PART 2

DESIGN AND ENGINEERING

AEC PROFESSIONALS COMBINE CAD AND BIM workflows with location intelligence to understand the surrounding environment and inform design and civil engineering decisions. Adding context and combining information gathered from aboveground and belowground help construction project teams develop better solutions. AEC teams can share project details for roads, bridges, and building projects with owners, builders, and stakeholders to achieve project deliverables and outcomes.

Engineering a large-scale project such as a new high-speed rail line involves much more than meeting the exacting requirements, calculations, and measurements to build integrated structures and compose supporting infrastructure, including miles of conduits, pipelines, and electronics. GIS helps focus the contextual vision of a project and serves as a universal language for communicating with decision-makers, reviewers, and workers. Before breaking ground on a project, AEC professionals must submit their preliminary designs for review and collaborate with government departments and agencies to gain permit approvals. GIS facilitates communication and permit approvals by organizing project details into maps and interactive 3D models that incorporate CAD and BIM designs.

GIS also simplifies the collection of accurate ground data for building sites and conducting soil, water, and environmental remediation evaluation and testing. GIS mobile apps feed collected data directly into GIS data layers, which can be analyzed and displayed in place with CAD and BIM designs, giving reviewers and decision-makers contextualized views of the project and connecting that information with as-built designs, including drawings, diagrams, plans, and blueprints.

The real-life stories in part 2 focus on design and engineering. The first story explores the use of GIS to perform a multimodal needs assessment along a state's transportation network, evaluating congestion, safety problems, and much more. The second story illustrates the use of GIS to document assets above- and belowground, such as electric and gas utilities, surface water and sewer drainage, associated underground pipe networks, and maintenance holes. The final story illustrates the application of a unique digital twin strategy that includes 3D mapping to create an immersive, real-world experience that acts as a centralized, authoritative, and continuously updated data source, open to any team member.

PRIORITIZING INFRASTRUCTURE PROJECTS

Esri

TO PRIORITIZE TRANSPORTATION NEEDS, THE STATE OF Virginia uses The Geographic Approach to evaluate and score projects in six main categories: safety, congestion, accessibility, land use, environment, and economic development. The scoring program, called SMART SCALE, uses GIS to visualize and analyze all relevant data for projects in the context of location. The state Office of Intermodal Planning and Investment partnered with the Virginia Department of Transportation (VDOT) and Virginia Department of Rail and Public Transportation to develop the program.

"People are realizing that we need to attack transportation problems in a fundamentally different way," said Chad Tucker, SMART SCALE project manager. "There's a lot of great data sources that we have now that we can rely on to focus on the real problem areas and try to move the needle from a performance standpoint."

For example, a proposal to expand the Hampton Roads Bridge-Tunnel (HRBT) in coastal Virginia was ranked highest in one evaluation for its impact on congestion, access to jobs, multimodal and intermodal access, and travel-time reliability. The existing commuter route links some of Virginia's most populous cities separated by water and is an essential route for people living and working on opposite sides. Its need to handle growing traffic meets transportation and economic requirements, allowing local industry to continue to thrive.

In 2016, then Virginia transportation secretary Aubrey Layne credited SMART SCALE for being one of the primary drivers of the HRBT expansion, calling it a "keystone project" that tied together other transportation work in the region.

Another state project using SMART SCALE will improve nearly 10 miles of the I-64 corridor bridging the cities of Norfolk and

Hampton. The project will include the 3.5-mile stretch of the HRBT tunnel and will double the number of lanes from four to eight by 2025. Its $3.8 billion total price tag makes it the largest transportation project in Virginia's history.

The process of vetting proposed projects for Virginia's Transportation Plan (VTrans) begins with a multimodal needs assessment to evaluate congestion, safety, and more along the state's transportation network. "There are plenty of needs. That's the point," said Brooke Jackson, senior engineer at VDOT. Because transportation needs outweigh available funding, the metrics-driven approach lends fairness and a scorecard approach that shows applicants where their proposals succeeded or fell short.

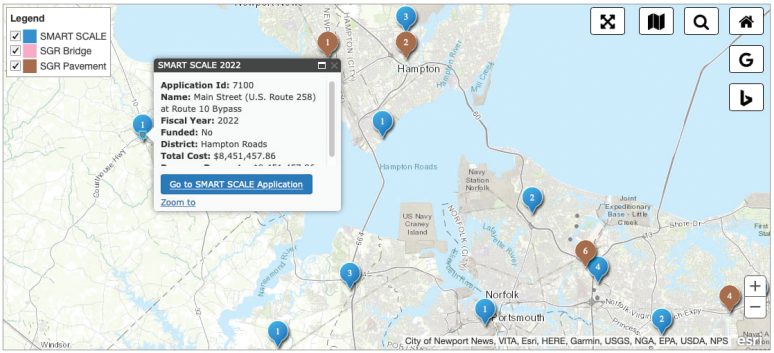
Funding rounds are open to Virginia cities, counties, towns, and public transportation agencies on a two-year revolving schedule. If a proposed infrastructure project meets a need identified by VTrans and the SMART SCALE program's readiness and eligibility criteria, the project can be considered and evaluated.

Before SMART SCALE was implemented in 2015, municipalities needed to qualify for a list kept by the governor. When a new administration came in, the project could be halted, money wasted, and no one held accountable.

Traditional funding mechanisms caused project delays. With no effective way to prove the value of the investment, political will was at the core of prioritization. SMART SCALE aimed to remove politics and let data and expected outcomes drive decision-making.

"Everybody can see the data and what could be studied," Jackson said. "It's not about picking and choosing political favorites. It's about providing benefits and improved system performance to help move people and goods."

The use of a public GIS-powered dashboard provides accountability for each project and project stakeholder. Anyone can see which projects have been selected for funding, why each project



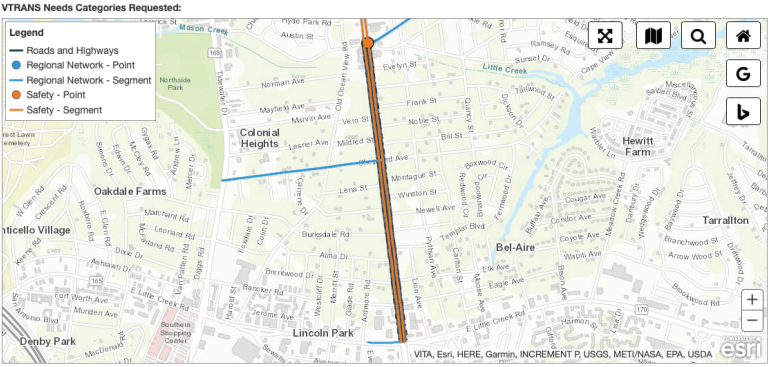
VDOT's public GIS dashboard ensures that each project and stakeholder is accountable. People can see which projects have been selected and whether they are on schedule and on budget.

was selected, and whether they are on schedule and on budget. Projects are also monitored throughout their life cycle to ensure they meet goals. Of the approximately 400 applications submitted each year, fewer than half are selected for funding. Funded projects are expected to be completed within six years.

Managing projects with the GIS-powered SMART SCALE approach ensures continuity between project description, features, sketch, and estimate. Any stakeholder, including residents, can refer to the interactive map and dashboard to follow progress locally and statewide.

SMART SCALE also addresses equity. Analysis of who benefits from projects is built into the process. This analysis did not always happen before SMART SCALE, which considers education and poverty levels in the evaluation and scoring of improvement projects. Accessibility, including access to public transit to connect people to jobs, is another key consideration for equitable mobility.

Whether projects are implemented by localities or by VDOT, their progress is tracked on the same public dashboard and held to set standards. This transparency encourages participants to explain



VDOT's public GIS dashboard is designed to engender public trust and program integrity by requiring participants to show their work and communicate publicly throughout implementation.

their mistakes—why it happened and how they will fix or prevent the problem in the future. Participants also must continue to show their work after funding and through implementation to gain the public's trust and bolster the program's integrity.

"With SMART SCALE, you're getting all the money you ask for, and in six or seven years we expect to see it built," Jackson said of the funded projects.

So far, the positive results in Virginia have shown SMART SCALE can be a model for other states to emulate when prioritizing and managing upcoming infrastructure projects.

"Communication is better, investment into the system is better," Jackson said. "Working toward a bigger goal with a plan is important. We are getting a lot more projects completed start to finish in a faster time with a transparent process."

A version of this story by Terry Bills originally appeared as "Virginia Ahead of Curve on Prioritizing Infrastructure Projects" on the *Esri Blog* on February 15, 2022. All images are courtesy of the Virginia Department of Transportation.