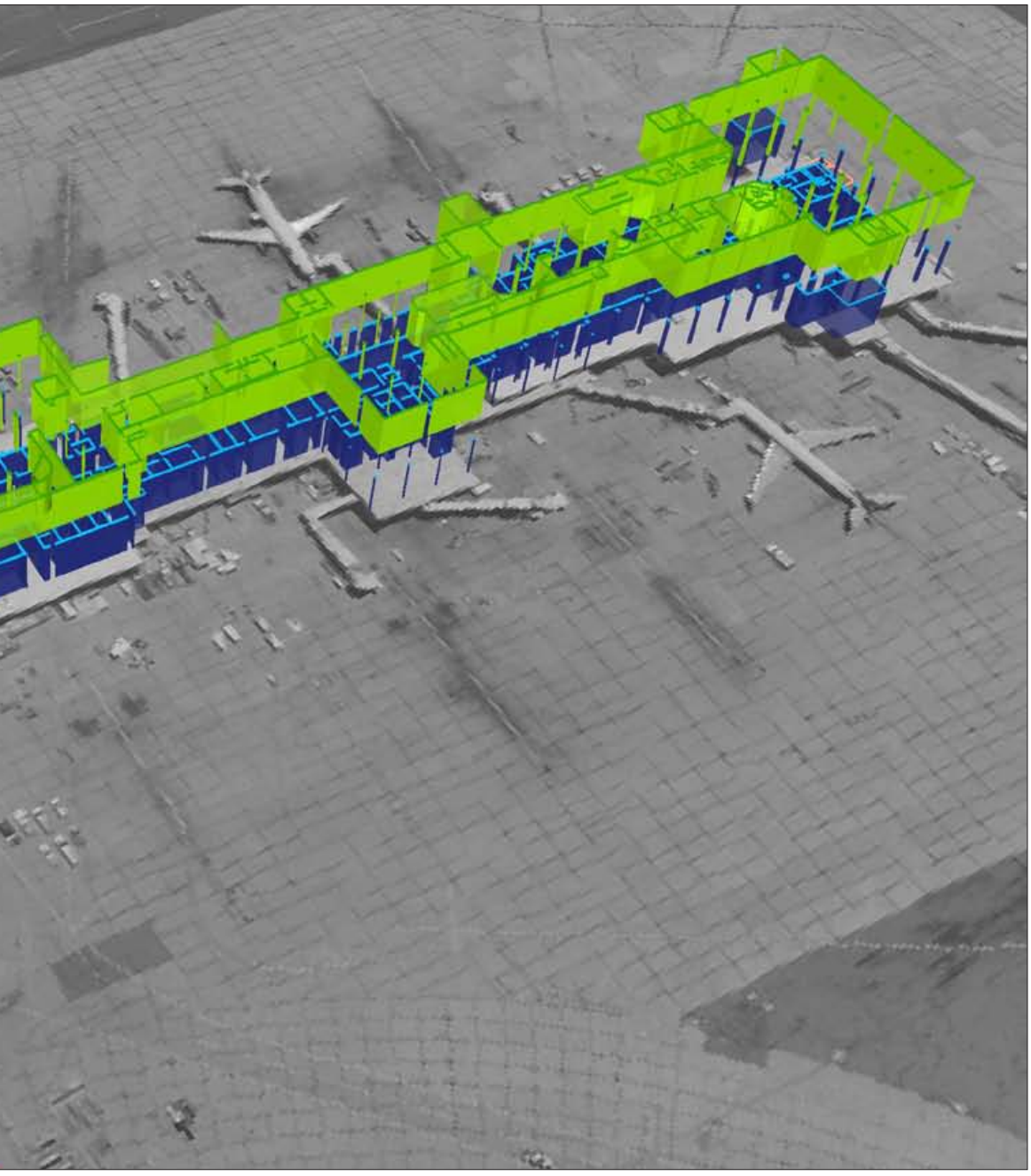

3D GIS Vertical Features from Multiple Floors, Stacked on Top of Imagery

Transforming Business with Geographic Knowledge

Starbucks Coffee Company's Patrick O'Hagan, manager of global market planning for the world's largest retail coffee chain, served some great advice to executives at the 2011 Esri Business Summit: don't put the buggy before the horse.

> "GIS is like a smartphone; if you use it, you are a believer. Those that don't have one don't really get it. But how an iPhone seems to transform the people who use it, this is how our company feels about GIS."
>
> Matthew Felton, Director of GIS and Research, MacKenzie Commercial Real Estate Services

When Starbucks first began using GIS technology and data in the late 1990s, the company's GIS staff flooded its staff members with data, especially those working with real estate. The employees needed to understand their trade areas to make vital business decisions about their stores.

O'Hagan's team created an ArcReader application that allowed staff members to access all the geodemographic and topographic data available for use in the company. While it was important to allow staff to have access to the data they requested, this approach didn't quite catch on.

"We held pretty true to the putting the buggy before the horse allegory, but in a futuristic sense," O'Hagan said, speaking in San Diego, California, to a group of 200 business executives from all over the world. While Starbucks staff had access to massive amounts of data, they had no way to easily analyze it. Today, O'Hagan's team provides analytics and business support, instead of a mass of data, to its real estate section. Instead of providing an open door to terabytes of data, the team uses ArcGIS for Server to create data-rich applications that staff members can access via desktops, on the Internet, and out in the field on mobile devices.

O'Hagan later pointed out during a panel discussion why this was a successful approach: "Our people don't want to know what GIS means or what it can do. They care about functionality, speed, and convenience. [Esri's] ArcGIS allows us to create replicable consumer applications that are exactly what they need."

Streamlining Business Processes

Warner de Gooijer, strategic analyst and project manager for global supply chain operations at Cisco Systems, Inc., also spoke at the summit, explaining how his company uses GIS. Cisco is the worldwide leader in networking, offering products and services that help companies share data and information securely anywhere in the world through a variety of ways. The organization is adopting Esri GIS technology and data to help streamline its global supply chain and continue to provide high levels of customer service.

"Leveraging GIS technology advances our analysis capabilities and introduces new methodologies for business analytics," said de Gooijer. "We realized that this important service could be enhanced with spatial analysis."

ArcGIS software will be used to create web maps and analysis that help position the company's service depots to provide customers with the best service quickly. The business requirements and factors that determine the response times vary worldwide, so finding a solution that worked across the company and could be adapted to each country was important.

Communicating through Maps

Other summit speakers included Matt Mikula, a principal at Edward Jones, an investment company that serves nearly seven million investors. Edward Jones has licensed Esri Business Analyst software and business datasets to assist in opening new branches. It is looking forward to using the technology to better understand its customers' financial needs, such as whether they are saving for a child's college education or getting ready for retirement. Nigel Davis, director of product de-

Patrick O'Hagan, Starbucks Coffee Company

velopment at Willis Re, a reinsurance adviser headquartered in London, England, also spoke on the importance of using geographic data to help his customers—insurance brokers—understand information to make better business decisions. Willis Re created a cloud-based application called eNCOMPASS for its customers that supplies data covering major perils worldwide, from flood zones in Latin America to earthquakes in New Zealand. Davis reiterated the need to keep things simple so people can really understand what information is being transmitted.

Davis agreed with Starbucks' O'Hagan as he explained that "interactive maps help in communication, but you have to be careful. Part of the challenge is not to overload people with information."

Becoming a Believer

Using geography as an information filter transformed the companies that presented during the plenary. Matthew Felton, director of GIS and research at MacKenzie Commercial Real Estate Services, explained that once his company got past the problem of not knowing what it was missing, it was sold on using GIS to visualize and analyze company data.

"GIS is like a smartphone; if you use it, you are a believer," Felton said. "Those that don't have one don't really get it. But how an iPhone seems to transform the people who use it, this is how our company feels about GIS."

Felton introduced his company to Business Analyst and Business Analyst Online. "For the first time, I think members of my company really saw their real estate," Felton said. "[They] had a lot of fun with the data, viewing and exploring information in a way they hadn't experienced before. The more they saw in the maps, the more questions they would ask."

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