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WHITEPAPER

Construction Data Meets GIS Visualization: Improving Transparency, Collaboration, and Efficiency

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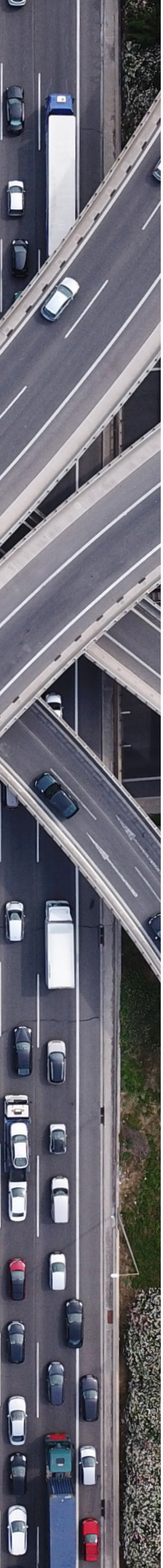
Infotech
August 2022

esri Partner Network Silver



An Introduction

Geographic Information Systems, or GIS, is a foundational technology for the future of construction project management. In this whitepaper, we'll define GIS and its origins, cover emerging GIS trends, review the benefits of geo-enabled field data collection, and take a look at the future of geo-enabled field management. Insights in this report are derived from technology pilot programs, industry statistics, and conversations with industry experts.

Defining GIS

According to Esri, the leading provider of GIS solutions, a geographic information system (GIS) is "a system that creates, manages, analyzes, and maps all types of data. GIS connects data to a map, integrating location data with all types of descriptive information."

GIS databases have been around for decades, but their use in the construction industry exploded into prominence during the 1980s after the passage of the GASB-34 infrastructure asset requirements. This legislation required local governments to account for all of the infrastructure assets they own and track the financial implications of those assets.

Naturally, asset management became an essential part of a transportation asset lifecycle. The need to collect data on what assets are, where they were, and the condition of those assets became more important than ever before.

Today, everyone from transportation agencies to engineering consultants incorporates a GIS database into their construction project management process, enabling a better foundation for data mapping and analysis and improving everything from transparency to visibility. Let's dive into some of the emerging trends in the GIS community as it relates to construction.

Five Emerging GIS Trends in the Construction Industry

1. INFRASTRUCTURE INVESTMENT

The passage of the Infrastructure Investment and Jobs Act marked an unprecedented level of investment from the federal government into our national infrastructure. As agencies funnel these funds into infrastructure improvements, they will need to leverage the latest construction technology to ensure they are spending money in the best way possible to provide benefits to the public. The use of GIS databases will play a key role in construction management for these projects.

2. TRANSPORTATION ASSET MANAGEMENT

The concept of asset management may have begun decades ago, but organizations are all at different levels of sophistication when it comes to how they manage infrastructure assets during and after construction. As access to technology improves, local public agencies are able to integrate GIS databases with their asset management systems to ensure vital geographic data is in place.

3. FIELD MOBILITY

On many job sites, mobile phones and tablets have replaced orange field books or clunky laptops for the purpose of capturing field information. The ability to capture GIS information at the job site on a mobile device enables field personnel to get more done in less time while still building out comprehensive daily reports.

> **"As devices become smaller and more powerful, field mobility has just exploded."**
>
> ADAM CARNOW, PUBLIC WORKS INDUSTRY SPECIALIST, ESRI

> **"Many agencies are struggling with how to engage the public. The best ways to do it are with technology, and quite often, with a map-centric interface, because just about everything the government does has a location. It's just easier for people to understand data when they can see it on a map versus reading an address."**
>
> ADAM CARNOW, PUBLIC WORKS INDUSTRY SPECIALIST, ESRI

4. PUBLIC ENGAGEMENT & TRANSPARENCY

GIS tools help local public agencies adapt to the evolving demands of the next generation. As the public becomes more tech-savvy and government-involved, they don't want to visit an agency or make a phone call. They want to be able to access an app or a website with their own autonomy - these websites are often powered by a GIS database.

5. ARTIFICIAL INTELLIGENCE

Thanks to the Internet of Things (IoT), sensors are deployed regularly, all across the globe. Maybe it's a stationary water depth sensor or a mobile rover - regardless of the format, all sensors have one thing in common: a location. As these sensors emit data in real-time, capturing all of that data in a GIS database will be the first step for many agencies. But pulling insights from that data? That's where artificial intelligence, machine learning, and deep learning will play essential roles.

Seven Key Benefits of Geo-Enabled Field Data Collection

Understanding emerging GIS trends is important, but even more vital is understanding the "why" behind it all. Why make the investment into integrating your construction project data with a GIS database for visualization and analysis? As Carnow puts it, "it's a huge opportunity to add business value. When you're taking one system and connecting it to another, it's not one plus one equals two, it's one plus one equals three, four, or usually more times in business value."

Let's define that value a little further.

1. ENABLING THE GEOGRAPHICAL APPROACH

Let's get philosophical for a moment. The "geographical approach," as defined by industry leader Esri, is fairly simple – it's a process and a framework that allows agencies to apply geographic knowledge to their work. The geographic approach can begin in planning and carry on throughout the transportation asset lifecycle, as defined below.

"If you think of a process that starts with data management, you're collecting and managing data, and once you have that data, you can visualize it, map it, analyze it, and model it. Once we do that we can create plans and do what we call "geo-design," which is designing in a way where we're using the physical environment as an input so we can respond to things happening in the environment."

The geographical approach leads to improved decision-making for organizations.

2. ELIMINATING MANUAL WORKFLOWS AND ADDING EFFICIENCY

"Every time there's an opportunity for an organization to integrate two mission critical enterprise business systems, it should be a high priority, because it's a huge opportunity to add business value." – Adam Carnow, Public Works Industry Specialist, Esri

A seamless integration between your construction project data and a platform for GIS data visualization, mapping, and analysis is the kind of connection that can turn hour-long processes into minutes. Field data collection is expensive, dangerous, and fraught with human error. The ability to sync the location of field staff and the data they collect in real-time back to office staff adds efficiency, accuracy, and better collaboration between departments.

3.SUPPORT QUICK DECISION-MAKING WITH REAL TIME DATA

Construction is unpredictable – and that may be the understatement of the century. It takes place in the real world, not some imaginary, project-defined space where it's known that nothing will go wrong. When

things happen surrounding a project that agencies have no control over, they need to be able to react quickly and correctly. Bringing in the geographic context, whether it's through a comprehensive digital twin or an interactive map dashboard, allows agencies to make insight-driven decisions using the context of the construction project and its environment.

"You can enable what we call real-location intelligence, so you have business intelligence that you use every day to make decisions."

– Adam Carnow, Public Works Industry Specialist, Esri

4. TURN BIG DATA INTO CONCISE INSIGHTS

"No one cares about big data; they care about big analytics." – Richard Saul Wurman, Architect

Anytime an agency has a large quantity of data, there are challenges in extracting real-world value from it. As Wurman alludes to, data on its own is useless unless you can sift through it to find insight. By connecting the ample data that comes out of a construction project to GIS tools for data mapping, agencies can access applicable and sustainable tools that help extract insight via visualization and analytics.

5. SUPPORTING A DEEPER LEVEL OF ASSET MANAGEMENT

Geo-enabled asset management enables agencies to be proactive instead of reactive – identifying an asset before it breaks, or prioritizing maintenance based on certain criteria – these insights allow agencies to extract maximum value out of very expensive built assets.

Incorporating ArcGIS, Esri's GIS platform, into enterprise asset management systems allows agencies to see things they wouldn't normally see in a typical asset management platform. For example, an agency may have pipes in the ground across a county, but find that certain types of soil degrade pipe material more than others. If an organization knows specific soils that are deteriorating pipes, they can focus on those geographic areas and prioritize replacement based on soil-type – information they wouldn't have without GIS.

The Car Analogy
by Adam Carnow

Think of an organization like a car. Data doesn't drive anything. It's the fuel – it doesn't move the car, but it allows the engineer to turn, which moves the car forward. That engine is analytics. Organizations turbocharge their engine with spatial analytics, which provide valuable insight that ultimately makes the car more efficient and more performant. **How far are you willing to go for your construction projects?**

6. ENSURING EQUITY IN FUND DISTRIBUTION

"Social equity by default is a geographic question."

– Adam Carnow, Public Works Industry Specialist, Esri

The Infrastructure Investment and Jobs Act boasts some of the strongest ever federal requirements surrounding social equity and Disadvantaged Business Enterprise usage. Local agencies that want to tap this funding will need to take these requirements into account and ensure funds are spent in an equitable manner. GIS data is crucial to this process, as organizations need to know where these disadvantaged populations are and how they can best apply the resources in an equitable manner to effect positive change in quality of life.

7. INCREASING THE LEVEL OF SERVICE TO THE PUBLIC

"Most of the time people ask about the budget and the schedule. How far are we into it? Are we under budget? All of that information is readily available. It helps people better understand the money being invested in the community and get real-time status updates and projects. And they don't have to call the city manager, which frees up time for field work." – Mark Yerington, Manager GIS/CAD, Muscatine Power and Water

As the above quote points out, agencies are often used to taking calls from the public regarding some facet of a project. Geo-enabled construction data in a publicly available Esri dashboard can eliminate all the manual research that goes into answering public questions. If someone wants to know why their street is being torn up, they can look at a web browser and see that a water main is being replaced. Providing this information in easily accessible dashboards creates a greater level of transparency and service to the public, while also cutting down on the time staff may take to answer a question.

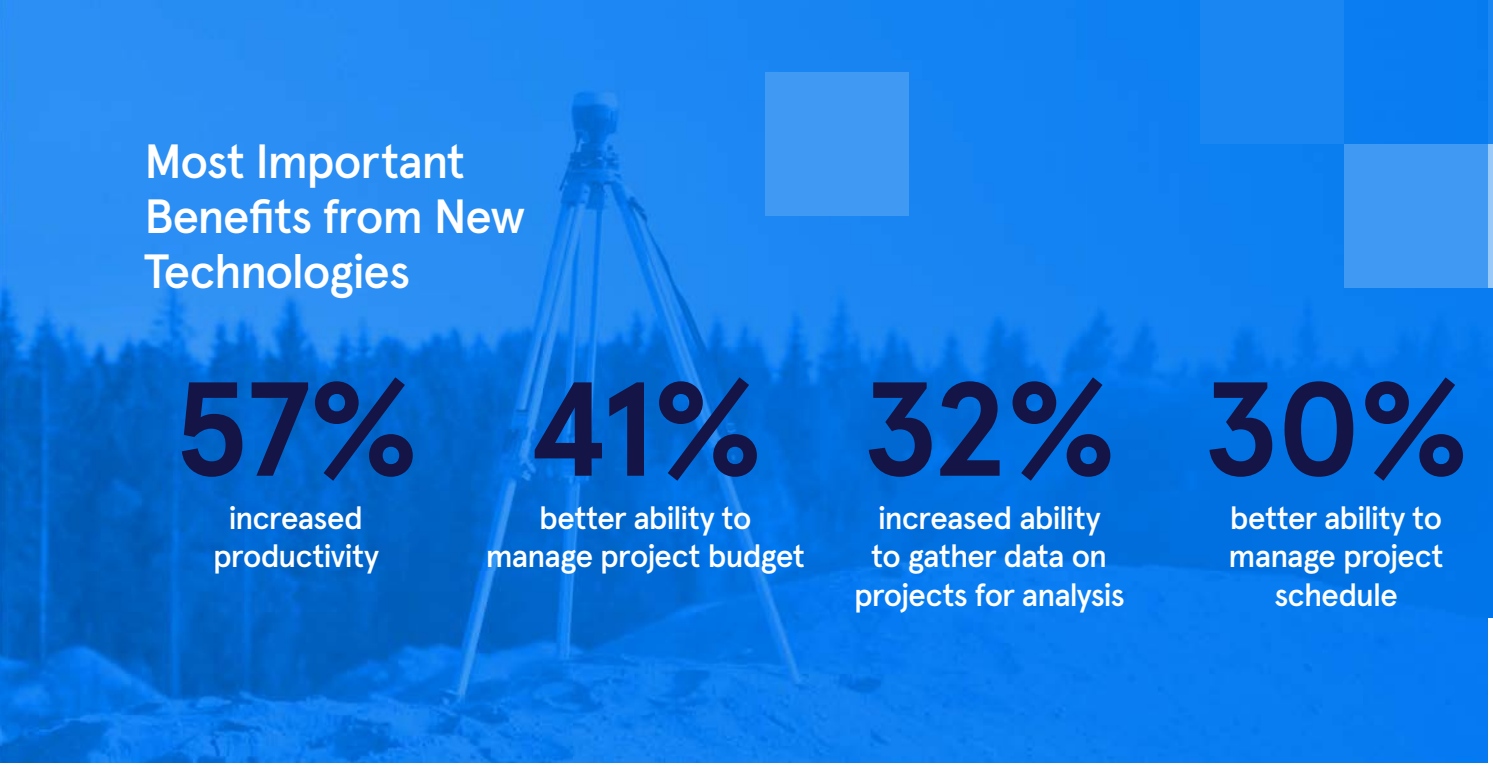
The Future of Geo-Enabled Construction Management

An Explosion is Coming

As infrastructure funding and project demands increase, more and more organizations are realizing the benefits of geo-enabling construction data collection to support Building Information Modeling (BIM), asset management, analysis, and more.

A recent survey conducted by *The Civil Quarterly* of civil contractors and engineers found that:

+ **28%** of civil construction teams use Mobile Mapping Systems, with an additional **23%** considering usage
+ **51%** of civil construction teams use drones to capture GIS data on projects, with another **28%** using advanced rovers



Most Important Benefits from New Technologies

57% increased productivity

41% better ability to manage project budget

32% increased ability to gather data on projects for analysis

30% better ability to manage project schedule

These numbers are expected to skyrocket in the coming years, especially as the benefits of geo-enabled field data collection align with contractor and engineer priorities:

IIJA Necessitates GIS Investment

"Organizations that are used to doing X number of projects a year are now going to need to be doing X, plus however many more projects with the same amount of resources."

– Adam Carnow, Public Works Industry Specialist, Esri

As the pressure increases on organizations to deal with an increased workload from the Infrastructure Investment and Jobs Act, teams will need to find ways to do more with less in a decreased time frame. The only way agencies can achieve this is through digital construction management. When ArcGIS integrates with digital construction management platforms to support data captures, analysis, transparency, BIM, etc., it increases the value of systems across the board.

More Organizations Realize Bottom Line Impact

For organizations still considering if geo-enabling their projects is the right decision, Adam Carnow shares a rallying call:

"The impact is going to be significant. Projects are going to run smoother. They're going to be more efficient. They're going to better react to changes in the project environment. They're going to provide better access to better data. And they're going to provide that insight for better decision-making. It will show up in the bottom line."

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Getting Started with Construction Data Visualization

Your construction project data, visualized.

Ready to see what geo-enabled construction management can do for your agency?

Through the Appia + Esri integration, agencies can connect their construction project data to live GIS dashboards and increase transparency with stakeholder access to executive overviews of state/local projects.

Here's how it works:

Connect

Appia® for construction administration and the Owner's Esri account

Aggregation and display capabilities

Collect & Record

Manage project progress in Appia

Capture precise geometry and spatial information via rover

Translate captured field data to inspector daily report

Visualize

Display construction project data in Esri dashboards

Scale for single municipality or statewide DOT

See an executive level overview of construction portfolio

Ready to explore how Appia + Esri can work for your team?

Visit **infotechinc.com/esri-partnership** to get started.

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