CONTEXTUAL INTELLIGENCE

How Location Technology Overcomes Complexity

Visibility | Efficiency | Accountability | Productivity

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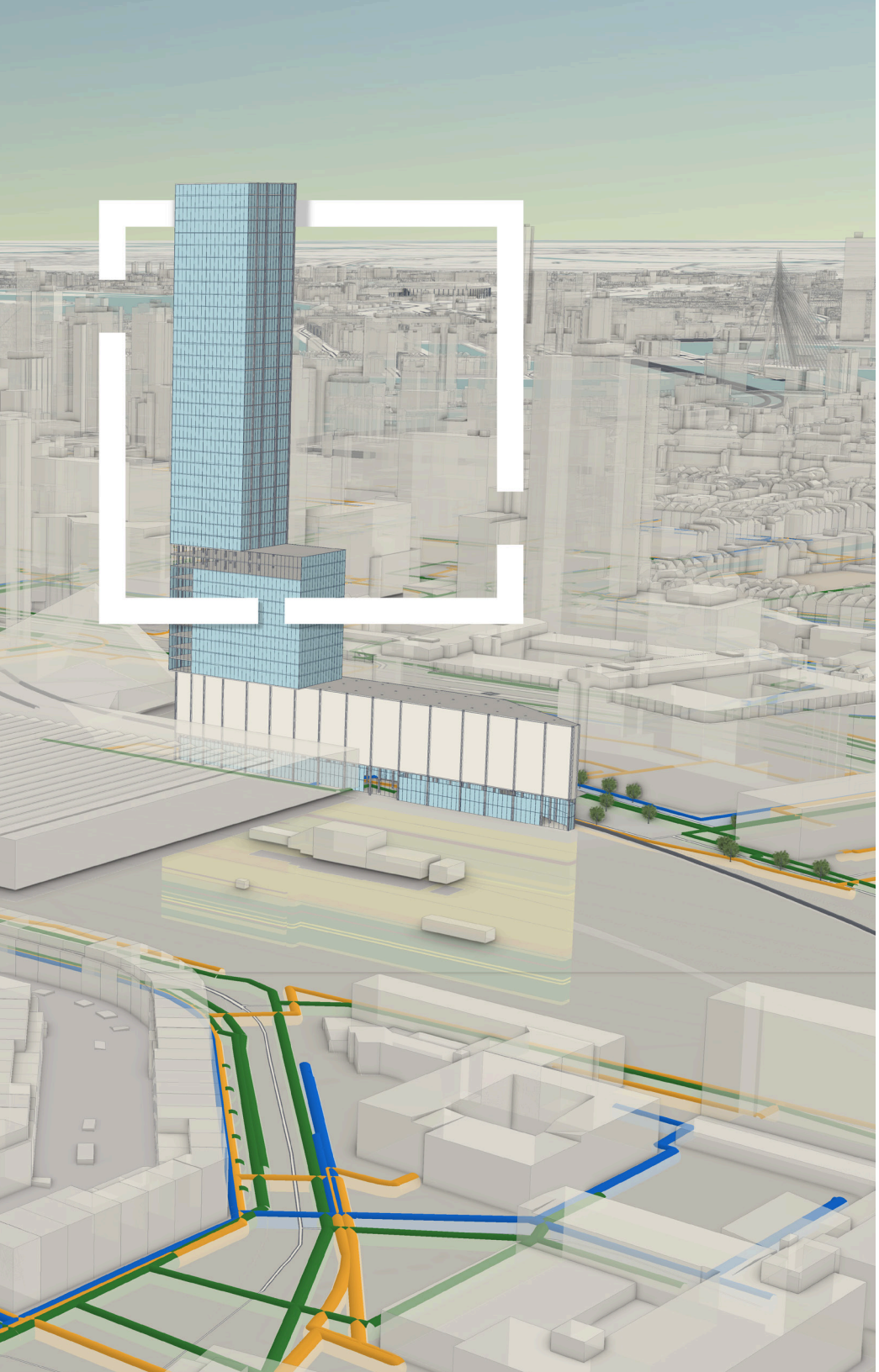


WHAT'S INSIDE

A Visual Building Inventory for Maintenance Accountability and Efficiency

The 80/20 rule in building maintenance holds that 20 percent of the problems consume 80 percent of your resources. Seeing where and when each problem is occurring, and reacting quickly, can turn this ratio around.

Without a visual inventory—a digital twin—of a building's assets and problems, it's more difficult to tackle jobs such as removing lead paint, upgrading heating systems, fixing water leaks that cause toxic mold, maintaining elevators, and eradicating pests.

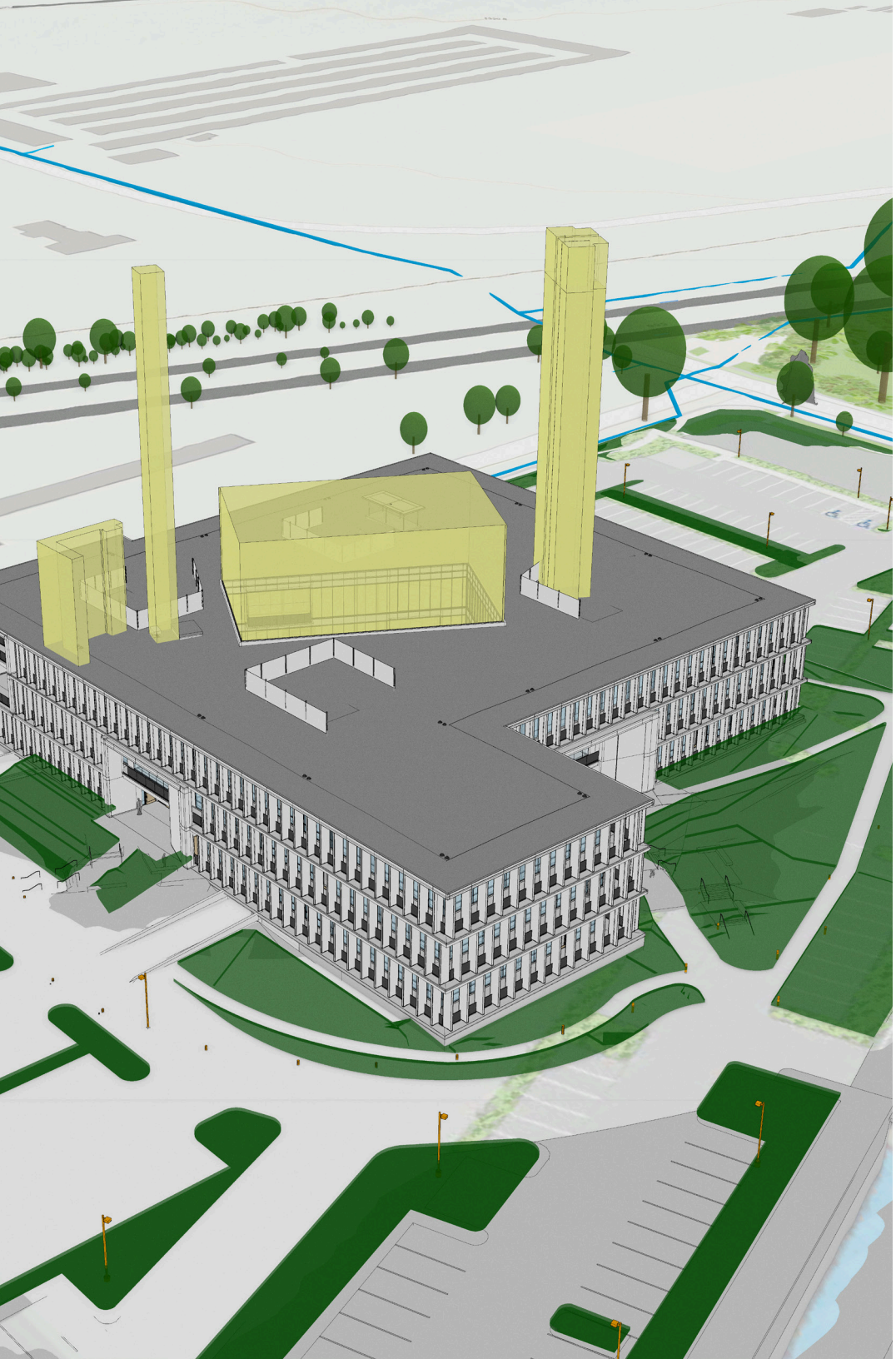
But when you can see each unit or apartment on a shared map that links directly to the Maximo asset management system, you gain work order visibility and greater accountability. By showing and sharing the location of problems, and directing maintenance workers and contractors to those problems, you see more efficient maintenance.

A smart map of an apartment building is not restricted to two-dimensional space. Its 3D scenes contain representations of all apartments and all work orders on all floors. It shows maintenance types and allows you to track progress at each building and each site over time. This level of visualization also helps determine root causes for maintenance problems.

The map serves as a window into the database. Click a feature on the map to access asset information such as an elevator's maintenance record. The map allows you to see and share each asset and issue or to see the totality of work orders for one building, a campus, or all buildings—across space and time.

This smart map has capabilities beyond record management. It performs location analytics to show, for example, where the majority of work orders are located, whether leaks are mitigated early on at their origin, or why utility costs are so high. Using the map, managers can place buffer zones around maintenance problems to see the impact on multiple units, alert tenants, and ensure that workers address the totality of the problem.

Today's maps are intelligent. They support a suite of easy-to-use and purpose-built apps to perform inventories or mark work completed, funneling accurate data for a big-picture view of problems and progress. ▶



Powering Maintenance Intelligence

Traditionally, facility managers have relied on computer-aided design (CAD) drawings to depict building interiors and route workers to where work needs to be done. Yet these static illustrations often don't reflect current configurations. By adding geographic information system (GIS) technology, managers can drive the data behind building maps, keeping them fresh and relevant. Moreover, capturing and visualizing maintenance data in 3D maps shows real-time information in multidimensional space.

CAD drawings are valuable within GIS, as are legacy schematic maps and other facility documentation, which can be scanned and added to the database. As a modern facility management tool, GIS technology can manage different types of information and quickly produce visualizations.

More than a single floor plan, the GIS-based integrated facilities map is a digital twin on which to visualize and analyze different types of operations information. For instance, by integrating GIS with Maximo, the building map shows units throughout the facility and keeps up with every maintenance action. By joining work order data to facility data, the user sees the location of work in the context of all buildings and campuses. Users can add all sorts of data to the map to see, for example, the locations of security cameras, ducting, and plumbing networks.

Digital facility maps scale to the view that users need to see, whether that is the entire complex, just one floor, or a drill down to the laundry room. Zooming in to a traditional floor plan simply magnifies the image. But map views seamlessly respond to a simple scroll of the mouse, scaling facility data to the view level. By doing so, users understand more about a site, building, apartment, room, or asset. ▶

Esri and IBM: Work Order Management System

Esri and IBM have been business partners for more than 25 years. The companies have collaborated on IBM Maximo Spatial to combine IBM's expertise in asset management with Esri ArcGIS technology. The result is a geospatial context and spatial analytics engine to make queries and understand problems. The combination offers seamless and dynamic access to GIS functionality from within the Maximo environment to provide map-based communication and offer new insights.

GIS is designed to integrate with other large systems that add details to the map such as tenants and occupancy. It provides the ability to explore a campus and each building to quickly see the status of an apartment or facility asset such as the heating, ventilation, and air conditioning (HVAC) system. It can also display real-time data such as service requests and tap into sensors that monitor energy usage or send alerts of pending asset failures.

Indoor maps simplify work order management. Maintenance managers receive a request or see a remotely sensed problem appear as a red dot on the work order map. The manager clicks the dot, sees the problem and location information, and dispatches a work order to a technician.

The technician receives the work order on a smart device and sees the problem description. To accept the work order, the technician taps an icon. Back in the office, the work order status automatically changes, which is noted on the work order map as the red dot changes to yellow. When the technician enters the building, they open the wayfinding app and follows its route to the problem's location. To begin the repair, the technician uses a mobile survey app to confirm the problem, take photos, and add notes. When finished with the repair, the technician taps the Complete icon, sharing photos of completed work, just like how Amazon provides a photo of a package to show the customer that the delivery has been completed. The app instantly streams the information to the GIS database, and the map's status dot changes to green. ▶

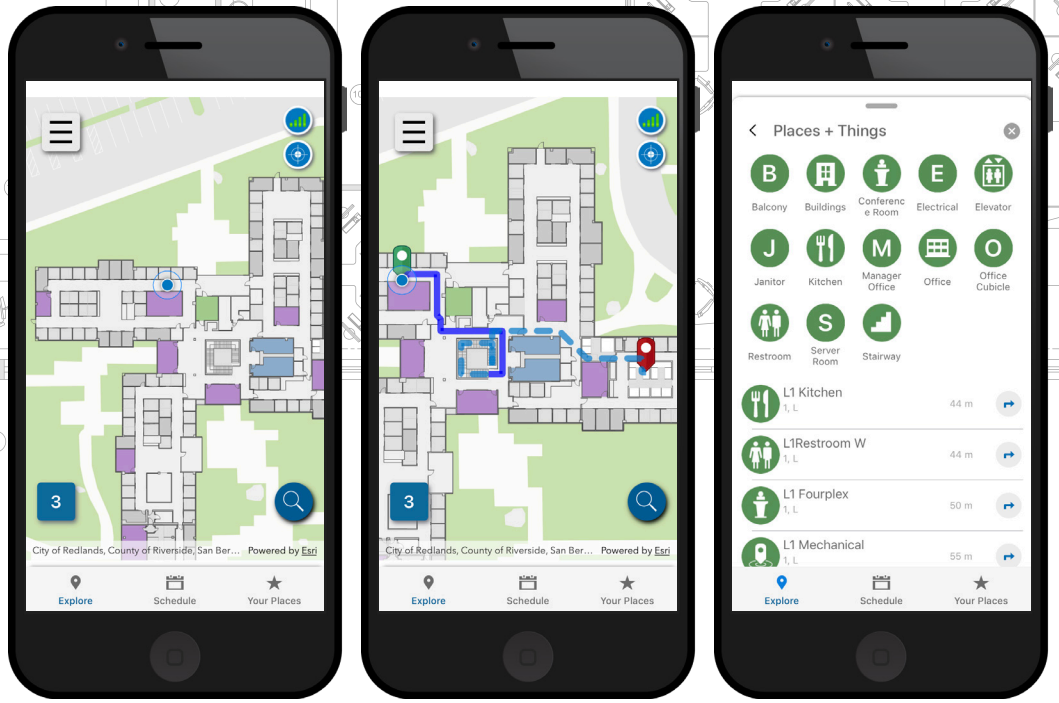
Maintenance Situational Awareness

Government organizations and multinational corporations manage geographically dispersed real property portfolios. For instance, a university's property portfolio contains academic buildings, maintenance yards, residence halls, theaters, and offices. An airport's portfolio includes terminals, indoor transportation, hangars, and control towers.

Keeping track of a wide range of property requires a powerful system to manage massive amounts of data. Real property files can include lease and ownership information, floor plans, operational systems documentation, energy usage, space allocation, maintenance history, and much more.

Mapping real property on a large scale reveals where and how facilities align with operational objectives. GIS indoor maps show where problems exist and where action is required. Real property managers can tap on a map and bring up vital operational information about buildings wherever they are in the world. Indoor maps scale, allowing managers to deeply drill into a building's information, see key performance indicator (KPI) metrics, and visualize relationships that help them make data-driven decisions.

Locally, real property managers can run GIS modeling tools to determine whether built facilities are performing efficiently. Predictive models also help forecast maintenance priorities. Operators use this information to evaluate space usage, improve efficiency, and decrease the total cost of occupancy. ▶



GIS IS DESIGNED TO INTEGRATE WITH OTHER LARGE SYSTEMS THAT ADD DETAILS TO THE MAP SUCH AS TENANTS AND OCCUPANCY.

Better Collaboration

Architecture, engineering, and construction (AEC) professionals have long used GIS technology to establish the location of assets and visualize the interplay between natural and built environments. Building information modeling (BIM) software has helped those same professionals plan and model the construction and operations of buildings and other structures.

By integrating digital data from GIS and BIM, you can see the full scope of work and the interdependencies of individual steps. At the same time, you gain a level of visibility that helps control costs and improve safety. At the executive level, an integrated GIS-BIM-asset management solution enables project leaders to visualize the evolution of a massive maintenance project across space and time.

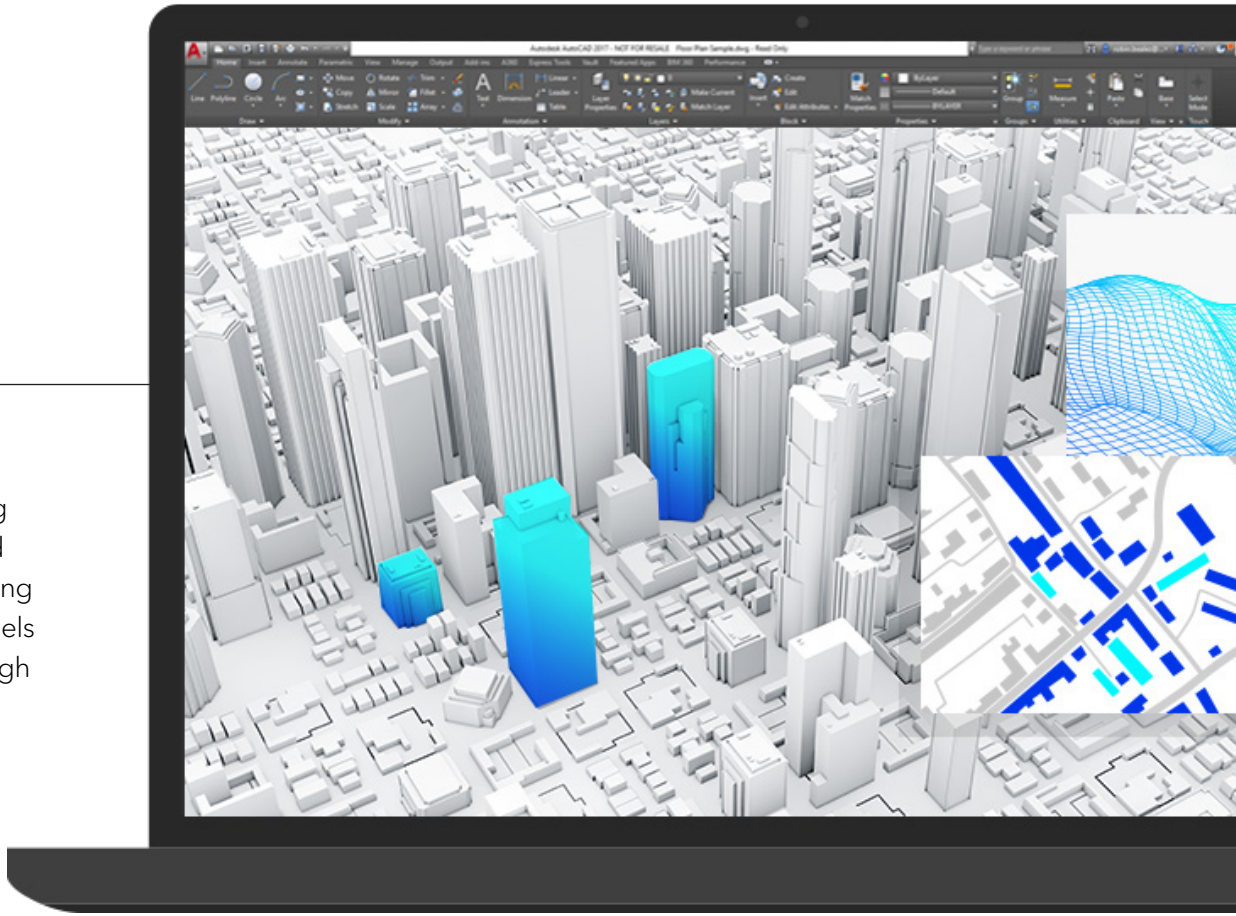
At the project level, the combined systems make difficult tasks safer and more manageable. Together, GIS and BIM reveal the precise layout of dangers such as underground utilities so that work can be planned with all safety considerations in mind.

Mobile apps provide a useful collaboration tool, letting users access shared views and information at any location and on any device. Apps extend the reach for engineers and administrators, showing where technicians are and what they're working on, and allowing work to be reviewed or fine-tuned as it's happening.

In more advanced facilities, sensors collect information about people and objects in the building and transmit it to a location service. Upon subscribing to the service, contractors and maintenance workers can share their current location with others who may need to find them.

The combined environments of modern GIS, BIM, and asset management in apps, desktop software, and the cloud provide an integrated and collaborative workflow. This removes information silos and improves understanding of projects in context, reduces inefficiencies, and delivers more sustainable and resilient infrastructure. ▶

Esri and Autodesk



Computer-aided design (CAD) technology initially focused on automating manual drafting tasks. Building information modeling (BIM), a process to achieve better efficiency during design and construction, has gradually pushed design tools away from drawing creation and toward digital models of real-world assets. The models created in modern BIM design processes are sophisticated enough to simulate construction, finding defects early in design and generating highly accurate estimates of budget compliance throughout dynamically changing projects.

Over time, GIS has also differentiated and become deeper in capabilities. GIS can now handle data from billions of events from live sensors, serve visualizations from petabytes of 3D and imagery data to a browser or mobile phone, and perform complex predictive analysis scaled over multiple dispersed processing nodes in the cloud. The map, which started out as a paper analytical tool, has been transformed into a dashboard or communication portal for synthesizing complex analysis.

In November 2017, Esri and Autodesk announced an industry collaboration to research and build new workflows between products from each company. The goal was to help their shared customers achieve better integration between BIM and GIS and to address pain points.

Esri's work with Autodesk includes transforming the project life cycle, providing continuous context of the site and the environment around BIM projects, and detecting site changes. Additional improvements are planned for the overall process of designing and visualizing the real world in 3D, and for building technologies to optimize infrastructure operations.

Combining geospatial information, field auditing, data capture workflows, and detailed design information gives all stakeholders comprehensive awareness and understanding of their projects. ■

Photo credit: NASA Langley/Kathy Barnstorff

NASA LEADS IN SPACE AND SPACE PLANNING

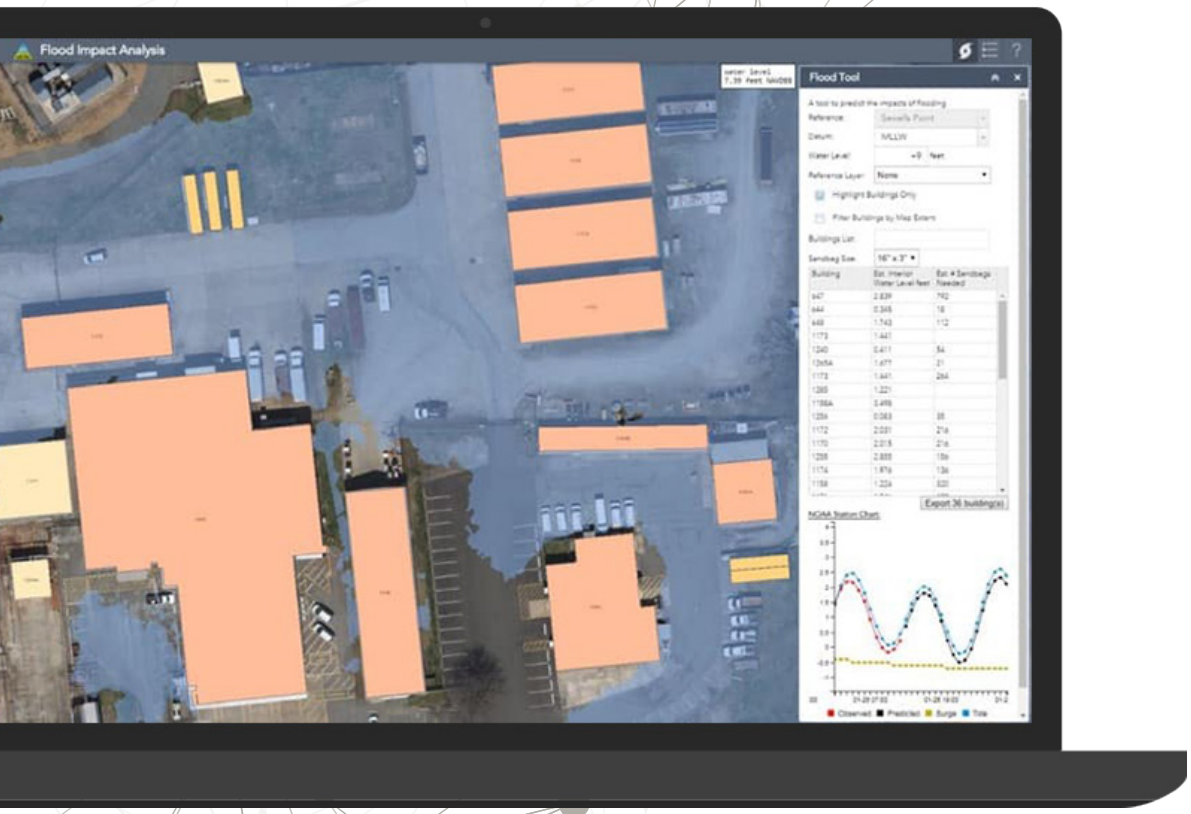
The National Aeronautics and Space Administration (NASA) Langley Research Center sits on a 764-acre campus that houses an array of aircraft- and spacecraft-testing facilities within more than 200 buildings. The site got its start in the early days of aviation and continues to focus on aircraft efficiency and safety research.

The GIS team at Langley created a digital twin of the entire center, complete with a detailed, engineering-grade map including both the interior and exterior of each building. The digital twin and the center's GIS are intended to help oversee operations and maintenance.

Tailored applications use the digital twin map as a backdrop for everything from daily maintenance and safety to flood prevention. To date, more than 300 curated apps are accessed by more than 3,500 users in each of the center's departments.

The ReVITALization office, which oversees a 20-year strategy for the deconstruction of aging structures and the construction of state-of-the-art facilities, uses apps the most. Staff regularly interact with 48 apps that address space management, real property management, and planning functions.

In 2004, the GIS team created a space allocation tool that was the first of its kind. Langley used the tool in its Reduce the Footprint program, which changed the average office size from 190 to 125 square feet per person. The space allocation tool aided tough decisions on how to juggle the locations of more than 3,000 targeted personnel. Considerations included the amount of space required, proximity to and synergy with various laboratories and research facilities, available power and water utilities, building security, and proximity of key personnel. The tool also balanced the need for new construction and weighed the cost of each scenario for comparison purposes. Langley achieved the objectives for Reduce the Footprint under time and under budget using the space allocation tool. ▶



The flood mapping tool uses the digital twin to allow the Center to visualize and simulate how flood waters will spread as sea levels rise, and which buildings are most vulnerable.

NASA (continued)

As part of its transformation, the Langley maintenance team has moved to 3D rather than 2D drawings. The 3D models inform many lightweight apps such as the Locator app that guides maintenance staff to the right piece of equipment. The team is working to expand the app's functionality by adding multimodal routing to safely navigate personnel down roads, paths, and hallways—whether by car, electric cart, or bicycle or on foot.

Given Langley's low-lying location next to Back River on the Chesapeake Bay, the center regularly relies on GIS to perform flood impact analysis and preparedness scenarios for weather events. NASA takes real-time measurements of tide and land heights. If flood response requires sandbags, the 3D model calculates how many are needed for each doorway.

Years of data collection are paying off with no input going unused. Langley's detailed view of facility information underpins competitive bidding for maintenance and operations. This ensures transparency when putting contracts out for bid and reduces contract padding, saving the center money.

When a bid goes out for cleaning or landscaping services, the center knows exactly how many bathrooms and sinks need to be cleaned and how many acres of grass need to be mowed. This detailed data reduces the risk for both the center and contractors, because it establishes a shared understanding of the amount and scope of work. ■

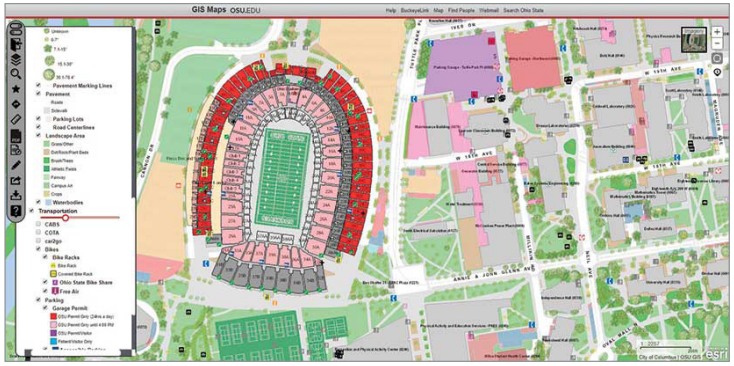
Ohio State Creates a Single Source of Truth for Its Campus

Ohio State University (OSU) enrolls nearly 60,000 students on its main campus in Columbus plus over 6,000 on six regional campuses throughout the state. OSU's assets include 1,283 buildings spread over 16,000 acres. In infrastructural terms, OSU is the size of a small city.

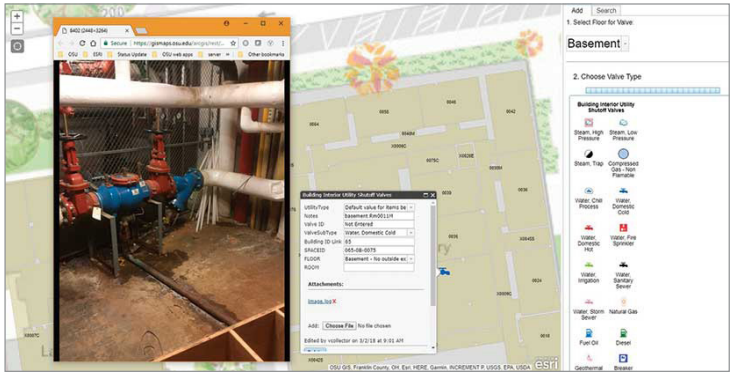
OSU's Facilities Information and Technology Services (FITS) office provides computer-generated modeling and data for building plans, interiors, and physical spaces. Along with AutoCAD, FITS uses Evolve FM for space management and Revit for building data. In 2013, the department moved all its spatial data onto one GIS platform.

GIS provides integration and standardization of data from FITS and other campus systems, and allows the data to be widely distributed throughout the university for administrative, management, and service-related functions. The GIS platform is a one-stop shop for asset management; data collection; and analysis related to planning, design, and construction. The GIS database includes an asset's location, condition, and general specifications such as square footage and construction materials, with links to leases, CAD drawings, and other documents.

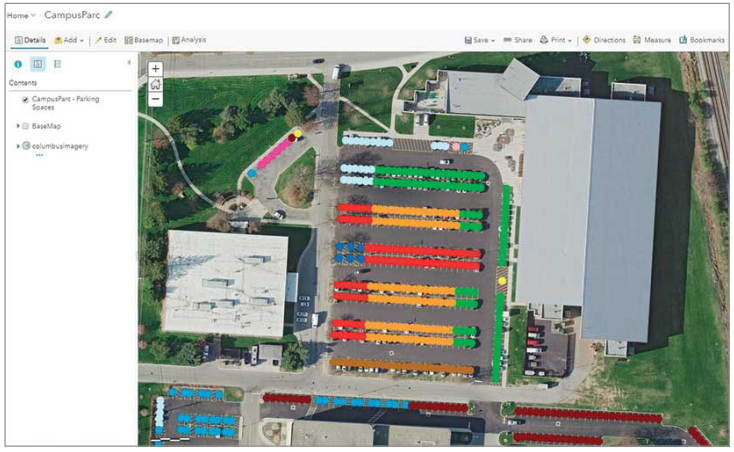
FITS's GIS platform also dynamically symbolizes and filters buildings by various criteria, including use, condition, and amenities. Users can access and build on various basemaps that display campus roads, parking lots, and landscape information. Staff with appropriate credentials can access restricted data such as police patrol zones; surveillance cameras; and even utilities, showing line, valve, and meter locations across OSU. An important facet of the GIS is its interactivity. For example, crowdsourced data can be added to indicate features that need updating. ▶



The primary application is GIS Maps, which provides answers to questions about buildings and available transportation options.



Asset management apps include the Shut Off Valve application, which collects and updates the location of shutoff valves both inside and outside many OSU buildings and includes pictures of the valves to assist in locating them.



GIS Maps shows campus roads, parking lots, and landscape information.

Ohio State (continued)

Specialized applications address specific informational needs. One app collects and locates shutoff valves inside and outside OSU buildings, with photos to aid in finding them. Another app records and tracks tree maintenance. Campus benches, tables, trash receptacles—any outdoor asset—are noted in another. Applications extend to crime mapping, energy consumption, and space planning. The functionality of GIS makes it suitable for mapping anything that happens on an OSU campus.

Over the past decade, OSU's main campus has undergone a major infrastructure and redevelopment project, including new facilities, roadway alignment, the restoration of a local lake, and the creation of a protective flood barrier. GIS is playing a major role every step of the way.

OSU uses its GIS to record location information with granularity. AutoCAD files include information such as floor measurements, the sizes of windows and doors, and the locations of stairwells. This extensive database aids in planned maintenance projects and emergency repairs. It also has allowed OSU to construct something approaching a digital twin of its facilities.

BIM software combines 2D plan drawings with vertical measurements between floors to render accurate 3D models that are then exported into a geodatabase. These models serve several purposes, including mechanical, electrical, and plumbing applications; structural engineering; and building design.

Perhaps the most useful feature of OSU's GIS platform is that it allows different datasets to coexist peacefully. Information isn't siloed or walled off from those who need it. Having one system that gives operations staff access to all the data they need to do their jobs pays enormous dividends in efficiency. ■

LAX Tracks All Projects from Planning through Construction

Over the last few years, Los Angeles International Airport (LAX) has steadily moved up the list of the world's busiest airports. Measured by passenger traffic, it currently ranks as number three. Maintaining a facility that's open around the clock, serving over 84 million people per year, is an enormous logistical challenge.

To help meet the challenge, LAX uses a GIS as part of its document management platform, integrating directly with Esri partner IBM's Maximo work order management software. Staff and stakeholders use the system to access work orders. The GIS displays the location of the project, with a geospatial interface for data. The platform manages 500,000 documents and creates logistic coordination maps based on the latest data. By bringing all this information together into a single platform, managers can better coordinate and monitor projects.

Outside contractors working for LAX submit phasing plans with location data. As the work progresses, they send information about where—and at what time—they'll be working. Throughout the project, they continue to update this information. Because the information includes location, airport management can use the GIS to track all projects, from planning through construction.

GIS also helps the airport coordinate multiple projects, ensuring that work in one area doesn't interfere with other work nearby. Visualizing information with GIS makes it easier to notice any conflicts among project schedules and locations. This ability to recognize and address potential problems before they happen helps the airport lower project contingencies, risk, and cost. ▶

LAX (continued)

The power of GIS at LAX extends beyond just record keeping. Airport operations are three-dimensional, and so is the GIS. Three-dimensional graphics make the impact of work orders and repairs easier to understand. If a moving sidewalk, elevator, or escalator experiences problems, for example, the airport can quickly assess the effect on pedestrian traffic, initiate repairs, and make decisions about rerouting movement.

LAX's innovative use of GIS unites field staff with managers. If an unexpected incident occurs—anything from leaky pipes to a broken window—airport staff at the scene can use mobile apps on tablets to mark the issue on the map. In addition to providing a way to quickly identify a location in a sprawling, multitiered facility, this feature gives field staff the opportunity to include associated information, such as photos and incident type.

At times when simultaneous incidents require managers to make quick staffing decisions, these tools support prioritization and action. If a maintenance incident creates a hazard for travelers, airport managers have a complete view of the danger and can decide how to respond, including whether to call in emergency personnel.

The GIS also integrates predefined workflows, so staff can access guidance on specific, preplanned procedures for event response. If something major requires immediate and sustained attention, field crews can see where to set up command posts; query nearby assets, such as underground gas lines or water pipes; plan response routes; and add supplementary notes. They can access lease information to view tenants in impact zones, along with their contact information. As fieldworkers move through a mitigation response, they can use their GIS app to check off each component of the incident management procedure.

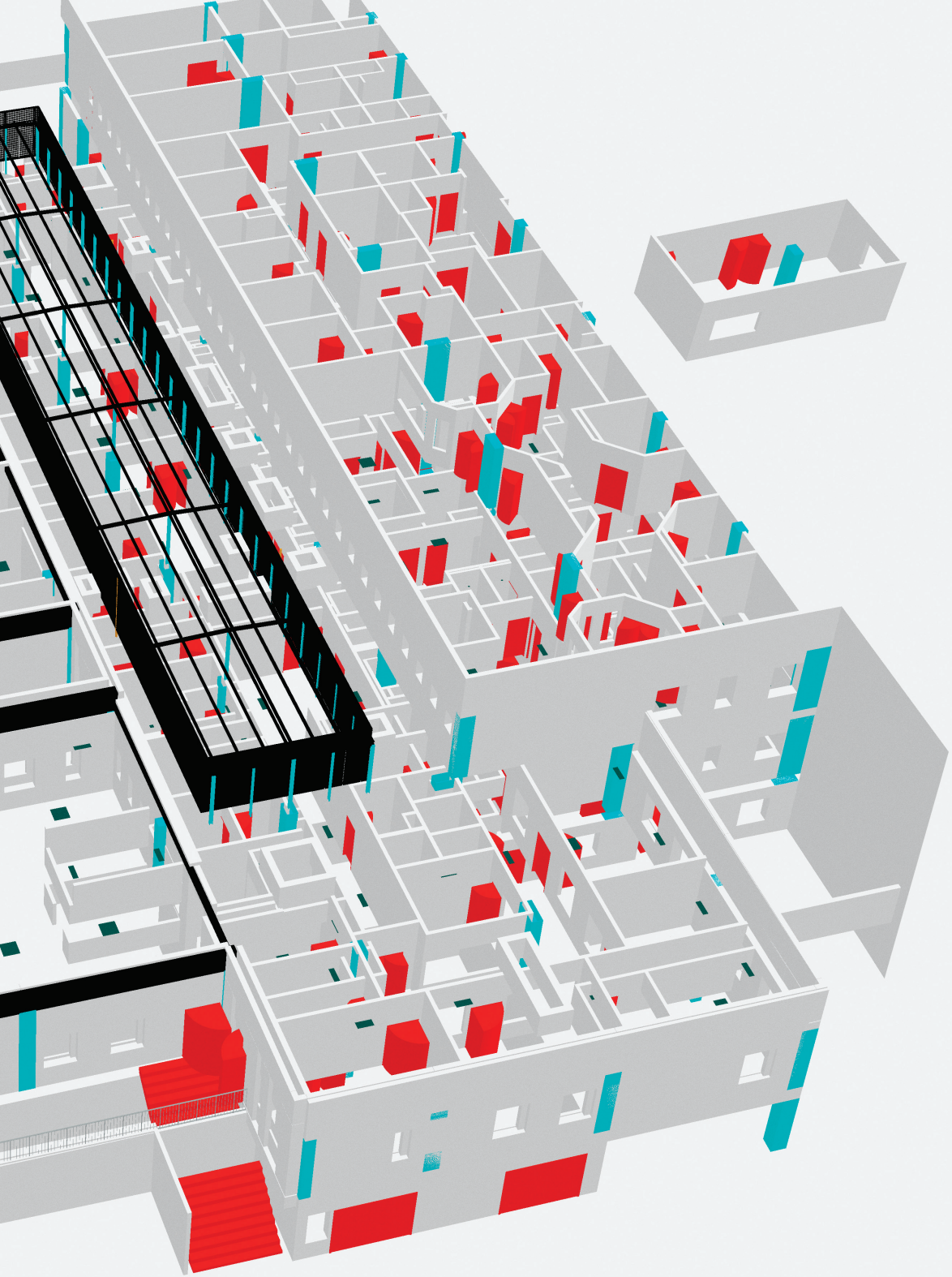
Operational awareness of facility space, project plans, and construction status ensures that maintenance projects stay on task without compromising traveler service. Furthermore, the airport maintains an immense geospatial data inventory of every item installed—from light fixtures to faucets—giving facility managers operational insight long into the future. With location intelligence, LAX better manages scheduling, planning, and other daily operations. ■

LOCATION INTELLIGENCE MOVES INDOORS

Apple

It's estimated that the average American spends 87 percent of their life indoors. While our trusted, GPS-equipped mobile devices help us navigate almost anywhere outside, they lose accuracy once we go indoors.

Indoor mapping, or the lack thereof, is often a challenge for people who need to move around a facility like a hospital, convention center, industrial facility, corporate campus, or airport. There is a growing demand for maps that show a person's location in relation to the inside of a building, helping them locate, for example, an available conference room or a high-pressure valve that needs immediate inspection. In fact, this is becoming increasingly important as companies situate their workplaces on large campuses. To have truly effective location intelligence, an organization needs more than just an indoor map. People need to know their current location—that "you are here" blue dot—to provide spatial orientation, and they need the power of spatial analytics to understand the relationships between people and assets that are moving in space and time. ▶

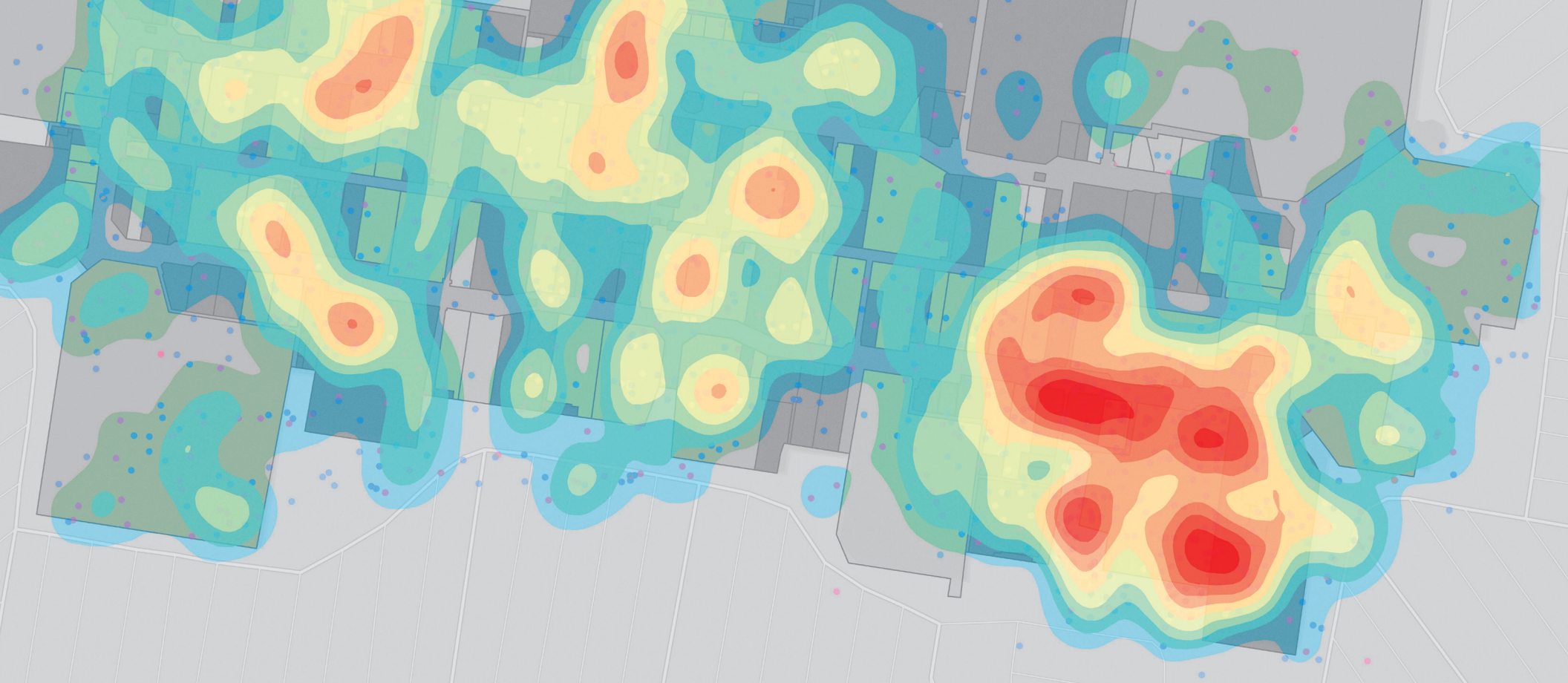


Bringing the Power of Location Inside

Indoor positioning is a new capability that brings the power of location indoors. It provides the foundation for indoor wayfinding, room finders, and even people finders in retail and commercial locations, corporate campuses, airports, hospitals, event venues, universities, and other locales.

Indoor positioning gives employees, customers, travelers, and visitors the ability to see and share their location in relation to important assets, rooms, departure gates, and offices. This information, combined with navigation, scheduling, and analytics, helps people inside buildings operate at an increased level of efficiency and safety. Using location intelligence tools, indoor positioning enables businesses and organizations to better coordinate space and other resources.

From simple mobile apps to complete enterprise systems, indoor positioning adds a new dimension to the application of location intelligence technology. Managers and executives can take advantage of indoor positioning and access interactive dashboards that stream data from sensors inside a facility. Meanwhile, visitors and employees benefit from indoor positioning by being able to use their desktop computer or smartphone to find information about the buildings they occupy. Building operators and occupants can access floor-aware, 3D maps to quickly access and explore critical business information such as the location and status of fire extinguishers and their last inspection dates. Enterprise knowledge workers, such as maintenance teams, IT, security, medical, and visitor management personnel, are particularly well supported by the emergence of indoor mapping and analytics. ▶



Using Apple's Indoor Positioning Technology

Esri uses Apple's indoor positioning technology to deliver accurate locations indoors. By enabling asset management, workflows, mapping, authoritative data, and ultimately the apps that deliver these capabilities, Esri is helping large venues provide an indoor enterprise solution with the crucial positioning element that Apple has developed. In many cases, Wi-Fi location services meet the business requirements of an organization without requiring the investment in Bluetooth beacons. The indoor position and floor level are determined using a combination of information coming from the sensors on the iOS device together with information from performing a Wi-Fi fingerprint of the building.

Apple uses indoor positioning for its indoor maps in Apple Maps. It has already activated its indoor positioning technology in 70 airports and 450 shopping centers, with more to come.

The company's pioneering work in indoor positioning is providing visitors and staff with a full layout of each airport or mall. It uses an interactive map to show the location of features such as restaurants, shops, bathrooms, gates, terminals, security checkpoints, check-in desks, and baggage claim areas. Different floors are also marked, allowing users to easily navigate the area. In an airport, where people are often on a tight schedule, being able to visualize an unfamiliar location can help travelers save time and avoid missed flights. In the case of a large and complex mall, stores can be filtered by category—clothes, beauty, or food, for example—enabling people to find what they are looking for faster. Many private organizations such as hospitals, universities, and corporate campuses, are following suit. ▶

Geoenabling the World's Buildings

Esri is using Apple's indoor capabilities to bring location intelligence, along with Apple's indoor positioning, to enterprise organizations and knowledge workers everywhere. The ability to bring situational awareness to mapping indoors is revolutionizing enterprise systems. This technology is helping organizations manage their facilities by enabling employees to see things like the precise locations of malfunctioning equipment so the proper maintenance personnel know where to go. It is also giving management the ability to see where all their employees are at all times so they can locate them if and when they are needed. This capability doesn't just improve workplace efficiency; it can also save lives. For operations and emergency response, this is particularly important, since places like hospitals rely on accurate information about where and when people will be at a certain room. In a large medical center with an emergency room or an intensive care unit, seconds count.

In the same way that people are already navigating streets and highways with mobile maps, any business or government facility can have geospatial awareness of indoor assets and processes. With the combination of advanced mapping and analytics and indoor positioning, companies, universities, airports, hospitals, and other large facilities are bringing precise location intelligence indoors. ■

Learn More

Esri solutions are used by 90 of the Fortune 100 companies, all 50 state governments, more than half of all counties (large and small), and 87 of the Forbes top 100 colleges in the US, as well as all 15 executive departments of the US government and dozens of independent agencies.

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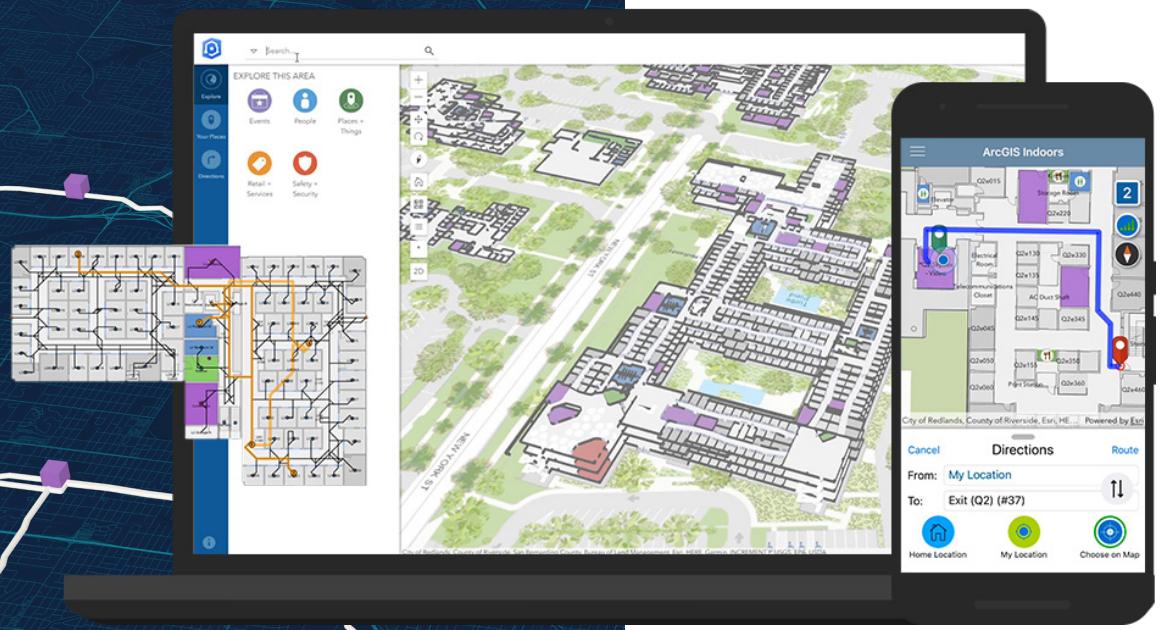
Get started today.



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