DIMENSIONS®

TECHNOLOGY REPORT 2023

Dewberry®

THE POWER OF TECHNOLOGY

I'm now in my second year of serving on Dewberry's Board of Directors. I began this position having enjoyed a fulfilling career focused on managing strategic operations for large-scale programs, applying integrated information technology, and driving innovation—in other words, optimizing performance every step of the way. And that's what I see here at Dewberry, day in and day out.

Whether creating proprietary software programs or working closely with industry partners on breakthrough technological innovations, Dewberry's project teams routinely apply these advances to solve our clients' most challenging problems with ever-increasing accuracy, detail, and efficiency. We've thoughtfully embraced emerging tools such as artificial intelligence, big data analytics, and augmented reality, and collaborated closely with clients to deliver stronger outcomes for their projects and programs. Streamlining processes enables us to re-align our focus on the bigger challenges and higher quality results. We're saving clients time and money, and problem-solving more effectively than ever before.

Technology in the AEC industry is a game changer—a "force multiplier" that provides leverage to help our experts provide innovative, responsive service. With the tools we have today—and those on the horizon—the ingenuity and resourcefulness needed to apply these resources in our practice have never been more important. I'm excited to be a part of this progress, and to see what's next.

THOMAS GREENSPON
Member, Board of Directors

DIMENSIONS® TECHNOLOGY REPORT

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Contact Molly Johnson with comments at media@dewberry.com

OUR HEADQUARTERS
8401 Arlington Boulevard
Fairfax, Virginia 22031-4666
703.849.0100

Craig Johnson, PE, 24GE03157500
Dewberry Engineers Inc., 24GA28047600

www.dewberry.com
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ON THE COVER
Tampa Bay South Shoreline Mapping, Tampa Bay, FL

ADDING A NEW DIMENSION TO GEOSPATIAL DATA PRODUCTS

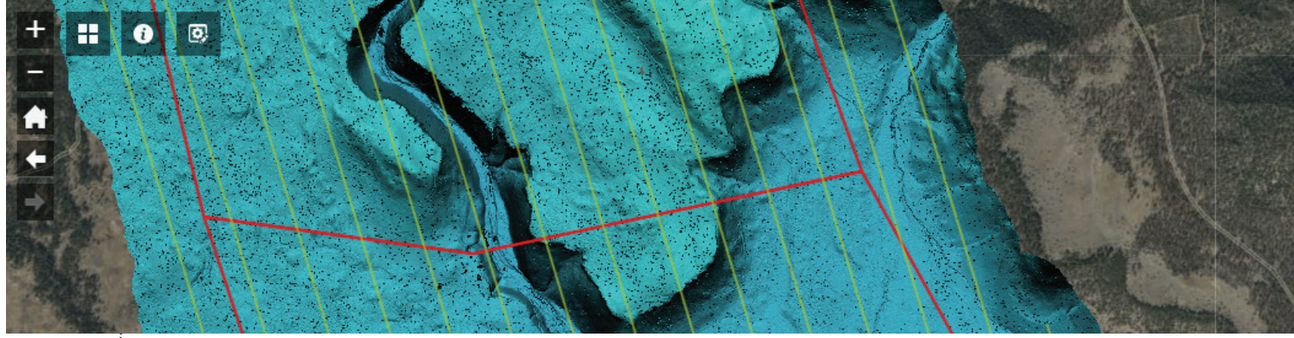
by James Parker, GISP, PMP
Associate, Senior Project Manager

In 1858, a French photographer launched himself in a tethered hot-air balloon and, from approximately 270 feet up, took what is considered to be the first aerial photograph—a view of a small village outside Paris.

Because the image has been lost to history, it's unknown how much detail was discernable, particularly since the film was processed in a portable darkroom inside the still-aloft balloon basket. Nevertheless, that simple photograph was the forerunner of today's powerful geospatial mapping and survey technologies. High-accuracy data gathered from airborne lidar sensors combined with equally powerful geographic information systems (GIS) and other tools now provide essential planning, management, decision-making, and communication tools used by government agencies and commercial enterprises of all sizes and missions. However, the ability to produce so much detailed data comes with a caveat. Just as that pioneering aerial photographer had to go through several steps to produce the initial film image, acquiring and processing digital data over a large area can take months, if not years to complete.

DELIVERING A COMPLETE DATASET

It's not just acquiring the data that can be a challenge, there's also the matter of getting the completed dataset to the client. These datasets are quite large, and far beyond the capacity of most convenient electronic transfer systems. That means geospatial services providers typically have to load the dataset onto external hard drives and ship them like any other type of package.



DimensionalView® is our GIS platform used to deliver projects by hosting spatial data and applications. Applications can contain detailed maps with layers from multiple sources, alongside charts, statistics, related media, and custom reports.

"3D viewer will allow viewers to access and begin to use their data sooner, rather than having to wait for the entire dataset to be completed."

And should a client's quality control (QC) check reveal any issues, the datasets must be returned for corrections the same way. The result is a back-and-forth process that takes copious amounts of time and gets quite expensive.

A MORE EFFICIENT SOLUTION

Our team is working on a way to make the process for clients to receive datasets faster and more convenient. This web-based three-dimensional (3D) viewer facilitates QC checks as the data is acquired and prepared. Clients can then transfer the finalized portions, also known as tiles, to a cloud-based server for storage and management in smaller segments. Along with eliminating physical shipping limitations, the new 3D viewer will allow viewers to access and begin to use their data sooner, rather than having to wait for the entire dataset to be completed.

We're fortunate to have a head-start in our development effort—DimensionalView®, our firm's web-based project management tool is accessible by customers to monitor project progress and examine preliminary, 2D raster images of the collected data before it undergoes full processing. Even though DimensionalView is a proven product, creating a fully functional 3D version for large GIS dataset access requires much more than simply adding some features.

CUSTOMIZING DIMENSIONALVIEW FOR GIS CLIENTS

We first need to understand the specifics of what to build and what exactly we want the application to do with the lidar data. Here again, we have the benefit of in-house experts with deep expertise with the technology, as well as a diversity of customers who can provide the user's perspective. We'll leverage these insights to identify the best software development technology or combination of technologies to build around. Security, performance, and cost will also be important considerations.

That process will yield prototype applications that we can test and gradually build into a production-grade viewer. By early next year, we hope to enlist a current GIS client to assist with more advanced testing and final development, ultimately adding the viewer to our lidar suite of services.

The 3D lidar viewer is a solution that clients want and need, especially on projects with time-sensitive elements. By delivering our data products in a way that's easier to access, customers will be able to make more well-informed decisions with confidence.

INNOVATIVE LIDAR TECHNOLOGY

NEW DEEP CHANNEL SENSOR YIELDING RESULTS FOR NOAA

by Emily Klipp
Senior Associate, Project Manager

Coastal land is constantly changing due to both environmental and human factors. Collecting coastal elevation data, both on land and in nearshore waters, helps to maintain up-to-date and accurate information so the impacts of storm events on our ever-changing coastal communities are better understood by government agencies at all levels, like FEMA, insurance agencies, scientists, and residents. The National Oceanic and Atmospheric Administration's (NOAA) National Geodetic Survey (NGS) coastal mapping program requires accurate and current elevation data of the nation's coastlines to provide regularly updated shoreline information for supporting maritime navigation, defining national territorial limits, coastal modeling, and managing coastal resources.

Topobathy lidar is typically employed as an accurate, efficient way to collect elevation data. These data, alongside aerial imagery, are used to extract vectors for generating shoreline data. This also provides a seamless topobathymetric data product for various applications within NOAA, such as maintaining shipping and navigation routes, and updating flood inundation models. We've recently worked with NOAA to acquire, process, and provide deliverables using aerial topobathy lidar and aerial imagery to help achieve these goals in Tampa Bay, Florida.

Our firm was the first private northern American company to own Teledyne Optech's new Coastal Zone Mapping and Imaging Lidar (CZMIL) SuperNova lidar sensor, which provides a point cloud that contains elevation returns from aircraft down to the bottom of the sea floor, to include vegetation, buildings, water surface, submerged objects, and most importantly ground and submerged seafloor. We use a series of automated and manual procedures to classify these points appropriately with the end goal being the use of the points to designate the ground and create a precise digital elevation model.

THE TAMPA BAY SOUTH PROJECT

We have been a NOAA prime contractor for many years, and in 2021, NOAA selected us for the Tampa Bay South Shoreline Mapping project to collect topobathy data and aerial imagery along the bay's shoreline and nearshore areas. This was one of the first projects we flew with a Teledyne CZMIL topobathymetric lidar sensor. This project proved the sensor's capability to collect bathymetric bottom data beyond the existing capabilities of many of the other sensors on the market. It can achieve returns from deeper than the average sensor and helps in environments where standard topobathy sensors would not be able to collect data due to turbid waters.

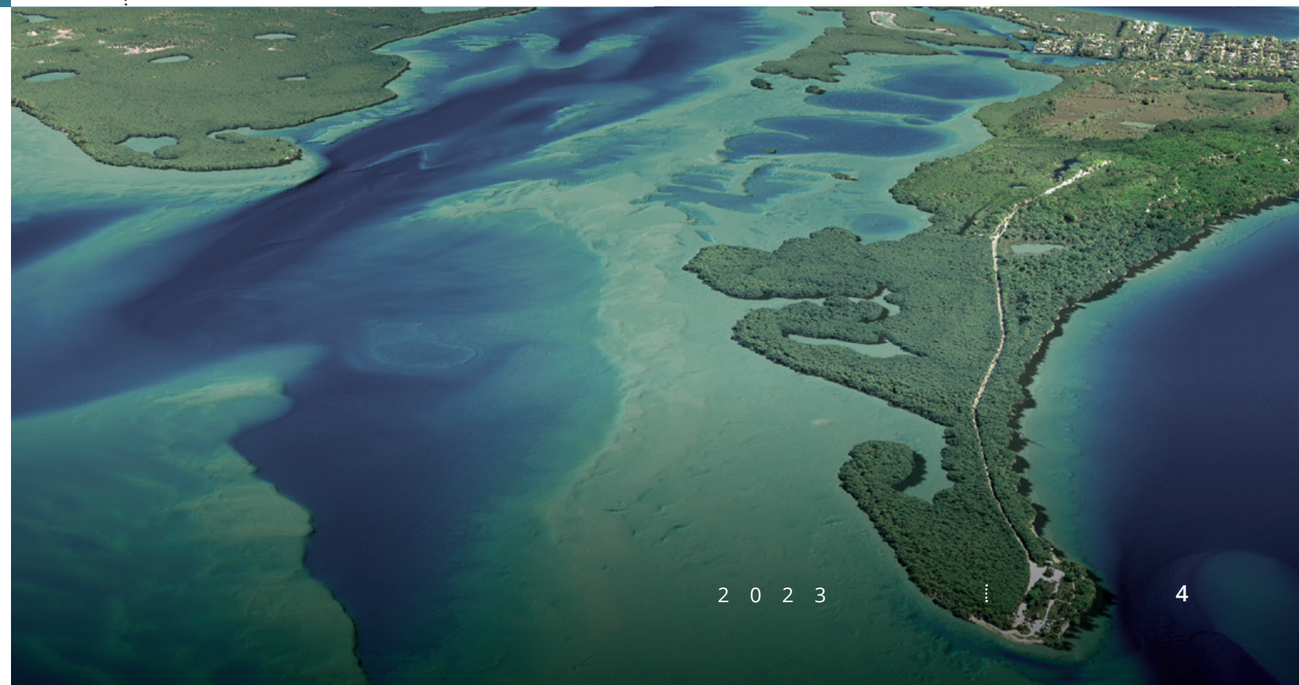
For example, the original project boundary provided by NOAA intentionally did not include the middle portion of Tampa Bay because its depths went beyond the assumed range for normal topobathy lidar. However, in order to get full coverage within the project boundary, it was necessary for the flight plan to extend beyond this boundary in several areas, and we successfully achieved bathymetric bottom measurements of the seafloor in the deeper waters outside of the NOAA-provided boundary.

A CLEARER FUTURE

After completion of the Tampa Bay South project, NOAA requested the same sensor, due to the turbid environment, to map the Indian River Lagoon on the east coast of Florida. Additionally, we mapped an area further offshore in the Big Bend region of the Gulf of Mexico, where we were able to achieve almost full coverage out to six meters in depth. In order to achieve bottom returns, NOAA also requested we use the sensor on the Big Bend project because of the area's location offshore and in deeper waters.

Our team continues to work with NOAA on similar projects across the U.S., including a large riverine topobathy project in Virginia. Because of previous success using the CZMIL SuperNova, our team is using it again so we can deliver a much clearer picture of elevation data in areas that were previously difficult to read.

The Tampa Bay South Shoreline Mapping project proved the Teledyne CZMIL topobathymetric lidar sensor's capability to collect bathymetric bottom data beyond the existing capabilities of many of the other sensors on the market.



OPTIMIZING ORGANIC LOADING PROCESSES

SUSTAINABILITY AND ADVANCED ODOR CONTROL TECHNOLOGY LEADS TO SUCCESS IN DURANGO

by Patrick Radabaugh, PE
Senior Associate, Chief Engineer

Recent upgrades to the Santa Rita Water Reclamation Facility (SRWRF) in Durango, Colorado, addressed several issues for the tourism-friendly city, including capacity and the ability to comply with regulatory requirements. Set along the scenic Animas River, the site is adjacent to an acclaimed whitewater recreation park, the Animas River trail, and Santa Rita Park—all important considerations as the city sought to expand and improve the plant.

Our design expanded plant capacity to 3.26 MGD; and focused on delivering a highly sustainable and energy-efficient facility. Given the proximity to the popular parks and trails, the need for odor mitigation and control was also identified as a priority from the start.

STATE-OF-THE-ART ODOR CONTROL TECHNOLOGIES

We conducted a series of charrettes and public workshops, during which community members shared their concerns about odors from the plant, as well as encroachment and visibility within the scenic setting.

Our design incorporated state-of-the-art odor control technology, including cost-effective primary and secondary odor mitigation and treatment processes that either pretreat the air or contain and treat odorous air. At the identified major odor-generating locations (headworks, primary clarifiers, digester support), the air is captured and treated through an iron-impregnated activated carbon system before release to the atmosphere. Activated carbon is a versatile, porous substance that attracts and contains odors, and the addition of iron enhances the carbon's ability to remove sulfide-based odor compounds, such as hydrogen sulfide.

A second process in these odor-generating locations consists of an air pretreatment system. The system utilizes ultraviolet light to produce hydroxl radicals that attack double bonds common in many odor compounds, thus eliminating or reducing the presence of odor

The upgraded treatment facility features an energy-efficient Johannesburg biological nutrient removal process, anaerobic digesters with innovative linear motion mixers and beneficial use biogas production, and visually appealing architectural and site design.

compounds at the source. Together, these technologies have significantly reduced odorous vapors that had previously been chronically problematic. Since coming online, the upgraded facility has only had one odor complaint, while prior to the upgrades, the facility was receiving one to two odor complaints per month.

SUSTAINABILITY FEATURES AND TECHNOLOGIES TO MINIMIZE ENERGY USE

We incorporated multiple sustainability features and technologies in the plant upgrade. The aeration system combines high speed turbo blowers (HSTBs), the most energy-efficient blowers in the market, with a diffuser system and control system that focuses on maximizing oxygen transfer while minimizing energy use. A custom-designed Johannesburg process biologically removes nitrogen and phosphorus from the water. The facility now produces effluent that meets and exceeds regulatory requirements for nitrogen and phosphorus.

New linear motion mixers in the anaerobic digesters require one third the horsepower of other conventional mixing technologies. The primary clarifiers collect influent wastewater carbon rich solids and send it to anaerobic digesters to produce renewable, methane-rich biogas, which is then collected and scrubbed for use in an energy-generating combined heat and power (CHP) process that produces enough power and heat to reduce outside energy use by 40%. The CHP process supplies heat to the anaerobic digesters and produces electricity. During the design process, the influent biochemical oxygen demand/carbon oxygen demand (BOD/COD) was fractionated to optimize the treatment process for the city and produce a high-quality effluent with minimal chemical and energy use.

The accumulation of these energy-efficient technologies has resulted in a treatment facility that requires less energy than similar-sized facilities while producing a very high-quality effluent. The effluent nutrient concentrations are so low that the City of Durango SRWRF will be allowed to postpone the future effluent nutrient regulatory requirements for 10 years.

In addition to the plant upgrades, the new administration building serves as a gateway to the site and a community amenity, with educational exhibits describing the plant's state-of-the-art treatment processes.

"The end product of construction was that we met our nutrient standard regulations on day one of receiving our permit, and that was very exciting," says Jarrod Biggs, assistant financial director for the City of Durango. "It was the culmination of a lot of effort, forethought, and planning."

STREAMLINING DRINKING WATER SAFETY INSPECTIONS

by Michael Hanley, EIT
GIS Developer

According to the U.S. Environmental Protection Agency, approximately 90% of Americans rely on public water systems for safe, reliable drinking water. While these utilities vary in both size and capacity, they are committed to providing water, free from contamination, from treatment facility to tap. It's a massive challenge, considering that the distribution network extends into many buildings that may contain any number of actual or potential cross-connections with non-potable piping. Without proper protection, an unintentional flow reversal could bring drinking water into contact with pathogens, creating a health risk that might go undetected.

Many states and municipalities mandate that buildings be fitted with backflow prevention devices that allow drinking water to flow in one direction. Though quite effective in protecting drinking water, these devices also require regular, comprehensive inspection and maintenance by the utility for proper operation and performance.

LARGER SYSTEM COMPLEXITY

This effort can be particularly daunting for large water systems, given the number and variety of backflow prevention devices that must be assessed, tracked, and, if needed, repaired and reinspected. Then there are the bookkeeping and other administrative tasks necessary to carry out the program as intended. Without the right tools to help manage the process, even the most well-trained water system staff could easily find itself struggling to keep the inspection program on track, and with inspection data that is accurate and error-free.

The city of Chelsea, Massachusetts, wanted to avoid those costly and time-consuming pitfalls as it transitioned its backflow prevention inspection program from a contractor to in-house management. With a population of approximately 50,000 across 2.5 square miles, the city is one of New England's most densely populated municipalities. As such, the city would have to perform approximately 2,000 inspections annually, each with different assessment, schedule, and reporting requirements. Though there were many technologies that could be used to develop the program, our challenge was to identify and optimize the best tools to match the city water system's specific profile and needs, and meet the Massachusetts Department of Environmental Protection's reporting requirements.

A DATA-DRIVEN SOLUTION

Our resulting data-driven and tablet-based solution converted existing paper inspection documents into digital survey forms that can be filled out quickly and easily. We also augmented the tablet form with features that help expedite the inspections, including locating backflow devices on a building floorplan and highlighting only those fields relevant to the type of device being inspected.

Linking inspection tools to the city's GIS and email systems helps speed the transfer of data between the field and the central office. For example, backflow devices that need to be inspected at a specific time appear on the tablet in a map or list format, and can be filtered any number of ways, such as by address or when the device was last inspected. Submitting the completed inspection automatically updates the city's GIS and utility records, while a failed inspection can trigger notifications to the appropriate city staff.

In addition, our team built a dashboard that provides city utility managers with a real-time visual of the program's high-level metrics, such as the number of inspections performed, results by area or type, locations of most recent failed inspections, and other valuable data. The dashboard also helps the city identify and address emerging issues with a cross connection before they become more serious.

> **"City utility managers now access a dashboard that displays high-level data like the number of inspections performed, results by area or type, and locations of recent failed inspections."**

If ever there was a win-win tool for water system backflow prevention programs, this may well be it. The city of Chelsea has a fast, economical tool to consistently monitor the program while inspectors can focus on the actual process of assessing device performance, rather than filling out cumbersome forms by hand. Best of all, it's an innovative approach to backflow prevention device management that can be adapted to any public water system of all sizes, benefitting both the utilities and the people who rely on them for safe drinking water.

TRANSFORMING TRANSPORTATION SYSTEMS THROUGH DATA SCIENCE

by Cody Pennetti, PhD, PE
Associate, Senior Project Manager

A new era of transportation planning is emerging by leveraging a combination of civil engineering, systems engineering, and data science. It is clear that data science is transforming how people work, and its impacts are only increasing with the rapid growth of machine learning (ML) and artificial intelligence (AI). Our team is already looking into how these technologies inform transportation planning for clients and their communities.

New methods of transportation data science eliminate the need to generalize transportation data. Modern data sources, such as connected vehicle data, smartphone devices, commercial fleet GPS hardware, remote sensing, and intelligent transportation systems have significantly improved the quality of transportation planning. With this increased resolution, engineers can evaluate improvements to transportation travel time reliability and identify emerging patterns to inform future design projects.

INFORMING FUTURE SUCCESS

Data science allows for project performance to be evaluated through the use of precise observations of its users. With data science, engineers are informed about the conditions that influence traffic operations before, during, and after a transportation project is complete. For example, metrics on congestion, speed of travel, number of crashes, types of crashes, severity, or location-specific events can be used to inform decisions on what should be done differently, better, or maintained on the next project. Better-informed projects help give our clients and communities better outcomes. A disciplined approach to data analytics provides reliable and consistent evaluation methods to instill confidence that decisions are best suited for a specific region and consider multiple criteria, such as safety, environment, and mobility. These criteria allow us to continue improving projects and processes to enhance the value for our clients.

COMMUNITY-CENTERED DESIGN

Precise data gathered from sources, such as connected vehicle data, allows for design choices that are tailored for unique locations, populations, and clients. Traditional data-gathering methods, such as annual averages and generalized transportation equations, tend to overlook the variability of traffic patterns across hours and days. Modern data science allows for operations that are designed to respond to real-time variable environmental conditions, including unique traffic events, system disruptions, and extreme weather conditions. This allows transportation planners to understand operational differences in communities across specific locations.

LOOKING TOWARDS THE FUTURE

As AI continues to grow and develop over the coming years, so will its functionality. Our engineers are currently using connected vehicle data to uncover insights that aim to use ML and AI to identify system risks. For example, connected vehicles reporting a high density of harsh or autonomous braking events could signify crash-prone intersections and access points before crashes are observed. New technologies and models will provide better information to engineers who will continue to develop new methods of implementation that best support the communities they serve.

DELIVERING PROJECTS THROUGH 3D MODELING

by Carl Kaczmarek III, PE
Senior Associate, Department Manager

Building information modeling (BIM) continues to be an effective way to create, manage, and share multidisciplinary digital asset data across the life cycle of a project, from planning and design to construction and operations. BIM offers many applications across the AEC industry. The software developer Autodesk reports that by 2024, the percentage of architects and engineers using BIM for more than half of their projects is forecasted to reach 89% and 80% respectively.

There are multiple BIM processes used by engineers every day. These technologies support project delivery, iterative design, community engagement, construction administration, and streamlined information management. Software applications used to facilitate project delivery are often designated by the client, following defined expectations.

Our team had the opportunity to apply BIM's 3D technologies on the Warrenton Southern Interchange design in Fauquier County, Virginia. The previously signalized intersection at U.S. Route 15/17/29 and Business U.S. Route 15/17/29 experienced a high volume of crashes, caused traffic delays for the growing community, and did not provide accommodations for pedestrian or bicycle traffic. The Virginia Department of Transportation (VDOT) selected our team to design and construct a solution that would alleviate the congestion and safety concerns.

SOUTHERN WARRENTON INTERCHANGE 3D MODELING

Our design team used Bentley's OpenRoads technology for the project, which allowed for real-world contextualization of the project site and 3D modeling. The software was used to develop a 3D design for plan production and the construction of the project. Our team also harnessed its capabilities during the design-build procurement, which helped us to quickly explore alternatives that led to a lower project cost for VDOT. These savings resulted in a funding surplus, allowing for contract options to be added, ultimately benefiting the end users. The 3D workflows also supported the rapid development of project construction limits and material quantity estimates for the subcontractor in early phases, and later analyzed a multi-stage traffic control diversion with grade changes of up to 30 feet.

The design team achieved plan approval within 12 months of notice to proceed, including two months of field investigations prior to design activities. This success continued through construction as the team received VDOT's highest Construction Quality Control Program score at the time, and a Design-Builder Performance Evaluation of four out of five. Our team's effective use of the BIM processes was a significant reason for our efficiency and overall success on the project.

SUPPORTING THE 3D TASK FORCE

Shortly after the Warrenton Southern Interchange project was complete, VDOT requested that our team participate in the Industry 3D Task Force, where our engineers gave their perspectives on Virginia's expectations of their consultants. We were able to help define what 3D deliverables and model management will look like in Virginia for years to come.

CLOUD ENHANCED

STREAMLINING ACCESS TO AIS DATA

by Ken Logsdon, Jr., PMP, GISP, ENV SP
Associate Vice President, Program Manager

In **12 YEARS'** time

30 BILLION data points

60 MILLION ship tracklines covering

10 MILLION square miles

= **6+ TERABYTES** of data archived and easily accessible

Automatic Identification System (AIS) vessel traffic data plays a crucial role in maritime operations and navigation safety, including various oceanic and coastal management activities. It is transmitted and received by vessels and collected by receivers on shore stations, providing real-time information about the location and characteristics of vessels in U.S. and international waters. This data is vital for supporting environmental and marine planning, ship routing, ecological research, and efforts such as oil spill monitoring or fishing density mapping. Notably, AIS data has been instrumental in the strategic planning of offshore wind farms and to reduce whale fatalities along the California coast.

The U.S. Coast Guard (USCG) collects AIS data through its Nationwide Automatic Identification System (NAIS), utilizing a national network of AIS receivers. To make this data accessible to the public, the National Oceanic and Atmospheric Administration (NOAA) and Bureau of Ocean Energy Management (BOEM) have collaborated to collect and freely distribute the USCG data through the Marine Cadastre Project.

Traditionally, the data was available through NOAA's previous data provisioning system and interfacing, which had been developed over many years. Accessing AIS datasets required using outdated FTP downloads and bulk CD mailing methods. After receiving a year's worth of data, NOAA's Office for Coastal Management (OCM) would have to process, organize, and upload it, resulting in a delay of more than a year before it was available.

UPGRADING TO NEXT-GENERATION GEOSPATIAL TECHNOLOGY

To meet the growing demand for AIS data and expedite delivery to the public, NOAA recognized the need to modernize its data provisioning system. With these considerations in mind, NOAA engaged our team to reimagine and build a new data provisioning platform, using the latest cloud and geospatial technologies.

The project encompassed five primary goals:

1. Develop an updated provisioning system capable of processing AIS data for quarterly dissemination.
2. Enhance the user experience by designing an intuitive interface with improved functionality.
3. Create a simpler system architecture that is easy to maintain, enabling future enhancements and rapid response to security issues and concerns.
4. Transition the system to a state where it requires minimal specialized services to keep it up to date, potentially allowing NOAA to modify and maintain it on site.
5. Improve the responsiveness and performance of the provisioning system.

One of the major challenges was the immense scale of existing data, consisting of more than 30 billion data points captured from 60 million ship tracklines covering more than 10 million square miles. Spanning a 12-year collection period resulted in over six terabytes of data that had to be archived and easily accessible in the cloud. This required a database structure that could both store a massive amount of information and ingest more frequent data inputs, and still be quick and responsive to user requests.

A VANGUARD PROTOTYPE

Employing a cloud-native design approach, we successfully built an updated AIS data provisioning system that met each of NOAA's goals, enabling new data to be brought online up to four times faster. The system features a self-serve geospatial map interface, allowing users to select their region of interest and time period to download historical AIS data directly to their inbox. The user experience is optimized for efficient data retrieval. Within three clicks users can begin downloading—despite the amount of data that the application must query through.

The project incorporates a multitiered architecture and serves as a vanguard prototype that can be replicated across NOAA's portfolio, paving the way to move other resources to the cloud. The provisioning system adheres to necessary federal procedures and security protocols, establishing a pathway for future cloud migrations.

This was a project that went through thoughtful technology envisioning and architecture planning, including rigorous development and deployment. It spanned several task orders—we broke the massive project into bite-size pieces so we could collaborate actively with stakeholders to achieve an accurate outcome. The redesigned provisioning system received several accolades, including the 2021 MAPPS Geospatial Products and Services Excellence Award.

HOW VR IS ELEVATING THE ARCHITECTURAL DESIGN OF MENTAL HEALTH SPACES

by Josh Becnel, AIA, LEED Green Associate, NCARB
Senior Architect

Collaborative virtual reality, or VR, has become an important tool in architectural design. Unlike the single-person experiences standard VR typically provides, collaborative VR allows multiple people to work together in a realistic 3D environment. These experiences can drive real results in terms of communication and design. Recently, we've been using collaborative VR in the design of different project types, including specialized psychiatric care facilities.

> **"Hospital staff used the technology to assess how patients can be observed no matter where or how they have positioned themselves, which helped us design the best possible conditions for patient care."**

The Oklahoma Psychiatric Care Center staff used the VR technology to assess their own sightlines and workflows in the facility's proposed dayrooms and patient spaces.

Using the technology puts designers and mental health facility stakeholders closer to the real experience of a space, creating new opportunities for better, more practical designs that 2D or even 3D renderings alone cannot accomplish. With these technologies, designers can give a guided tour of a virtual space to, for example, eight people simultaneously. Meanwhile, anyone without a VR headset can watch a projection of the experience in a conference room. This extends the shared experience to participants who benefit from the real-time interactivity of their peers.

We recently deployed this multi-user VR technology for the new $88-million Oklahoma Psychiatric Care Center located in Tulsa. Hospital staff used the technology to assess their own sightlines and workflows in the facility's proposed dayrooms and patient spaces. This allowed staff to completely assess how patients can be observed no matter where or how they have positioned themselves within the space. This kind of insight is helping us design the best possible conditions for patient care and healthcare operations, and support better outcomes for all users of the facility.

CONTRIBUTING TO BETTER OUTCOMES IN PSYCHIATRIC CARE FACILITIES

VR technology helps advance the goals of practitioners and improve the experiences of their patients. Designers and facility stakeholders can visualize equipment clearance issues, optimize spaces shared by facility visitors and staff, and determine how tall or wide staff stations should be in ways that are practically impossible without the use of VR.

Healthcare practitioners can realize professional benefits using VR. They can interact with the digital space and understand how it will flow as they work with their colleagues and patients. Designers can gather otherwise overlooked insights by watching them sit, stand, and move around the space.

THE FUTURE OF VR IN MENTAL HEALTH FACILITY DESIGN

I anticipate that before too long, many clients, including those in the mental healthcare space, will begin to expect VR as a way to visualize spaces throughout their proposed facility during early stages of design. It's key that designers be adaptable to these developments, including possibilities for better project understanding and schematic designs.

DECARBONIZING HEALTHCARE FACILITIES REQUIRES PLANNING, PATIENCE

by Natalie MacDonald, PE, CEM
Project Manager

At the outset of the green building movement, healthcare facilities were considered particularly challenging given their near-constant need for energy-intensive systems and infrastructure. Over the years, advancements in mechanical and electrical systems technology have not only helped many newer facilities reduce their energy use, but also achieve the highest levels of LEED® certification.

Now, healthcare facilities face a new challenge—decarbonization, or reducing operational and embodied carbon emissions throughout a building's life cycle.

Though building decarbonization is part of a multifaceted focus on sustainability and mitigating climate change, healthcare facilities have drawn particular interest as they have been found to account for as much as 10% of U.S. greenhouse gas emissions. Several federal agencies are exploring ways to make healthcare more sustainable, including a voluntary program launched last year by the U.S. Department of Health and Human Services aimed at cutting nationwide carbon emissions in half by 2050.

There are other drivers as well—community-based efforts to reduce carbon footprints and studies published in leading medical journals that suggest increased health risks associated with climate change. As such, taking steps to reduce carbon emissions becomes a natural part of a hospital's mission.

TAKING THE FIRST STEP

Building decarbonization can be overwhelming, even for healthcare facility managers who have tried to keep current with sustainability trends and technologies. There are also misperceptions: that decarbonization is prohibitively expensive and must be completed all at once.

Though some investment will be needed to upgrade certain building systems, decarbonization is a carefully planned process that takes time to implement and see results. The good news is that most healthcare facilities already may be reducing their carbon footprint via routine energy reduction measures—replacing fluorescent lighting with LEDs, repairing refrigerant leaks, or applying nighttime HVAC setbacks to operating rooms and other low-use spaces.

> **"Most healthcare facilities already may be reducing their carbon footprint via routine energy reduction measures."**

Benchmarking and monitoring system performance by metering utilities can also provide the information needed to determine what a hospital is already doing, how much energy it's consuming, and how much carbon is being emitted. Facility owners can also weigh the costs and benefits of various short- and long-term improvement strategies, and gauge progress toward overall decarbonization goals.

Larger system-level decarbonization approaches, such as switching from oil- and gas-power to electricity, require understanding the age and performance of what's already in place. For example, rather than overhauling a relatively new gas-fired steam boiler with an all-electric system, a healthcare facility may be better served by looking for operational and maintenance improvements that will optimize the existing system performance—a process called retro-commissioning.

MICROGRIDS AS A CLEAN ENERGY OPTION

A critical consideration of any decarbonization strategy is the reliability of back-up and emergency power. The U.S. Centers for Medicare and Medicaid Services (CMS) recently issued a categorical waiver to allow incorporation of microgrids—a combination of energy assets that work together with intelligent controls—as a source of supplemental power for hospitals. This move, along with changes to National Fire Protection Association (NFPA) standards, could lead to more integration of clean energy systems in hospitals.

While decarbonization is a long-term facility-specific process of learning and evaluation, the benefits are well worth the effort. Being aware and doing the smaller scale things now is just as important as the bigger things that may come later.

REIMAGINING ENERGY INFRASTRUCTURE WITH RESILIENT AND INDEPENDENT MICROGRIDS

by Stephen Webb, PE
Senior Associate, Senior Project Manager

Microgrids are driving exciting energy innovation across a number of different industries. As renewable technologies become more accessible, microgrids help organizations more effectively manage their energy, save money, and reduce their environmental impacts while reaping the rewards of sustainable and resilient solutions.

A microgrid can support facilities and functions with its own island of electricity production, storage, and consumption. For example, one of our recent projects involved designing a large-scale microgrid for a U.S. military base that will integrate a solar photovoltaic (PV) farm as part of its local utility. The grid combines that resource with natural gas generation and battery storage, and can support 130 buildings for 14 days in island mode—without electricity from the public grid.

MICROGRIDS EVOLVE OUTSIDE THE PUBLIC GRID

When the public utility is unable to provide energy—like when important facilities lose power—a singular renewable energy source, such as a solar array, cannot make up for that loss until normal conditions are restored. This is a big problem that's becoming more dangerous as extreme weather conditions become more common and jeopardize the public grid.

Facilities with microgrids can rely less on public utilities, which also helps the facility owner adapt to the wider adoption of electric vehicles (EV), batteries, and other elements of the electrification revolution. Additionally, as organizations combine their energy needs with renewable incentives, microgrids can help them hit their targets and save money at the same time.

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MICROGRID DEMAND IS GROWING ACROSS INDUSTRIES

Building microgrids isn't an entirely new concept. Some of our past projects have involved generators and battery backups for hospitals, industrial and commercial facilities, and other establishments that are similar in scale. But there's a difference in our latest work: along with helping facilities operate in "island mode" using finite stored and generator-based energy, now they can also function in connection with long-term generative resources such as solar energy.

For instance, in a recent project with an industrial machinery client, we combined solar and battery storage, creating an all-electric microgrid solution for its sales and administration buildings. The arrangement helps with sustainability efforts and provides electricity during outages.

A private microgrid can even become a resource for the public grid. A private university in New Jersey has a microgrid that utilizes solar PV, combined heat and power, and battery energy storage that can meet the university's energy needs while operating in island mode in the event of a grid outage. When there is no outage, the microgrid feeds its abundance of renewable energy into the public grid.

A LASTING SOLUTION FOR FUTURE ENERGY NEEDS

The U.S. Department of Energy (DOE) launched its Microgrid Program Strategy in December 2020. Its vision is to establish microgrids as essential building blocks of a new energy architecture that supports resilience and decarbonization, among other benefits.

Today, the demand for microgrids continues to be strongest among campus-style environments, where key decision makers understand how this technology can boost their organizations' energy resilience and help them reach their sustainability goals.

Every microgrid is unique, so they all come with their own individual challenges. But as the desire for clean and reliable energy grows, we'll continue our efforts to make microgrids more accessible. Since microgrids can support virtually any business, campus, or community, I expect they will only become more in-demand and efficient over time.

Dewberry

8401 Arlington Boulevard
Fairfax, Virginia 22031-4666
Address service requested

www.dewberry.com

CONSTRUCTION SEQUENCE VIEWER

A NEW TOOL FOR CONSTRUCTION COORDINATION

by Hillary Palmer
Program Manager

We recently announced the development of a new software tool, the Construction Sequence Viewer (CSV), to aid in project sequencing and phasing. CSV enables time-dependent interaction for design drawing elements through a browser-based interface that leverages ArcGIS Online.

Use of CSV for temporal, or time-enabled, coordination can be applied to a wide range of projects, from preliminary site development through building construction. Temporal aspects of a project may be viewed with other GIS information such as imagery, elevation data, or soils. Users can modify start and end dates as needed and quickly reach optimum sequencing solutions.

CSV has also been configured to meet Controlled Unclassified Information (CUI) requirements for federal government clients. A product of our enterprise innovation commitment, the tool has quickly proven effective in coordinating complex projects with clients, subconsultants, and contractors.