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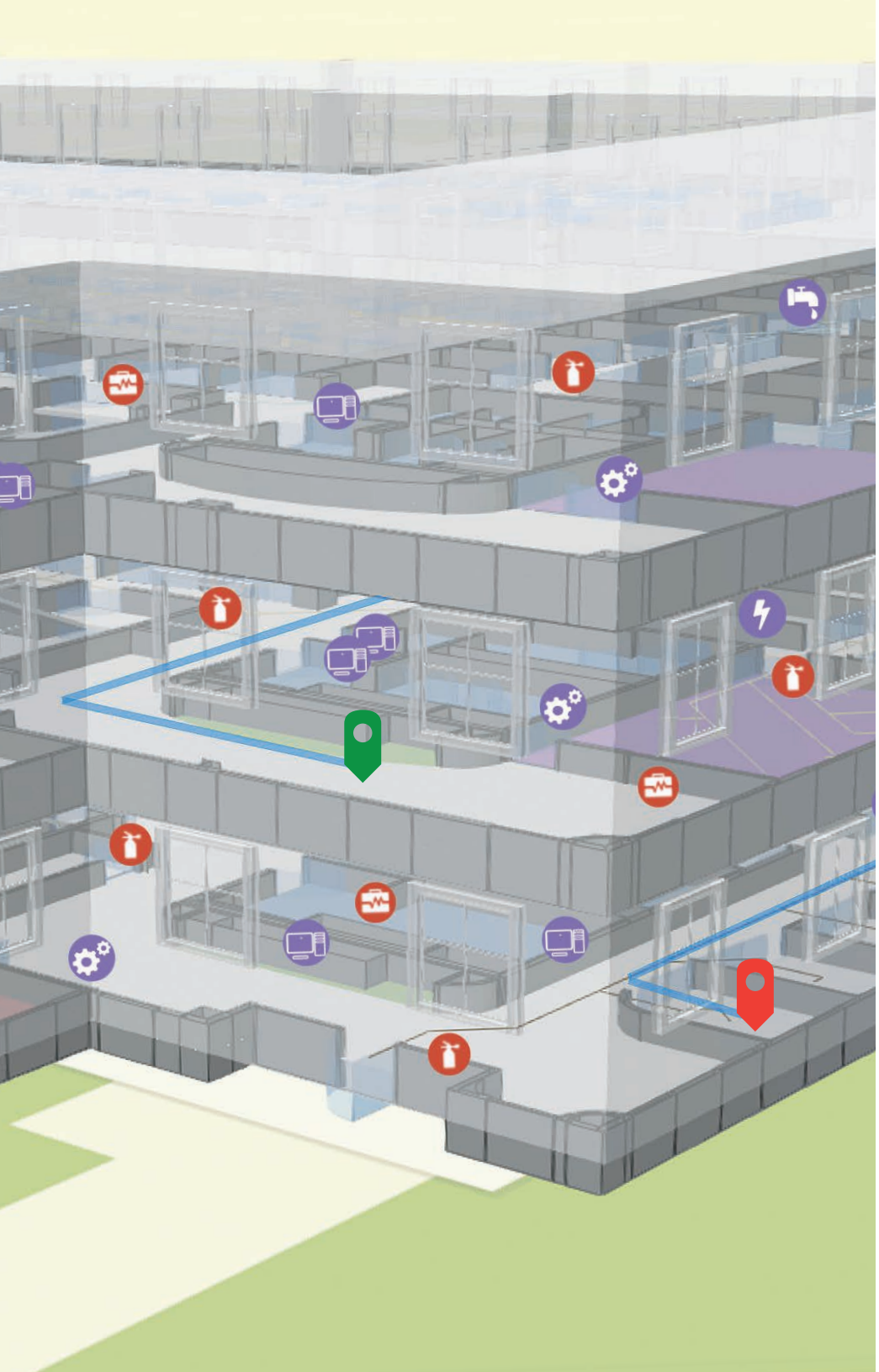
INDOOR LOCATION INTELLIGENCE

Making Operations More Efficient with a Digital Twin



WHAT'S INSIDE

Managing Facilities More Efficiently with a Digital Twin

The 80/20 rule in building maintenance holds that 20 percent of problems consume 80 percent of resources. Seeing where and when each problem is occurring, understanding historical context of spaces and assets, and knowing the most strategic course of action to react quickly can turn this ratio around. A digital twin of one's facilities–essentially a virtual representation of the real world–can help in understanding the location and condition of all assets in context with one another. Without it, facilities management is much more difficult.

Digital twins incorporate physical objects, processes, relationships, and behaviors, and can be used to accurately represent a facility's past, observe and monitor its real-time performance, and explore or predict what it will look like or how it will function in the future.

Taken a step further, and paired with indoor positioning systems, a digital twin can help us virtually see where we or others are in relation to surroundings and assets. That's where the precision offered by a geographic information system (GIS) ensures accurate location data and context when creating a digital twin of one's facility, building, or campus.

By understanding the location of problems–across both time and space–and directing maintenance workers or security personnel to those problems for quick resolution, organizations are already experiencing increases in operational efficiency. This level of insight is achieved through an indoor GIS and communicated via digital maps. Interactive views of these smart maps are available with details of an entire site, facility, or building; a single floor; or an individual room.

As a component of a digital twin, indoor GIS does more than produce maps of assets. It also includes wayfinding for navigating complex and distributed facilities; space management to make the most of one's building; real-time indoor positioning for employees and visitors; and data collection for mobile work, all tied together with deep analysis to inform intelligent facilities management.

Indoor location intelligence is leveraging digital maps across the organization–from mobile workers to office employees to facility managers–to produce big-picture insights for decision-makers interested in getting the most out of their operations. ▶

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 GIS maps, managers can drive the data behind structure maps, keeping them fresh and relevant. Moreover, capturing and visualizing maintenance data on 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 IBM Maximo, the structure 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's the entire complex, just one floor, or an individual room. Zooming in to a traditional floor plan simply magnifies the image. But digital map views seamlessly respond to a simple scroll of the mouse that scales facility data to the view level. By doing so, users are able to understand more about a site, building, apartment, room, or asset. ▶

Esri and IBM: Work Order Management System

Esri and IBM have been partners for more than 25 years. The companies have collaborated on IBM Maximo Spatial Asset Management to combine IBM's expertise in asset management with Esri's ArcGIS technology. The result is a location and spatial analytics engine to query 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 a 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. A request or a remotely sensed problem appears on the work order map as a red dot. The maintenance 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 by the red dot changing to yellow. Upon entering the building, the technician opens 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 to share 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 properties 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 Integrates with Other Enterprise Systems, Adding Geographic Content to All Data.

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. Now, facilities management and operations teams are also leveraging the same technology to enhance the impact of data-driven decisions, using GIS and other datasets.

Indoor GIS can act as the backbone of a digital twin, ingesting data from multiple sources—work order management systems, BIM, enterprise asset management (EAM) software, and more. By integrating digital data from GIS and BIM, users can see the full scope of work and the interdependencies of individual steps. At the same time, this newly gained level of visibility helps control costs and improve safety. At the executive level, a solution that integrates GIS, BIM, and asset management 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 facilities managers 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 devices and objects in the building and transmit it to a tracking service. Upon opting in and subscribing to a location 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 a collaborative workflow. This removes silos and helps people understand projects in context, reduces inefficiencies, and delivers more sustainable and resilient infrastructure. ■

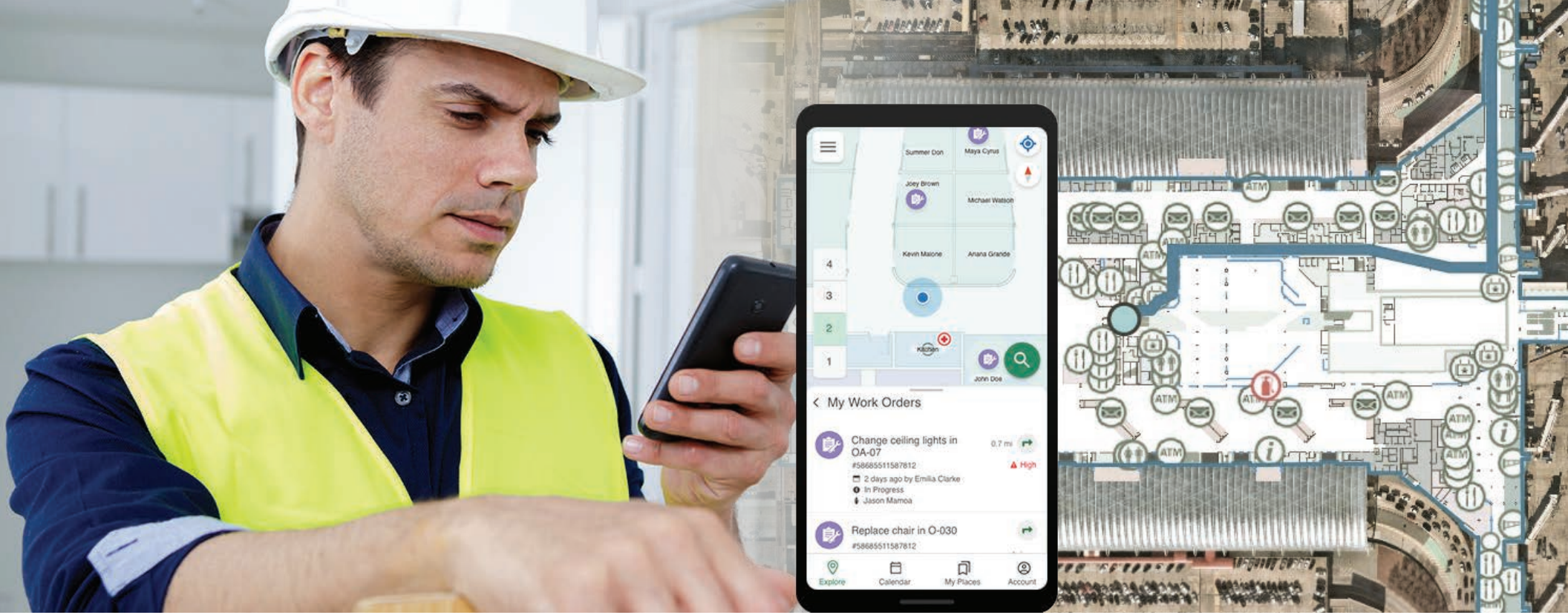
Location Intelligence Moves Indoors

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

The lack of indoor mapping often presents a challenge for people who need to navigate the inside of a hospital, a distributed network of government facilities, an industrial building, a corporate campus, or an airport, for example.

There is growing demand for maps that show a person's current 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—seen as the familiar "you are here" blue dot—to gain 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 intelligence 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.

Staff and visitors can see and share their locations relative to important assets, rooms, offices, and points of interest. This information—combined with navigation, scheduling, and analytics systems —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 smartphone to find information about the buildings they occupy while on the go. 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 most recent inspection dates, with the context of their current location. 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 that is enhanced with indoor positioning. ▶

Indoor Positioning Technology—Location in Real Time

Esri's ArcGIS indoor positioning technology delivers accurate locations indoors. By enabling asset management, workflows, and mapping–as well as offering the authoritative data and apps that deliver these capabilities–Esri is helping organizations with large facilities provide an indoor enterprise solution with the crucial positioning element. In many cases, those organizations can enjoy the benefits of Esri's indoor positioning technology with existing Wi-Fi location services without needing to invest in Bluetooth beacons. The indoor position and floor level are determined using information emitted by sensors on iOS devices, combined with the results of performing Wi-Fi fingerprinting of the building. For organizations that prefer to use Bluetooth beacons, indoor positioning is available with this hardware option as well.

Organizations that deploy indoor positioning solutions with GIS are able to provide visitors and staff with a full layout of the facility using an indoor map, as well as users' precise location in the facility based on the whereabouts of their device. With floor-aware navigation, users can pull up directions to key points of interest, like specific restaurants, airport gates, shops, conference rooms, or restrooms, and navigate to them in real time. The same interactive maps that are used for enhanced visitor experience can also be leveraged by security staff and service personnel to locate specific assets, along with identifying and sharing the locations of team members and accessing mission-critical information on-site–all within the context of where they are at the very moment the data is accessed. These intuitive maps are helping demystify complex facilities by providing precise locations on demand–enabling people to more quickly find what they are looking for. ■

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 with more than 200 buildings housing an array of aircraft- and spacecraft-testing facilities. The center 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 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.

Facilities and operations teams at Langley overseeing 20-year strategy for the deconstruction of aging structures—as well as the construction of state-of-the-art facilities—are the teams that use 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 employees. 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 need with the cost for new construction in each scenario for comparison purposes. Langley achieved the objectives for Reduce the Footprint before deadline 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 floodwaters will spread as sea level rises, and which buildings are most vulnerable.

NASA (continued)

As part of the research center's transformation, the Langley maintenance team moved to using 3D models rather than 2D drawings. The 3D models inform many lightweight apps such as the Locator app, which guides maintenance staff to the right piece of equipment. The team also expanded 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.

Because of Langley's low-lying location next to Back River off of Chesapeake Bay, the center regularly relies on GIS to perform flood impact analysis and create 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 bids go out for cleaning and 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. ■

Michigan State University Creates a Comprehensive View of Its Campus

"If we end up saving 15 minutes a day per employee, those time savings not only result in substantial cost savings to the university—thousands of dollars a day—but also improve our response times and service to our campus customers."

Fred Woodhams
Communications Manager for Michigan State University's IPF Strategic Initiatives

Michigan State University (MSU) has more than 50,000 students on a 5,300-acre campus that includes 565 buildings and about 61,000 assets to maintain—no small task for any facilities management team.

Navigating the campus can be daunting for anyone, and MSU's infrastructure planning and facilities team (IPF) wanted to ensure that workers—both new and experienced—could find their way inside the university's many buildings as easily as they could outside.

IPF had been leveraging GIS technology for years to map and manage exterior assets like parking spaces, sidewalks, fiber-optic cable, landscaping features, and underground utilities.

Expanding the university's spatial data infrastructure (SDI) to include interior building features would allow new staff to become familiar with the campus sooner, reduce waste and improve the worker experience, and give staff working inside buildings access to the same level of information as staff working outside. ▶

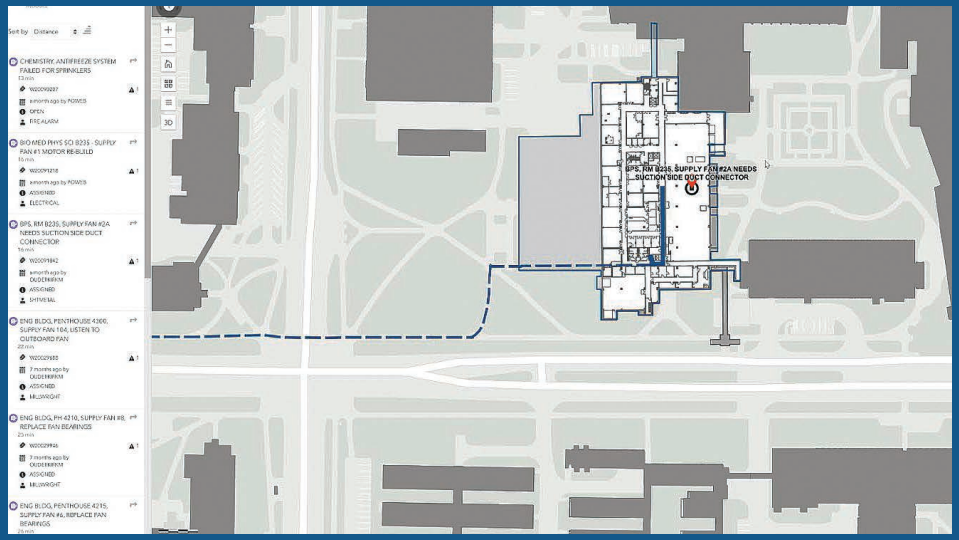
Michigan State (continued)

Staff have access to Esri's indoor GIS solution—which pulls information from the Integrated Workspace Management System (IWMS)—at IPF office desks and via mobile devices, so technicians can view important facilities data and maps as well as their job list wherever they are. This has enhanced efficiency by organizing work orders on the basis of location, directing staff to the precise asset that needs servicing, and ensuring that those responding are prepared for each job they receive. For example, a worker responding to a work orders for a specific pump, fan, HVAC component, and fire extinguisher would be directed to service the assets located nearest one another, rather than seeing work orders in a tabular format. The view saves time otherwise spent backtracking across campus or physically searching for the asset.

MSU's indoor GIS application has improved speed of service, resolving the common problem of facilities data being locked up in a system that those doing the physical work on-site did not have access to. Now MSU has a comprehensive picture of university operations by mapping outdoor assets as well as indoor assets and making that information available to those who need it. ■

Across a wide space like Michigan State University's 5,300 acre campus, having a detailed map to show building locations, and the assets within those locations, is key for facilities management.

Floor plans, space characteristics, and assets can change, so they need to be kept in a living map that can be updated with the latest data. These maps can be used across the organization.



The ability to configure multiple categories and subcategories will allow staff from different trades to look for and find assets in ways aligned with their needs.

Geoenabling the World's Buildings

Innovative organizations from all sectors are using GIS, BIM, and other data sources to create a comprehensive digital twin of their operations, improving facilities management as well as enhancing user experiences with location intelligence.

The ability to bring situational awareness to mapping indoors is revolutionizing enterprise systems. Digital twins are helping organizations manage their facilities, enabling employees to see things like the precise locations of malfunctioning equipment so that the proper maintenance personnel know where to go. This technology is also giving management the ability to see where all employees are at all times so that they can be located 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 people are and when they 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, people at any business or government facility can use geospatial awareness of indoor assets and processes. With the combination of advanced mapping and analytics and indoor positioning technology, 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 US 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.

Find out more about Esri's facility management solutions.
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