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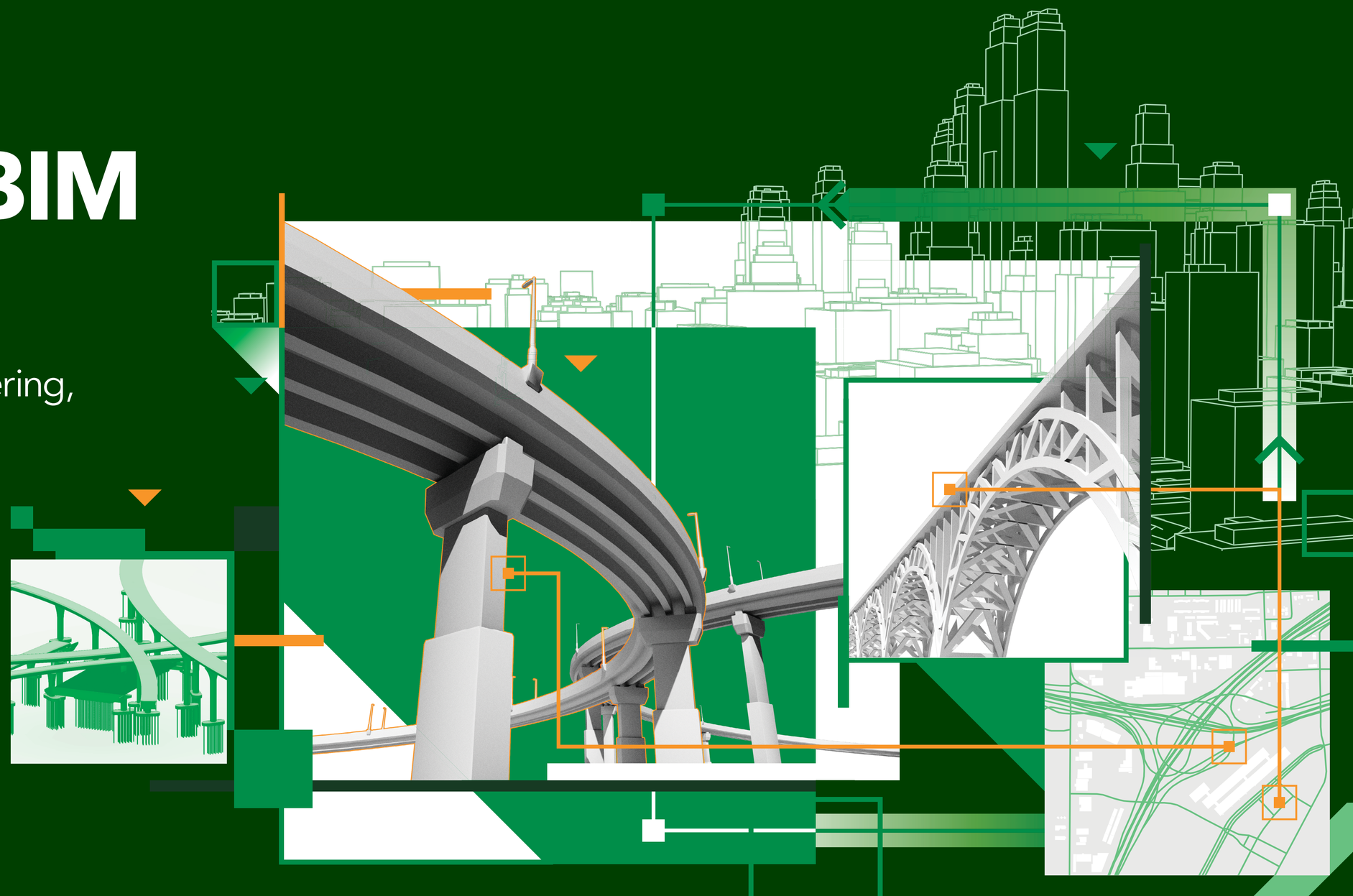
GIS and BIM

Collaboration in the Cloud

for Architecture, Engineering, and Construction



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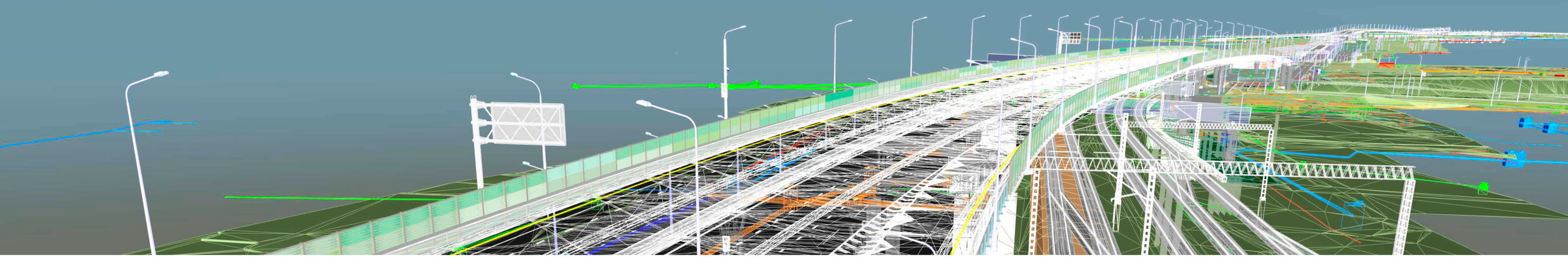


Introduction

Construction waste and design inefficiencies can greatly affect the success of a project, according to an *Engineering News-Record* article. It's estimated that 30 percent of materials from construction sites find their way into a landfill. To put it another way, **for every three buildings we build, we throw one of them away**. That equates to 2.2 billion pounds of solid waste by 2025. This waste is a result of a fragmented industry.

According to a *McKinsey & Company* report, architecture, engineering, and construction (AEC) firms that are boosting productivity—some by as much as 60 percent—are doing so through a focused effort around four key areas in their practice:

1. **Rethinking the design and engineering (D&E) process**
2. **Improving supply chain management and procurement**
3. **Improving on-site execution**
4. **Infusing their processes with digital technology, new materials, and advanced automation** ■

Returns on Investment on Small- and Large-Scale Construction Projects

	Average Design Time Saved	Average Construction Time Saved	Average Project Cost Saved
Small projects (Length <= 10km & Area <= 100 sq. km.) *No of projects - 50*)	**22.2%**	**45 days**	**5.9%**
Large projects (Length > 10km & Area > 100 sq. km.) *No of projects - 30*)	**28.3%**	**90 days**	**13.1%**

AEC Productivity

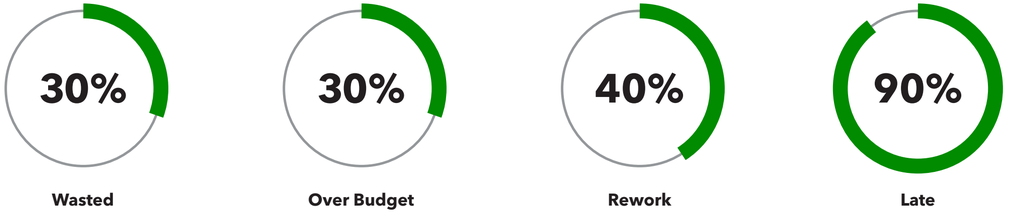


Figure 1: GIS and BIM Integration: A High-Level Global Report by *Geospatial World*, Autodesk, and Esri, 2022.

Figure 2:Returns on Investment on Small- and Large-Scale Construction Projects from GIS and BIM Integration: A High-Level Global Report by *Geospatial World*, Autodesk, and Esri, 2022.

Figure 3: AEC Productivity Metrics on the Percentage of Projects Producing Waste, Going over Budget, Requiring Rework, and Delivered Late from GIS and BIM Integration: A High-Level Global Report by *Geospatial World*, Autodesk, and Esri, 2022.



AEC Productivity and Standards

AEC Productivity

It's important to understand that the processes causing so much waste are the same inefficiencies plaguing the AEC sector. Errors, incomplete information, unclear project detail, location-specific data, and more all lead to us needing to rethink the D&E process and infuse digital technology in every aspect of the processes.

Companies that see productivity improvements are committed to advancing automation and controlling upstream data handling to improve the reliability of quantities, catch errors earlier, and create data information exchange standards.

AEC Standards

Information standards such as ISO 19650 seek to streamline the complexity of project delivery, introducing unified language and common workflows to help alleviate the issues caused by disparate data sources siloed behind firewalls and legacy systems.

The adoption of ISO 19650 exists on a spectrum across multiple regions and is highly dependent on local regulations, but it does set the stage for the foundation of data exchange protocols and roles across ever-expanding global teams. Its goal is to meet the needs of the industry to have a positive effect on productivity and project management. ■



ARCADIS

GIS and BIM INNOVATOR

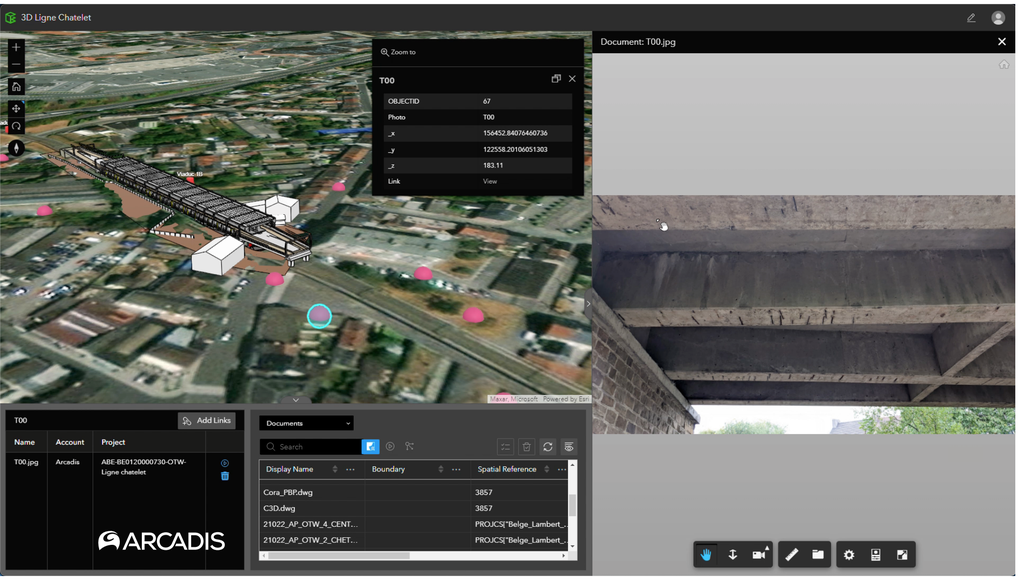
François Appéré

Global Autodesk Platform Leader, Arcadis (US)

Connect with Appéré on LinkedIn

François Appéré is responsible for the management and execution of the Autodesk contract for Arcadis, globally. He has participated in global leadership and development programs and is passionate about improving design and construction processes as well as leveraging new technologies to improve the working experience and reduce our overall impact on the natural environment.

> ***"Teams have highlighted the need for robust standards and agreements to connect geographic and building information successfully.***
>
> –François Appéré



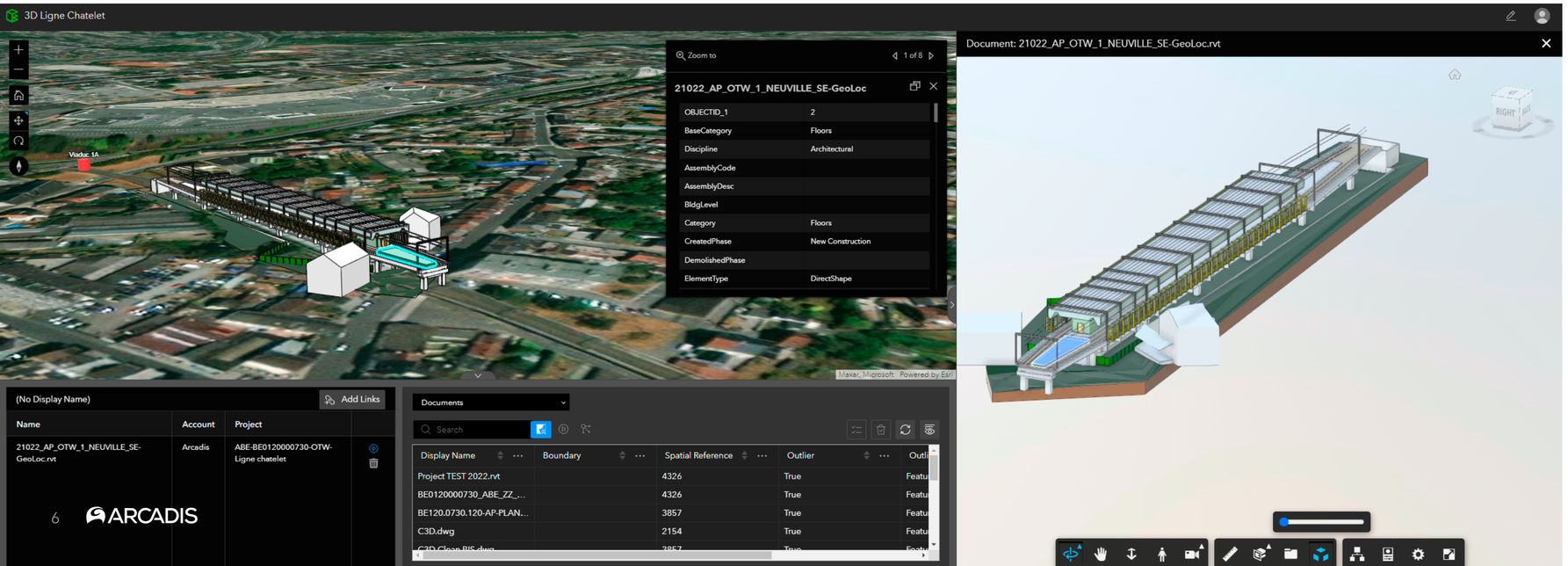
By François Appéré

AEC professionals have used building information modeling (BIM) and geographic information system (GIS) technology for over a decade, and the engineers, designers, and planners at Arcadis played their role in helping the industry transition toward these data-oriented ways of delivering projects and have seen project quality, level of collaboration, and stakeholder engagement increase. This is made possible by more practitioners leveraging new digital engineering approaches.

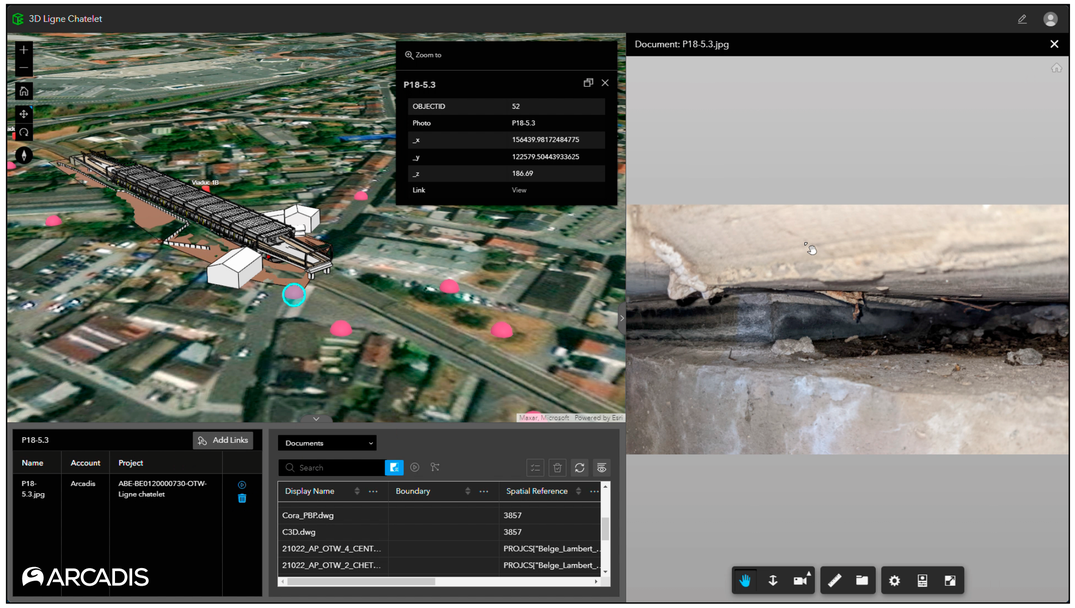
The software landscape is changing

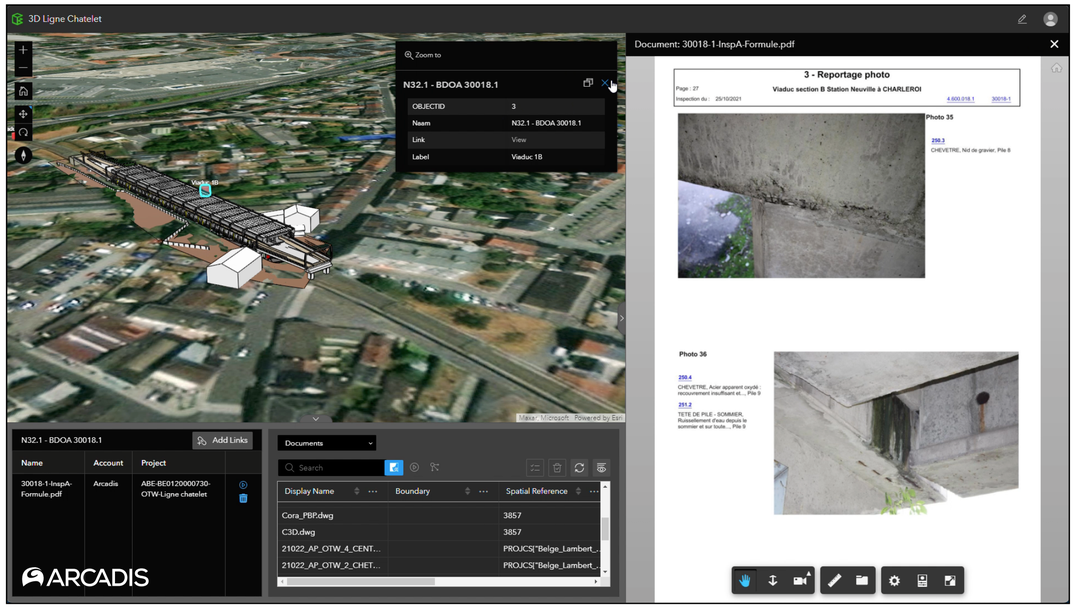
Simultaneously, **Esri and Autodesk have made tremendous progress in solutions that bridge the gap between geographic and design information**. Developing ways to merge GIS and BIM on the technology side has helped connect teams who weren't used to working closely, and large-scale infrastructure schemes are the first to benefit from those new connections.

Arcadians now use cloud-based GIS platforms, like ArcGIS® Online, to display and share design-related data like BIM or computer-aided design (CAD) elements with the rest of the team, including nontechnical decision-makers and asset owners. These solutions are great at handling large-scale, heavy, and geographically spread datasets and allow teams to navigate and access information relative to long corridor assets like roads, railways, rivers, and canals.



ARCADIS





ARCADIS

Integrations and automation

Integrating information from different software solutions may be time-consuming and even redundant despite recent technology improvements. But Arcadis has invested energy in using data integration platforms like FME to automate workflows, and adding automation to our transformation processes helps ensure the design information shared through the GIS environment is up-to-date and provides value to the team. It's critical for the long-term and wide adoption of new digital workflows, as users regularly return to the shared repository to access project information.

Finally, teams have highlighted the need for robust standards and agreements to connect geographic and building information successfully. It aligns with the ISO 19650 standard describing the importance of predefined information management for projects using BIM execution plans.

Similarly, **projects leveraging GIS and BIM technology should know ahead of execution the various users' expectations, digital use cases, roles and responsibilities, access, and processes related to sharing information** (frequency, format, platform, etc.). Such documents should help define who should receive what information and at what stage of the project, allowing increased and broader collaboration across the supply chain. ■



HNTB

GIS and BIM INNOVATOR

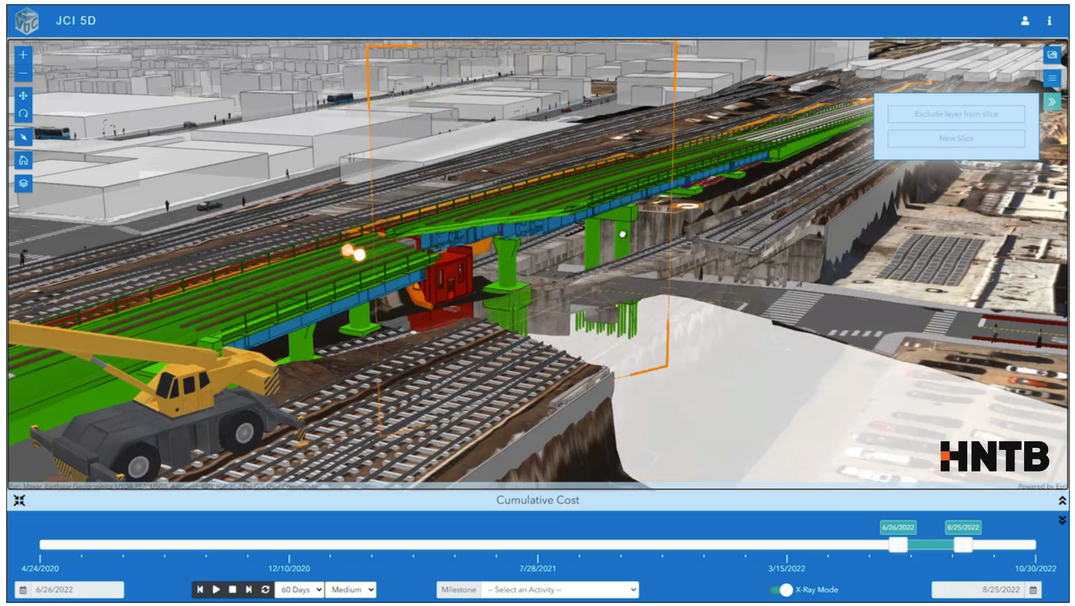
Darin Welch

Associate Vice President, HNTB (US)

Connect with Welch on LinkedIn

Darin Welch is an accomplished geospatial manager with a demonstrated history of working in the civil engineering industry. He is skilled in geospatial applications and solutions development and technology project management. Welch is an innovative professional and creative problem solver. He has a Master of Science in Geographic Information Science from Northwest Missouri State University.

> *"Where we're trying to head with this type of digital delivery engagement is 'integration without translation.' This is a foundational concept that is important to us as our GIS and BIM delivery strategy.*
>
> –Darin Welch





By Darin Welch

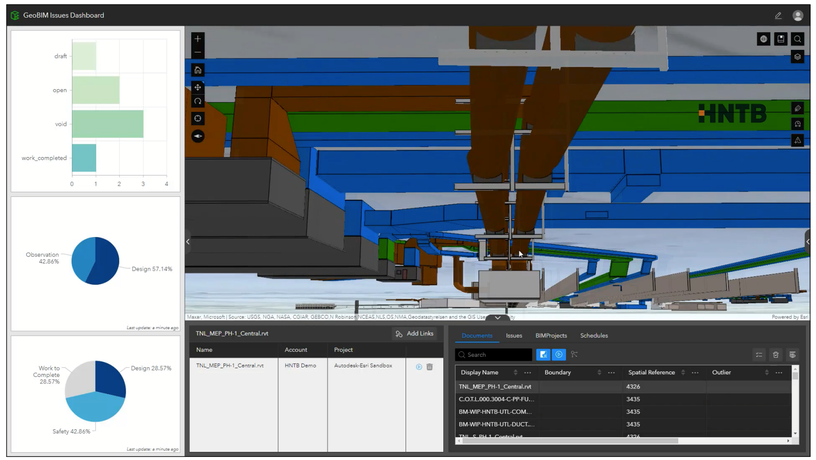
Direct integration plays a pivotal role

It's easy to take for granted the capabilities we have right now, today, at our fingertips to perform direct interoperability between GIS and BIM. With this direct integration using secure, web-based connections, **we're on the verge of an explosive movement within the AEC industry to streamline how we overlay, understand, visualize, and analyze infrastructure design data**. Quite simply, this ability to achieve BIM and GIS collaboration is a pivotal point, and I believe we'll look back a few years from now and realize it was only the beginning.

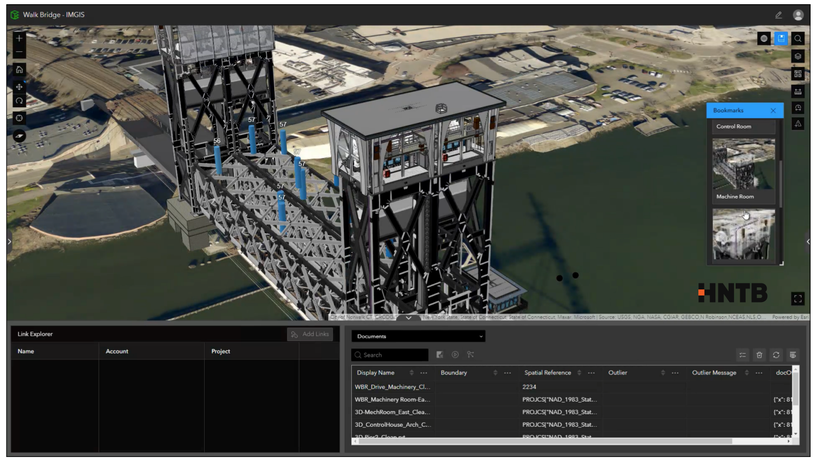
We are on the verge of an explosive movement within the AEC industry to streamline how we overlay, understand, visualize, and analyze infrastructure design data.

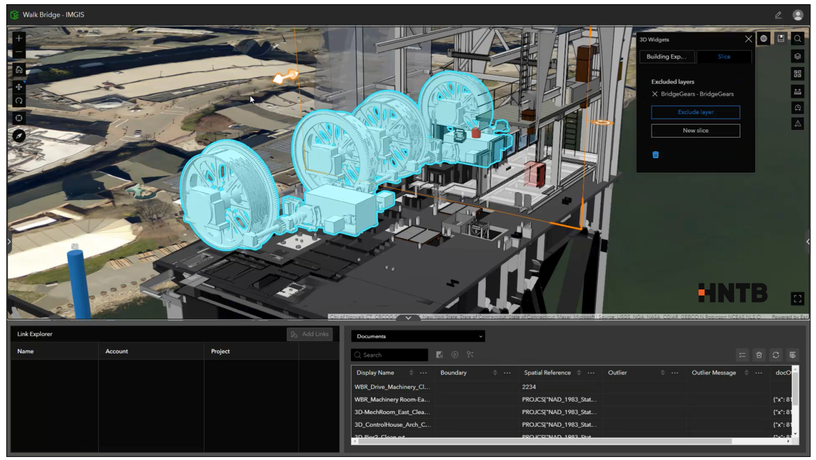
Direct integration means that we no longer have to perform timely and risky translations from one format to another. It means we don't have to sacrifice quality when data from one system doesn't quite align or contain all the information that was lost in translation. It also means that we can install more trust in our teams, by providing a link directly to the authoritative sources of truth from either system. Most of all, it means that **we can be better decision-makers, with confidence that we're using data that has been designed through seamless convergence** and continually refined by data-driven professionals.

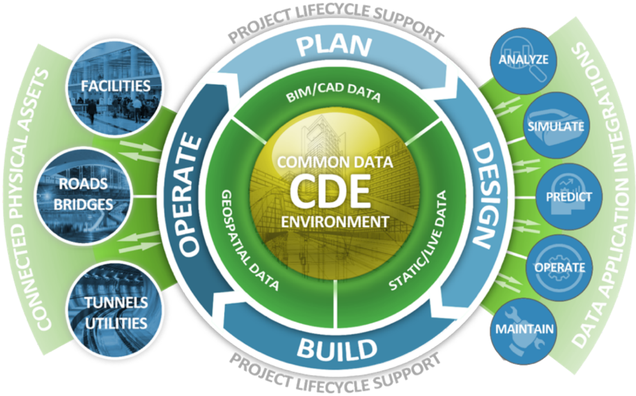
HNTB











The integration and intersection of GIS and BIM have specifically allowed for the breaking down of silos.

The derivatives of this information are nearly countless and becoming more automated—from planning visualization to design-model conflict detection, to construction phasing scenario evaluation, and through operations and maintenance that informs capital planning—an integrated design ecosystem, powered by BIM and GIS working together, means the end of limitation and the launch of endless possibilities.

The opening up of Esri and Autodesk's technologies to integrate through the cloud has empowered our teams at every level—from the down-in-the-weeds doers and designers to project and agency leadership. ■

HNTB



VolkerWessels
Infrastructuur

GIS and BIM INNOVATOR

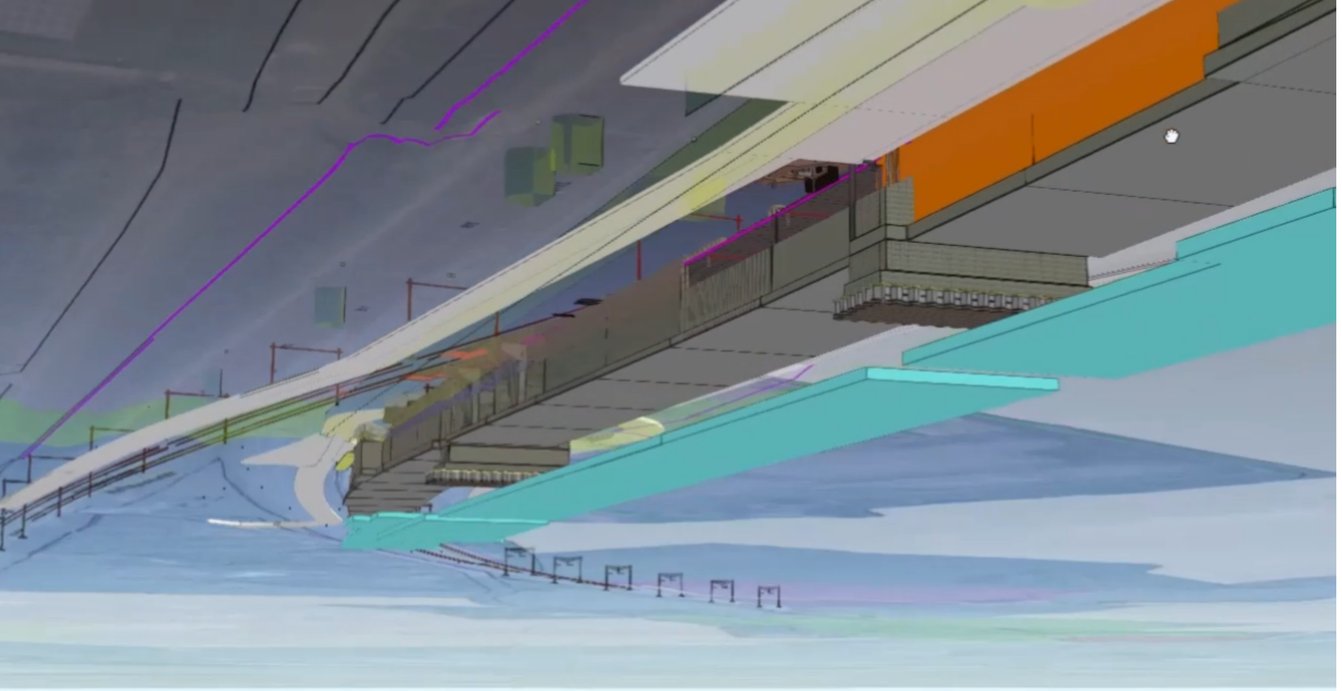
Jeroen Tishauser

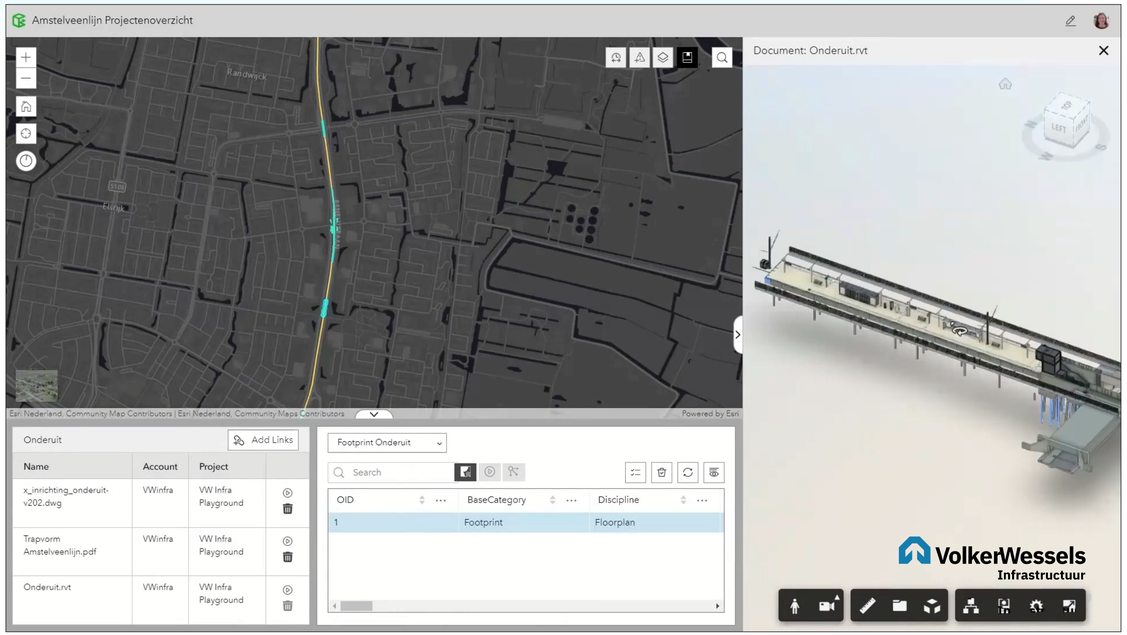
VolkerWessels Infrastructure (Netherlands)

Connect with Tishauser on LinkedIn

As a civil engineer, Jeroen Tishauser has a background in road, rail, and site design. He is especially interested in the automation process using built-in functionality or custom-made integration to further enhance the information flow within projects. Change management, working with people, and creating value for the customer are his focus now as an information manager.

> *An integrated BIM and GIS approach forms the foundation of a project strategy in order to make the data accessible to all project stakeholders.*
>
> —Jeroen Tishauser





VolkerWessels
Infrastructuur

By Jeroen Tishauser

It’s part of our project strategy

Our projects require vast and diverse datasets ranging from civil structure designs and layout plans to the location of ground utilities. **An integrated BIM and GIS approach forms the foundation of a project strategy to make the data accessible to all project stakeholders.**

The information management team maps the different aspects of the project, from underground utilities to ground-level surroundings, making sure to consider the availability of land, time schedules, transport routes, and more. Standardized map layers are created and stored so the information is accessible to team members who need it when they need it. As a result, we have a single place where information about substrates and topographies—land register details, cables, pipes, etc.—is all kept, and all data is organized through this central location.





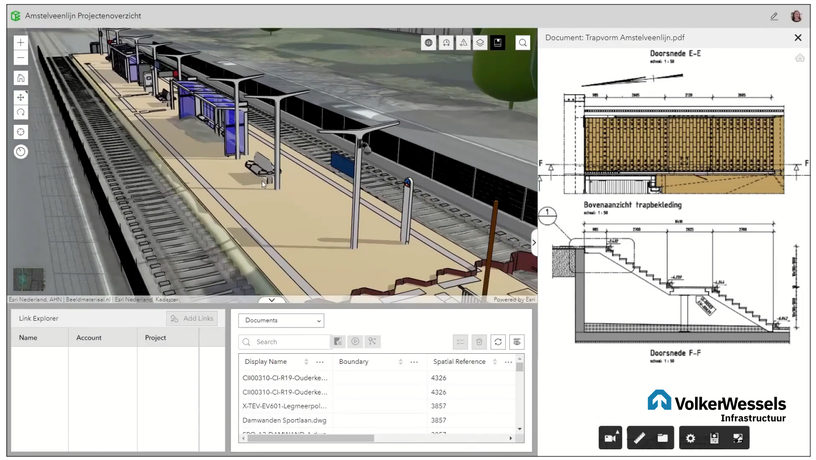


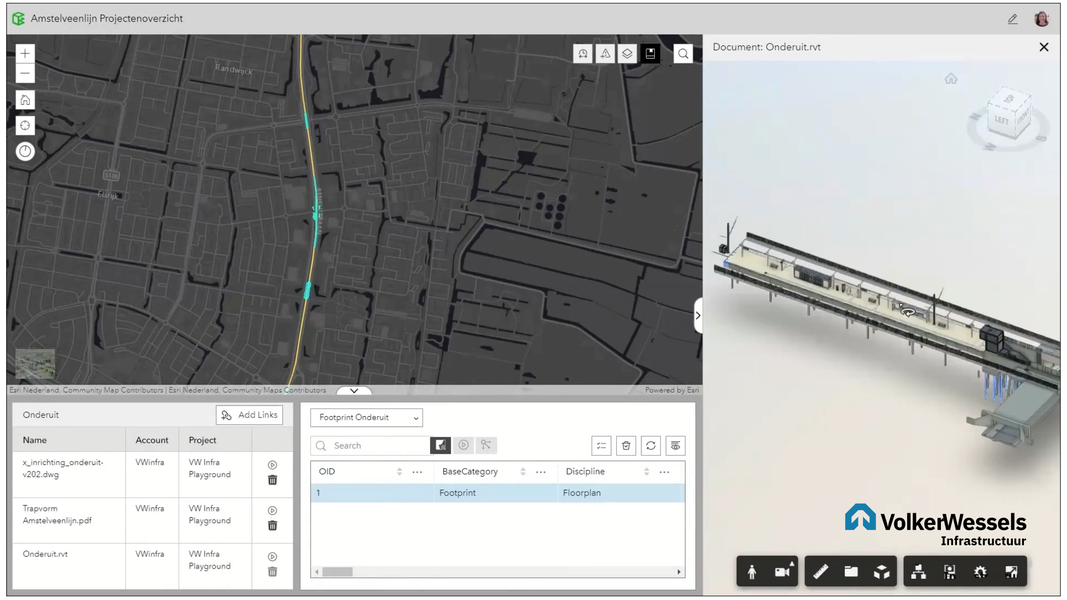
VolkerWessels
Infrastructuur

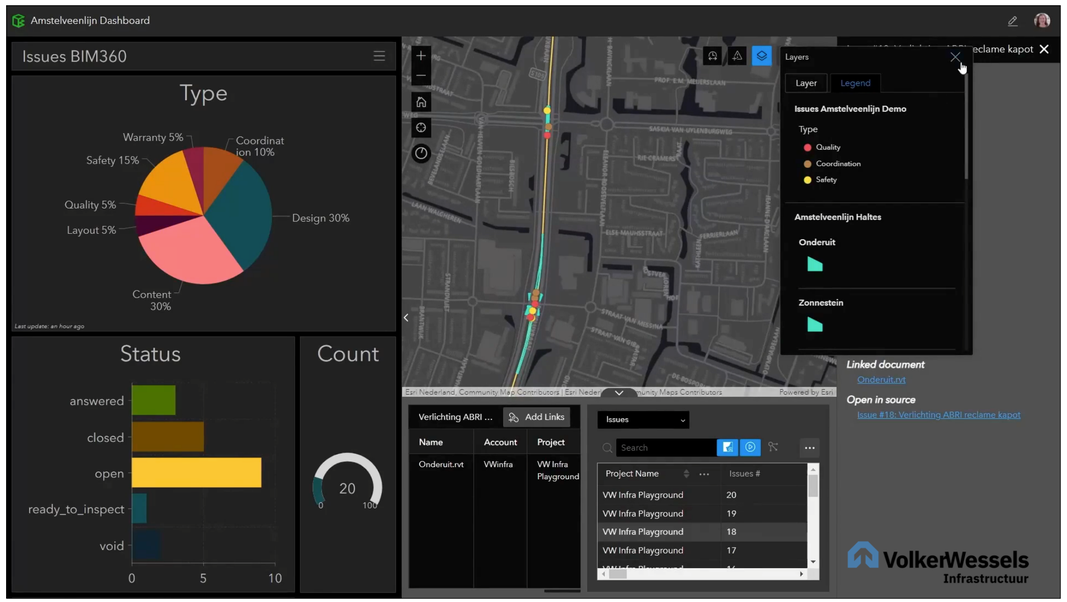
Design data and GIS working together

The integration and visualization of design data and map data bring new levels of insight to the geospatial understanding of any project. The ability to integrate design into maps—not only importing design data but full automation in updating maps based on design plans—means our mapping becomes more accurate and compelling. Logistics, work schedules, and inspection data are universally available, saving time where project members would otherwise check and request information from different teams and wait for a response.

With the integration of BIM with GIS, all team members can view the planning processes alongside a timeline, ensuring everyone is updated on the project status and predicted outcomes.







VolkerWessels
Infrastructuur

BIM and GIS integration success

Historically, project teams would download information and import it into their software of choice. It was not always up-to-date and often resulted in duplicated efforts and team members working with old data.

Integrating BIM with GIS was an important step to ensure team members have access to up-to-date project data where updates to the GIS data are automatically reflected in the BIM design model. Any geospatial information contradictions, such as cabling or gas pipes that impact a design, can be more easily identified and addressed by designers without needing to visit the site or request additional information from their GIS teams.

By connecting BIM and GIS data with scheduling data, for example, we can provide useful insights into how to divert traffic while roads or tracks are rebuilt. This improves phasing, scheduling, logistics, and communication—key aspects of projects where the minimal impact on operations is important. ■



What Are the Primary Goals for Bringing GIS and BIM Together?



One common experience to access project data

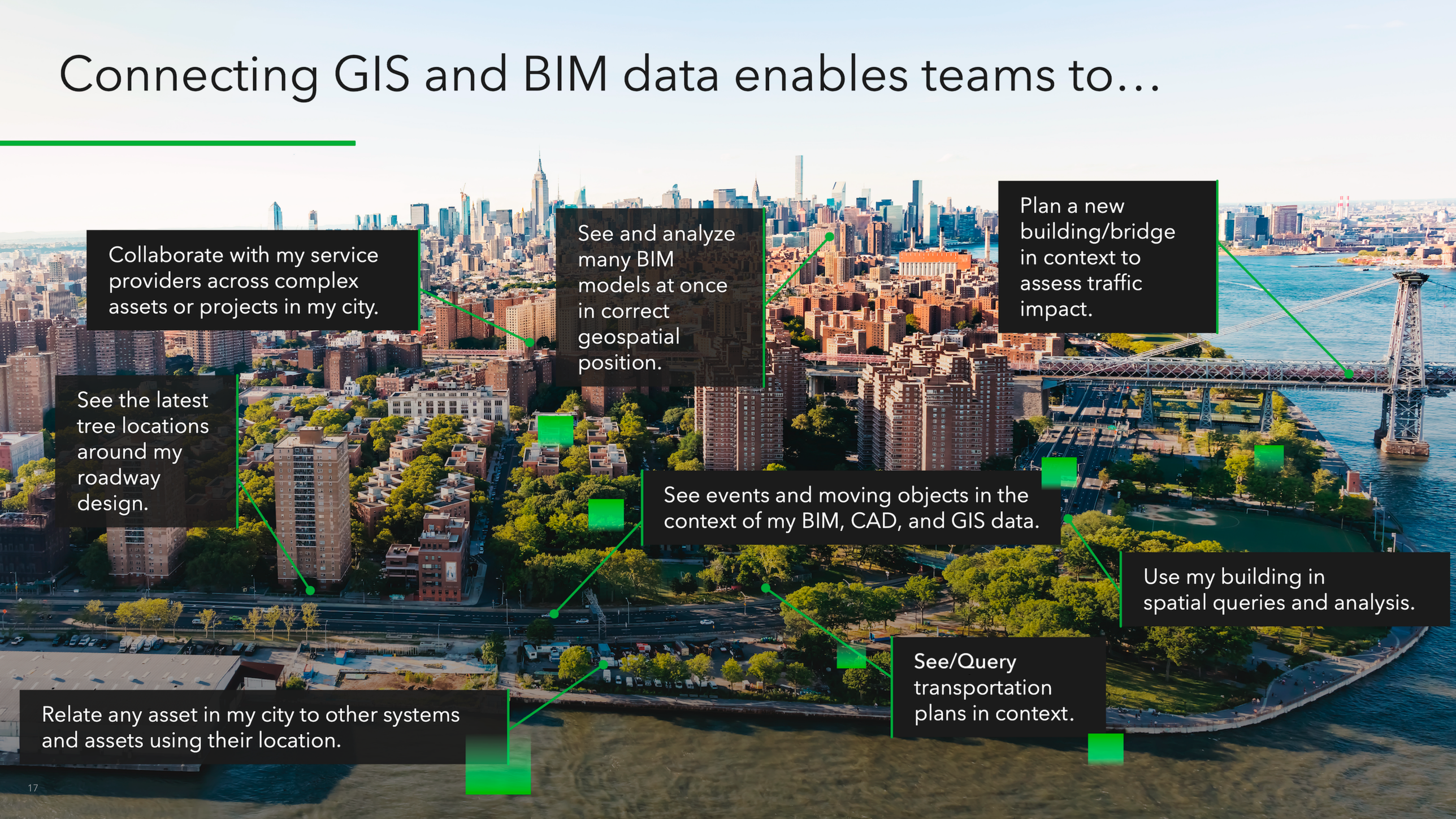
Population growth and urbanization are driving demand for new buildings and infrastructure, such as roads, bridges, and utilities. At the same time, **much of our existing infrastructure is aging and needs to be rebuilt. It's estimated that global infrastructure investment and spending will reach $94 trillion by 2040** to meet these demands. We want to simplify how teams view and retrieve project information by providing a single access point that makes it easy to locate documents and BIM data across multiple systems.

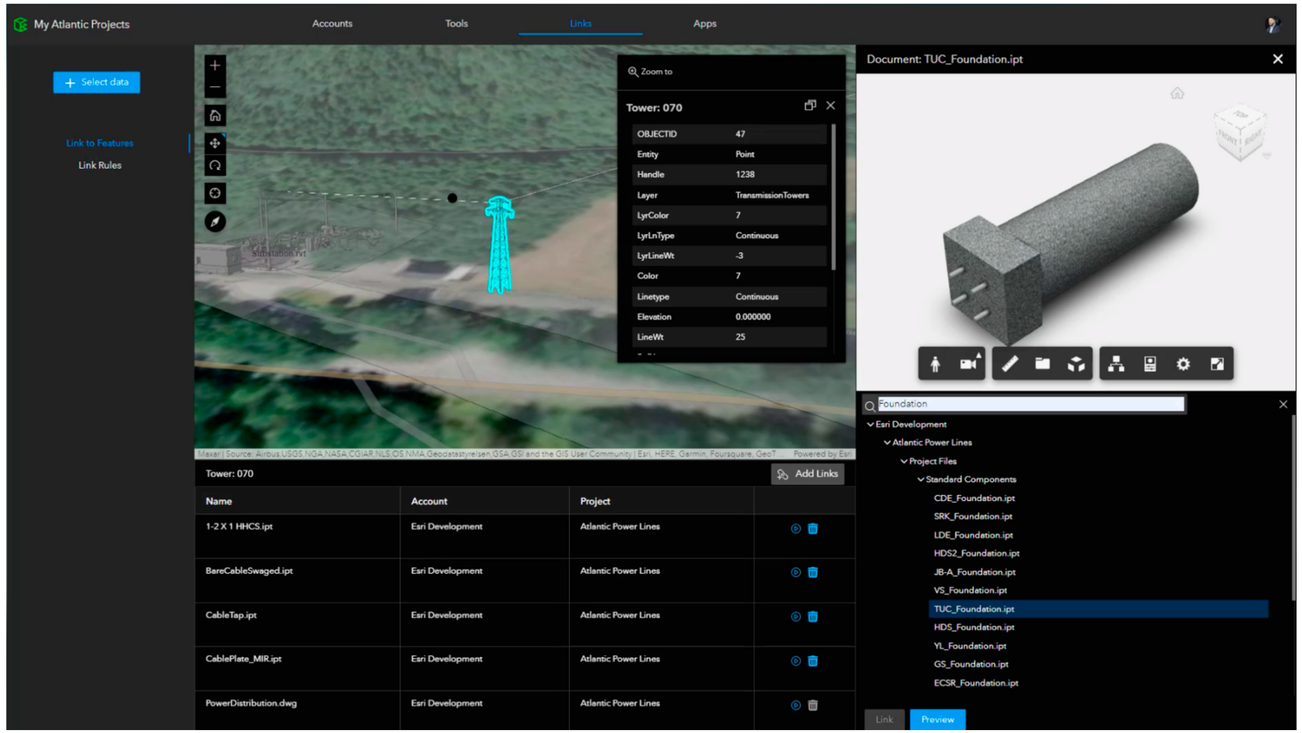
- Leverage ArcGIS technology and Autodesk Construction Cloud® in a unified web-based experience with task-specific apps that consolidate and visualize project and portfolio-level information, including BIM models, supporting documentation, GIS data, and issues.

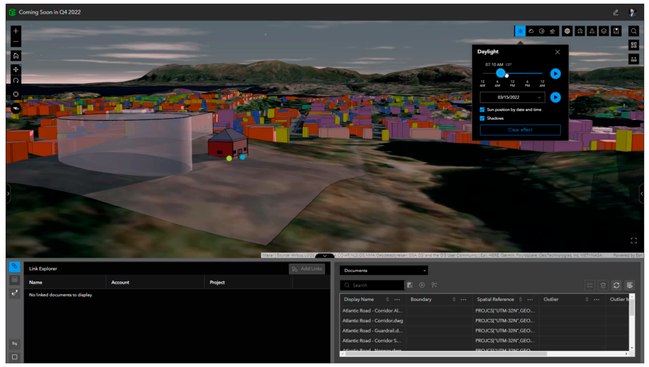
- Maintain connectivity to original data sources on separate systems by using dynamic links that keep your project connected and data easily accessible. After projects are delivered, continue to use ArcGIS GeoBIM℠ to access stored data and live services and enable or manage team members' access as needed.

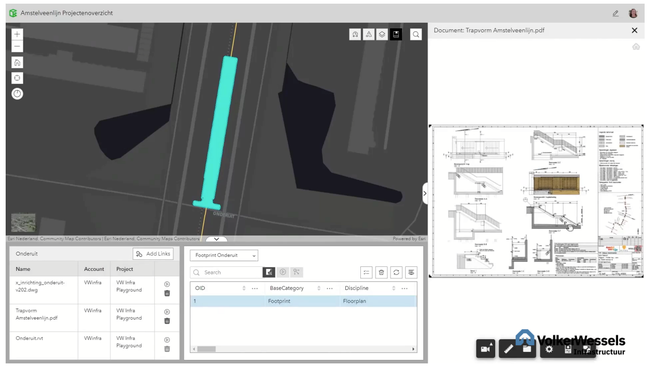
- ArcGIS GeoBIM includes an easy-to-use project index that enables you to quickly access all data tied to the project location within a map. ArcGIS GeoBIM offers a common platform across projects for teams to review BIM models, documents, and issues in a geographic context.

Connecting GIS and BIM data enables teams to…





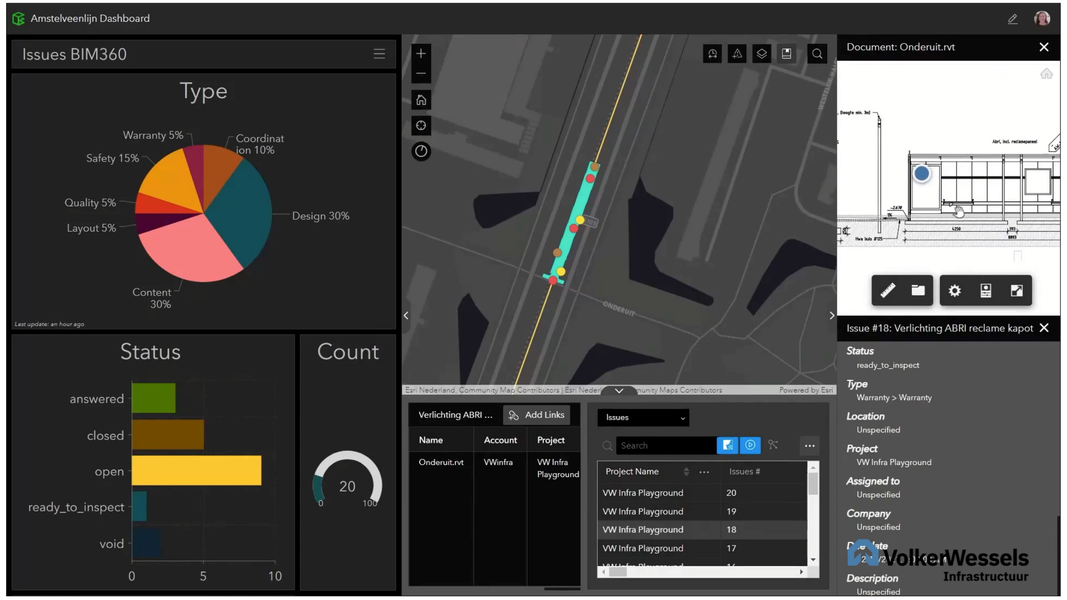


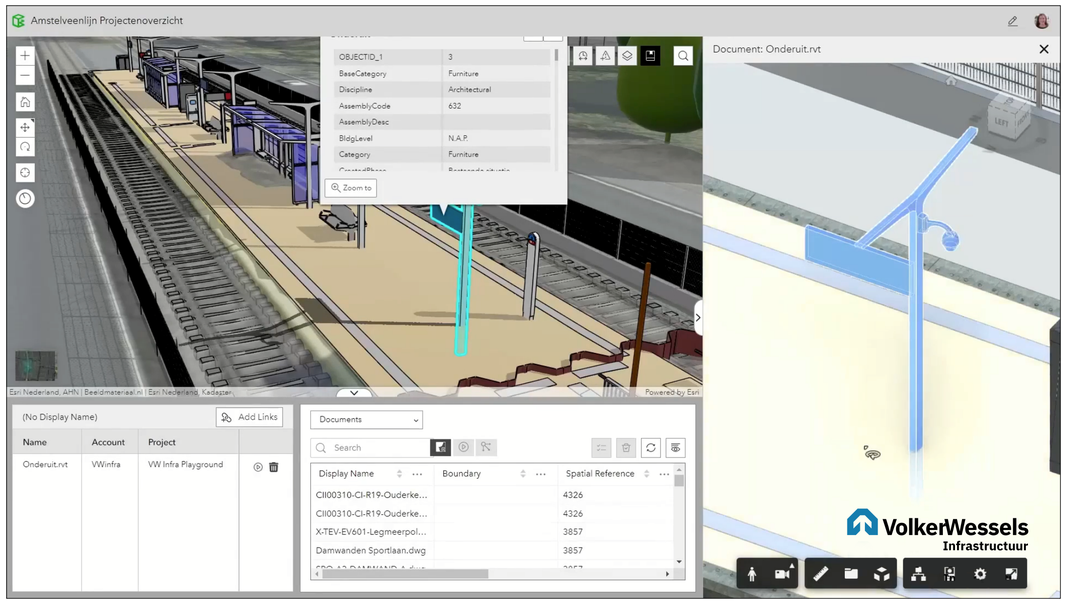


Organize projects without reorganizing your data

We want our documents and data organized in the source locations and access our GIS and BIM project content through a common web-based app experience.

- Reuse GIS and BIM data on multiple projects in the same geographic region and reduce data duplication and acquisition costs.
- ArcGIS GeoBIM maintains dynamic links to documents and models in Autodesk Construction Cloud so that when new versions are available, they can be incorporated with existing and new project information.
- Keep your data in the source location. ArcGIS GeoBIM is a cloud-to-cloud solution that simplifies how project teams view, manage, and store project information by dynamically linking to the source.
- ArcGIS GeoBIM is highly configurable and can be used with project data organized to meet standards such as ISO 19650.
- ArcGIS GeoBIM includes an easy-to-use project index that enables the user to quickly access all data tied to the project.

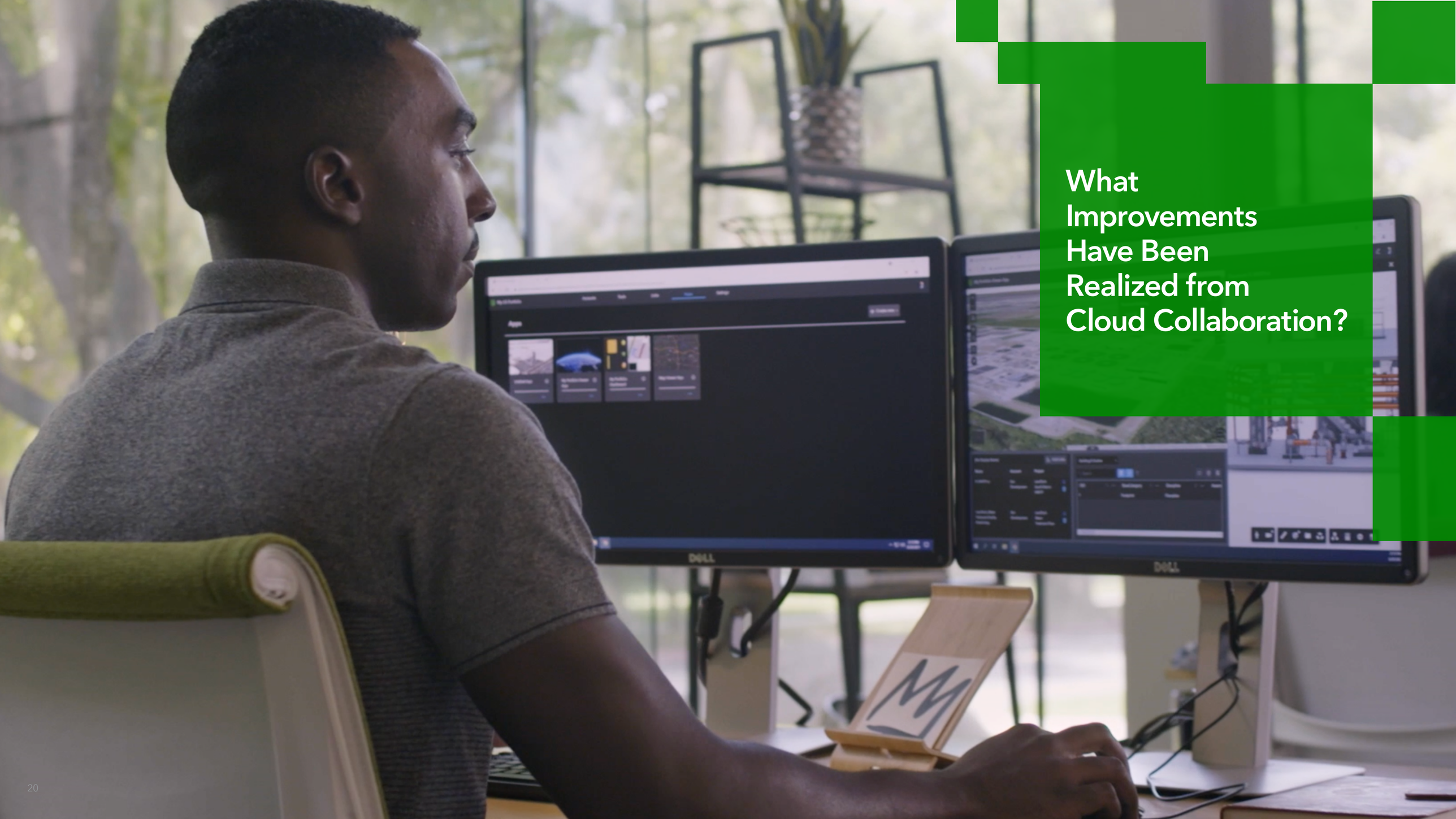




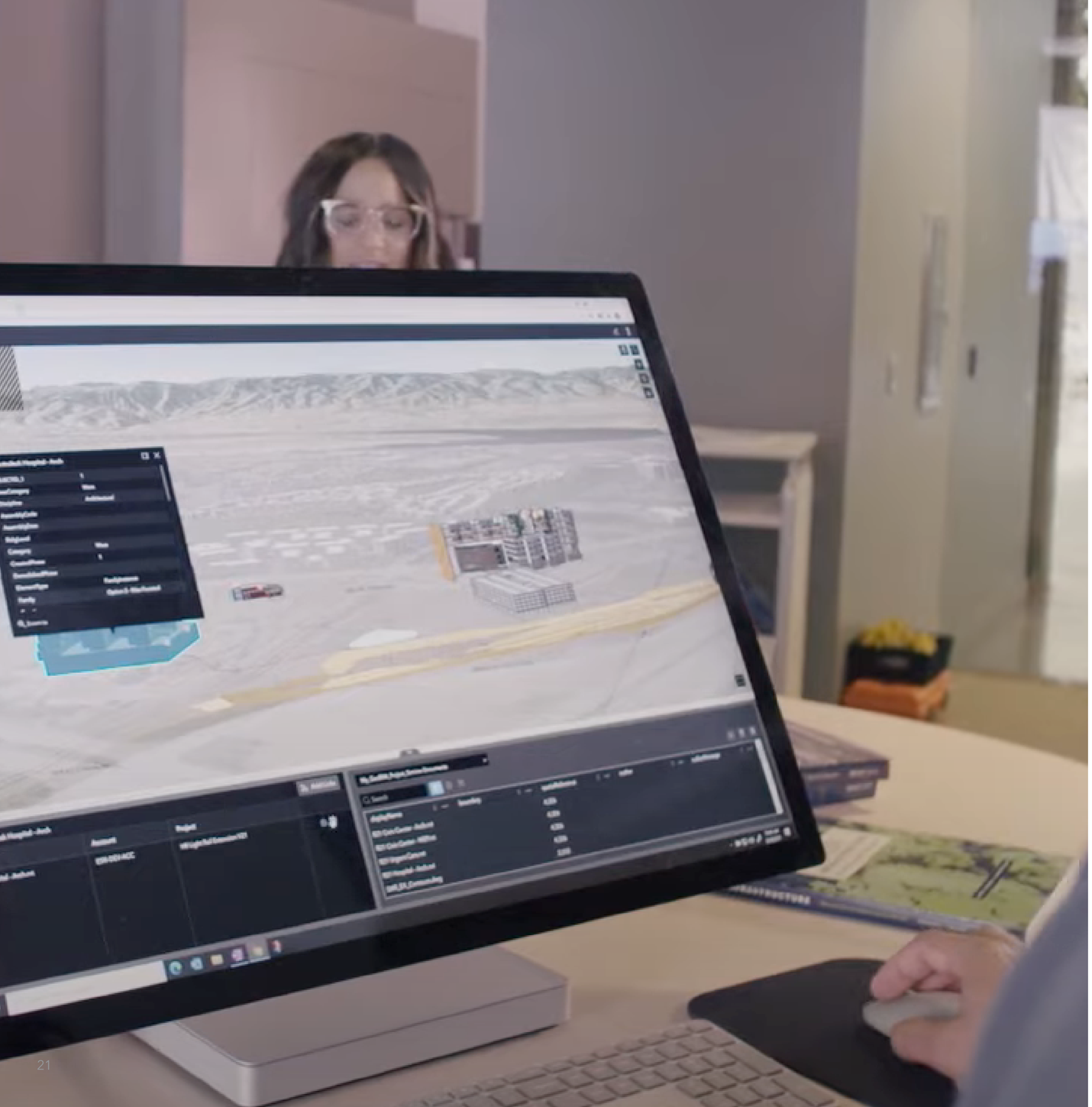
Configuration, not customization

We need to quickly configure purpose-built experiences for different team members to explore project information and do work.

- Easily connect to and reuse content hosted on Autodesk Construction Cloud in configurable web mapping apps without needing custom, one-off solutions.
- Converting BIM, CAD, and GIS information may be difficult over the life cycle of the project. ArcGIS GeoBIM reduces data conversion with a direct, repeatable cloud-to-cloud connection. Standardize the tools managers use to view project status and performance by viewing task completion, budgets, documentation, BIM models, and related project information in a scalable web experience that is easily reused on future projects.
- ArcGIS GeoBIM connects multiple cloud-based systems using standard integration technologies, thus reducing the costs and risks of in-house custom development.
- ArcGIS GeoBIM is built on ArcGIS technology, which allows for integration with multiple systems through industry-standard enterprise technologies and techniques.



What Improvements Have Been Realized from Cloud Collaboration?



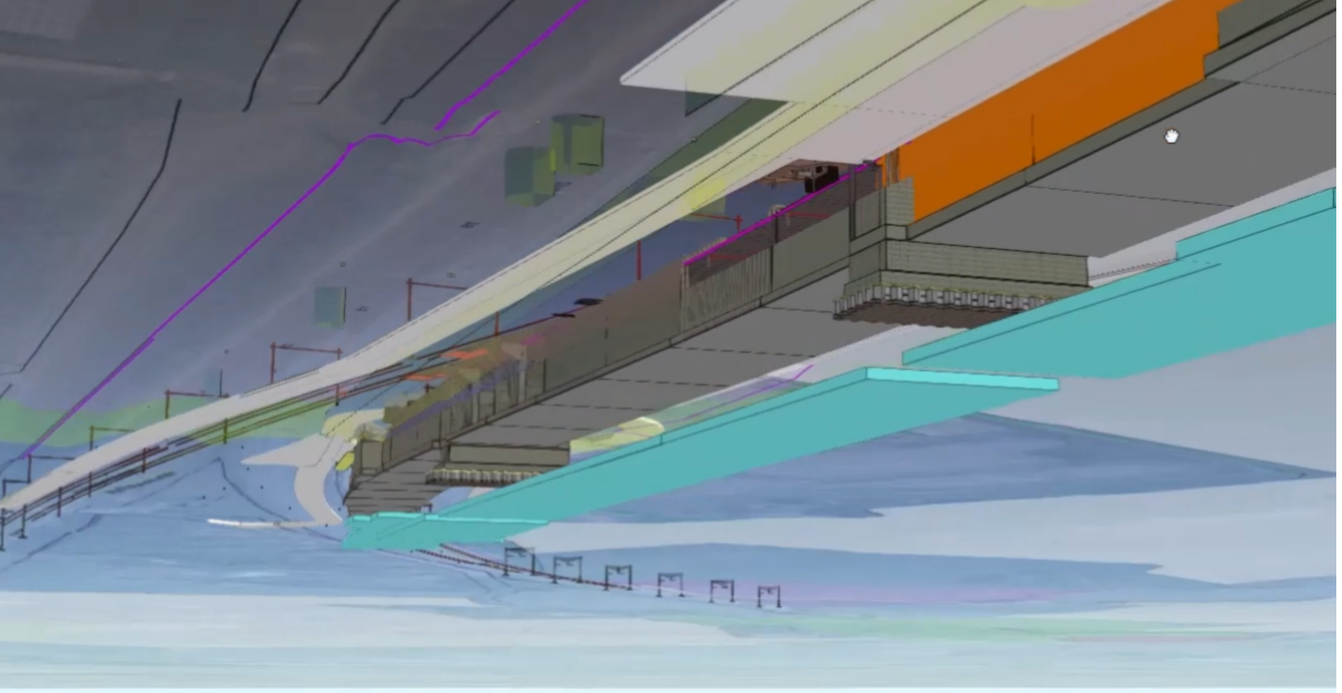
Communicate current project information easily and securely

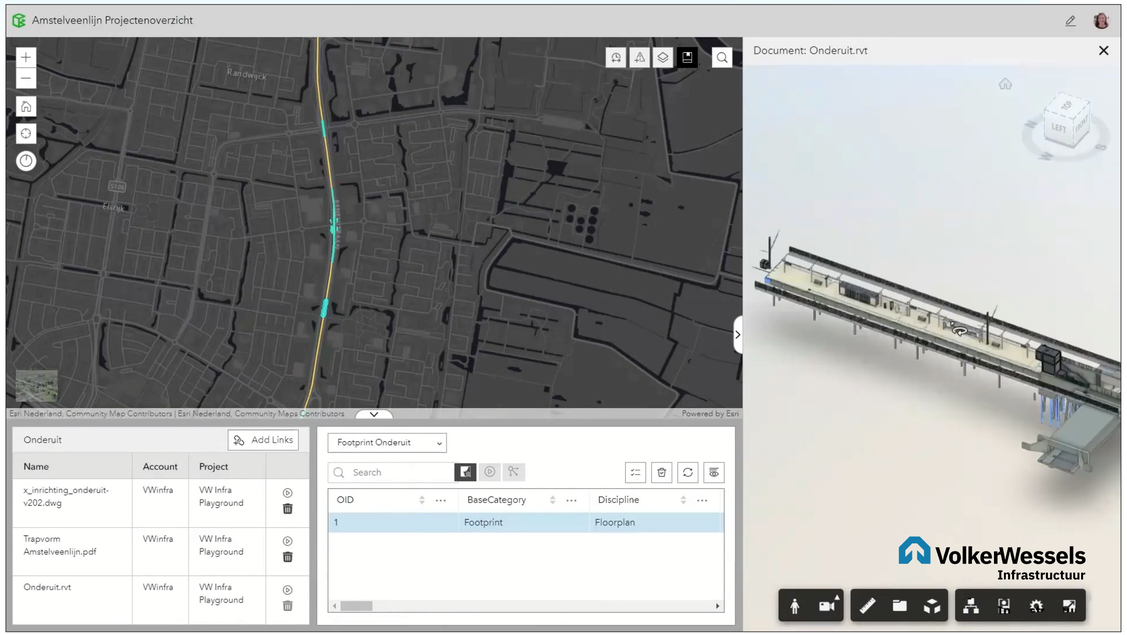
We've found that we can share easy-to-use ArcGIS GeoBIM apps with stakeholders to enable them to explore project information and issues that are important to them.

- Share ArcGIS GeoBIM apps that include dashboards to show project status indicators such as issue completion, timelines, and asset locations.
- ArcGIS GeoBIM apps provide configurable, easy-to-use views into single projects or entire programs of multiple projects that can be tailored for specific stakeholders or meeting requirements.
- ArcGIS GeoBIM apps provide industry-standard-based security through the ArcGIS named user model, enabling project teams to control who can see which apps and data.
- Data linked through ArcGIS GeoBIM can be reused in out-of-the-box web-based experiences in ArcGIS apps, such as ArcGIS StoryMaps℠ and ArcGIS Experience Builder, as well as custom web experiences, to enable the reuse of data that fits the collaboration or communication needs of the audience.
- Using an AEC Project Delivery Subscription, ArcGIS GeoBIM can be extended to share and collaborate on workflows with customers.



What Issues Are There with Georeferencing BIM or CAD Data in GIS?





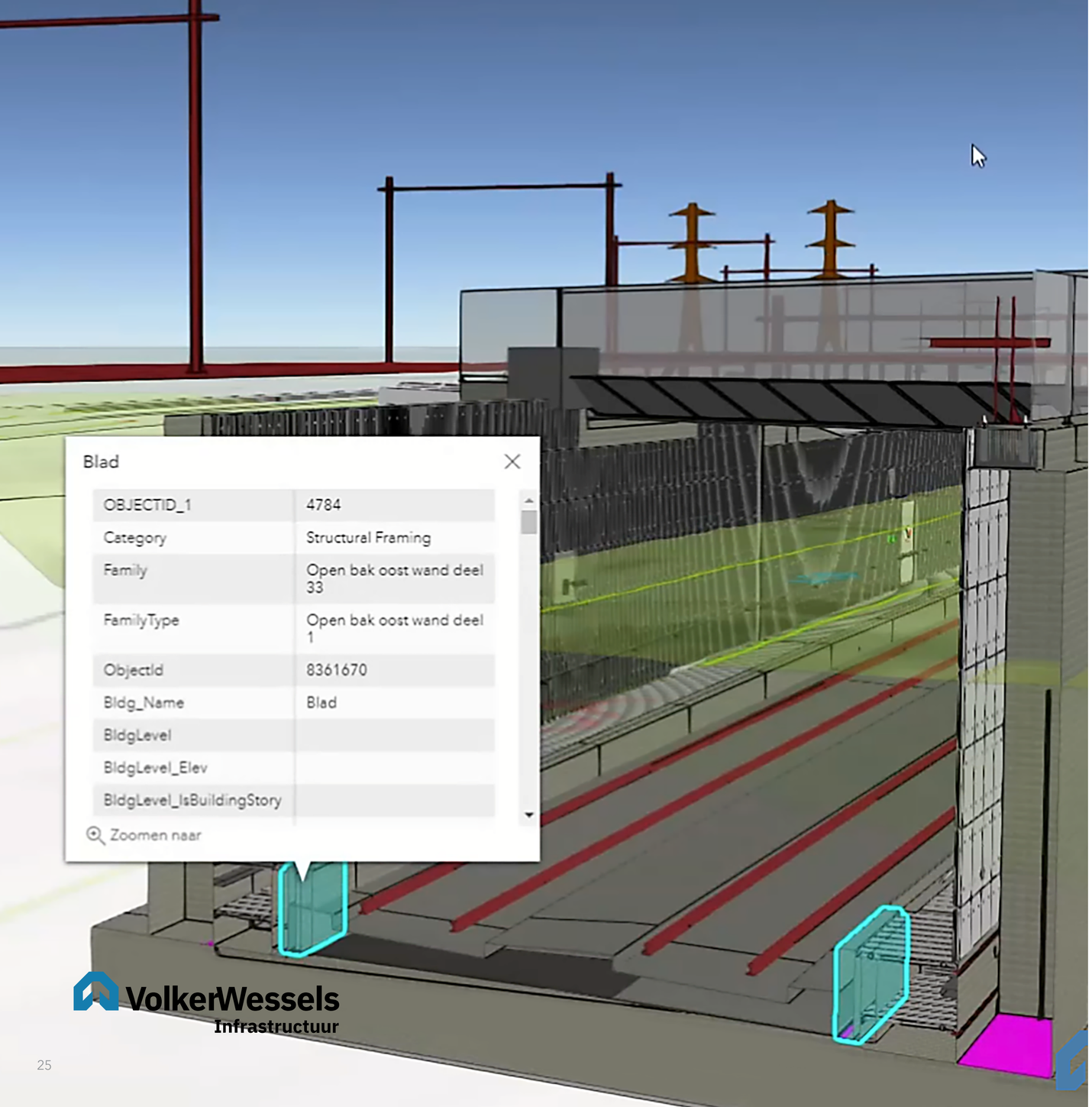
Minimize costly model conversions

We must reduce the need to continually convert our data. By linking to BIM models, data, and documents stored on separate systems, we're able to focus on improving our design rather than on file formats.

- ArcGIS GeoBIM links directly to BIM data sourced from the Autodesk Construction Cloud or Autodesk BIM 360®, reducing the need for data to be moved, duplicated, or converted.
- ArcGIS GeoBIM saves teams time by linking to dynamic BIM datasets that display new versions without the need for custom conversion or coding.
- Data from multiple sources can be viewed in ArcGIS GeoBIM allowing BIM models and related project information to be visualized in one place across an individual project or an entire program or portfolio.
- When data does need to be converted, ArcGIS GeoBIM works with standard ArcGIS services, such as building scene layers, that can be created using Industry Foundation Classes (IFC) and Autodesk Revit® content.



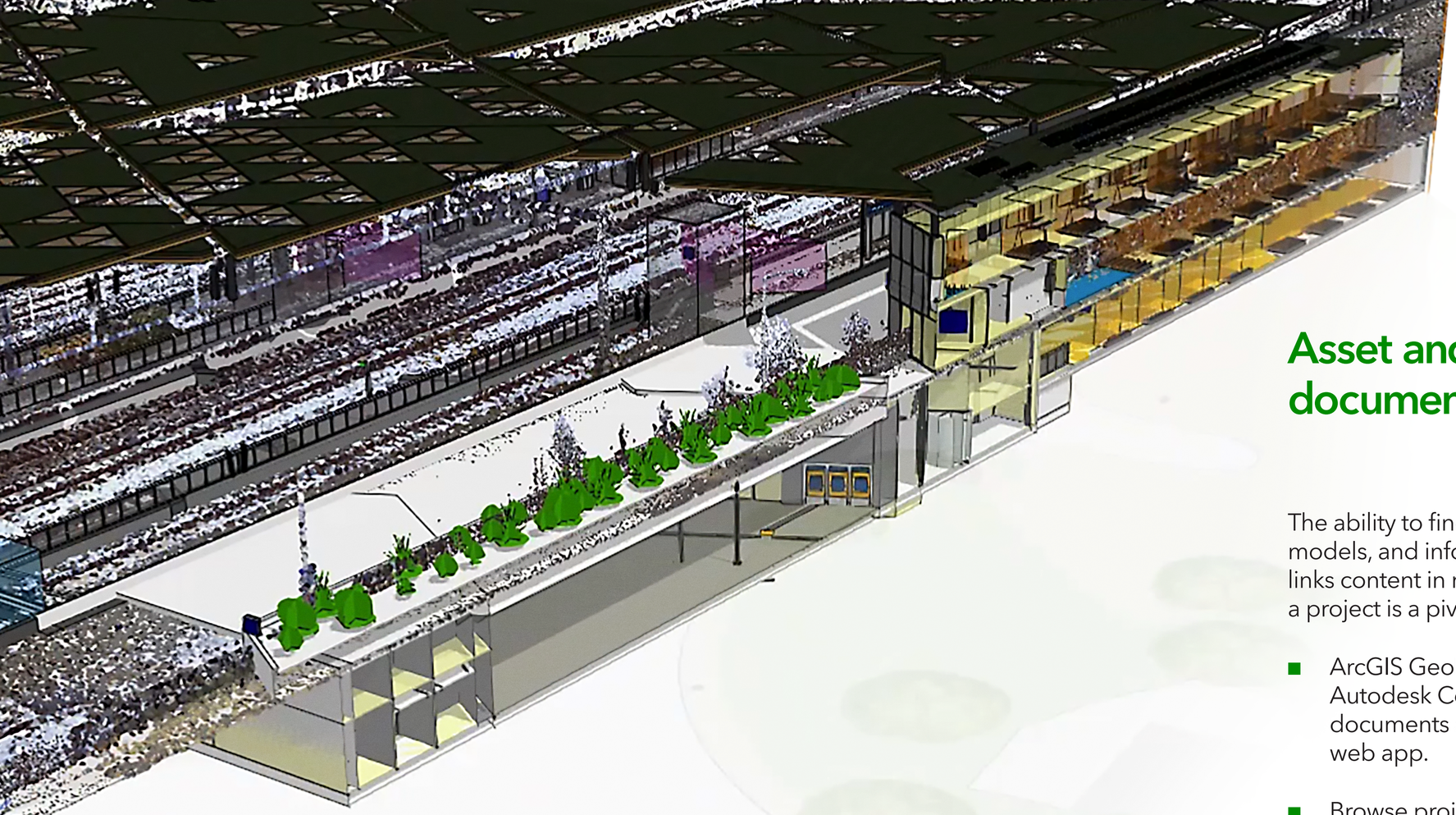
How Has the Integration of GIS and BIM Changed Stakeholder Management?



See all your project activities in one place

We can now allow all stakeholders to explore and browse project data, issues, and documents in a geospatial context through an easy-to-use web app. No complex software installation is required.

- Gain access to up-to-date GIS and BIM data that can be viewed on a map in 2D or 3D, used in charts, and explored in tables.
- View GIS data and converted BIM models on a web map from anywhere without having to use specialized desktop authoring tools.
- Explore issues from Autodesk Construction Cloud and Autodesk BIM 360 along with GIS and other BIM data.
- Connect to dashboards and tabular information directly from the web map. View boundaries derived from Autodesk BIM 360 and Autodesk Construction Cloud documents.

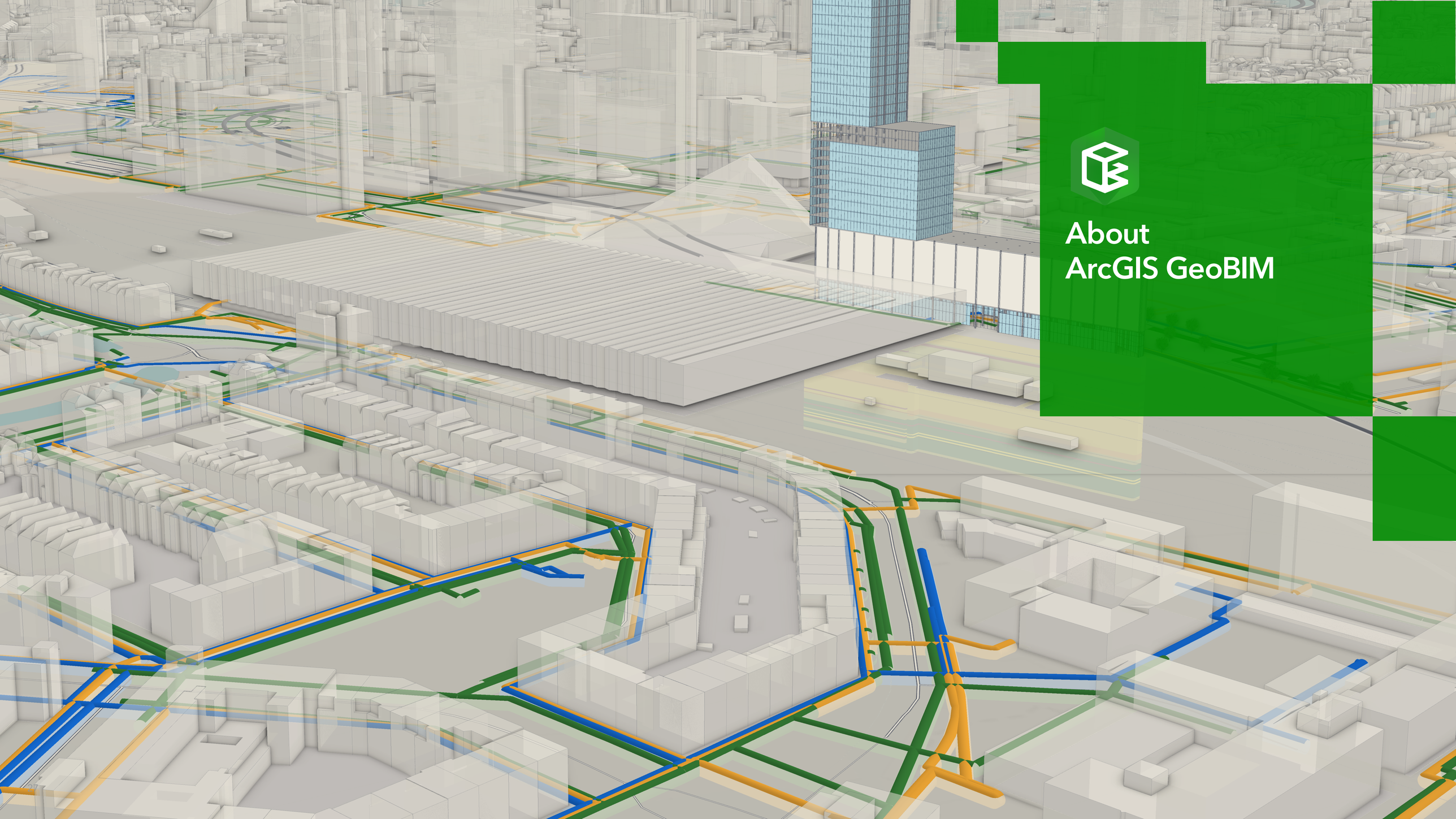


VolkerWessels
Infrastructuur

Asset and engineering documentation is at your fingertips

The ability to find construction and design-related documents, models, and information using a map-centric web interface that links content in multiple systems through the shared location of a project is a pivotal point.

- ArcGIS GeoBIM connects your organization's GIS to Autodesk Construction Cloud to enable linking to documents and models directly from a map-centric web app.
- Browse project folders and view documents and models in BIM 360 and Autodesk Construction Cloud directly from ArcGIS GeoBIM.
- Design files can be viewed directly in their project locations through ArcGIS GeoBIM using the Autodesk Forge® Viewer.
- Buildings, utilities, or corridor models can be visualized along with global terrain content, imagery, and other GIS data for context in ArcGIS GeoBIM.



About ArcGIS GeoBIM

> *"ArcGIS GeoBIM enables us to provide web-based access to anyone on the project team with ease of entry and intuitive tools. Our project team members can get the answers they need. They can ask questions of the data, especially in 3D, and explore it through a shared lens.*
>
> *–Darin Welch, HNTB*



About ArcGIS GeoBIM

Improving project coordination and delivery

ArcGIS GeoBIM delivers an innovative, easy-to-use web-based experience for teams to explore and collaborate on BIM projects and issues, using data from multiple systems in a geospatial context.

AEC and operations teams can easily work with linked data and documentation in configurable web apps to simplify communication and collaboration.

- See all your project activity on one map
- Keep your project and asset data organized
- Minimize model conversions by connecting to the source
- Communicate project information easily
- Connect ArcGIS to the Autodesk Construction Cloud

Learn more at
go.esri.com/arcgisgeobim



About Esri and the Value of GIS

What is GIS?

GIS technology is for managing, sharing, and applying geographic information to deliver value across the entire organization. **GIS helps to improve efficiency, communication, decision-making, and collaboration across teams, disciplines, and expertise.**

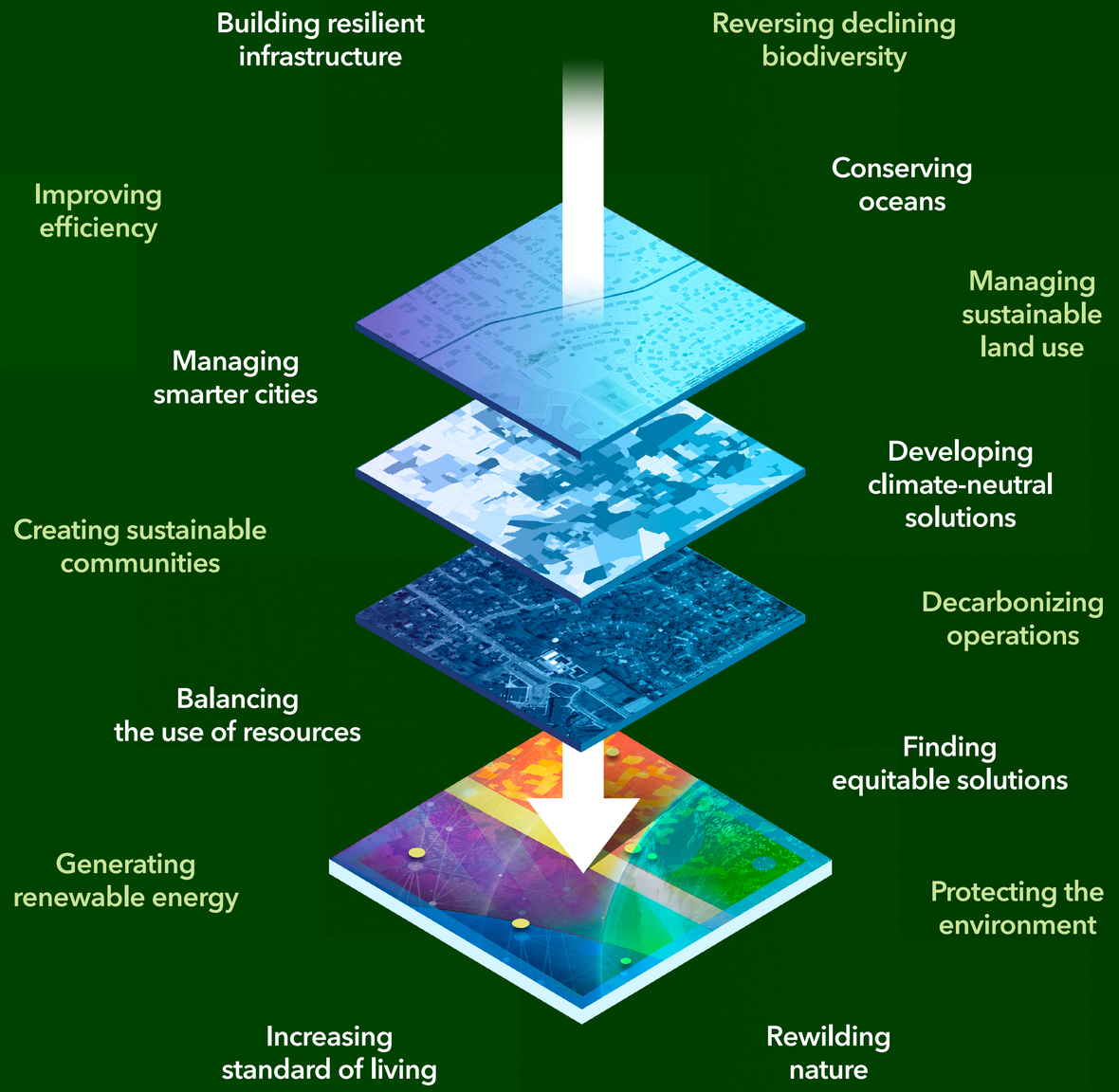
GIS and location intelligence enable AEC firms to achieve better outcomes and stand out from peers through:



GIS and the geographic approach

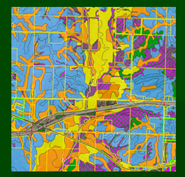
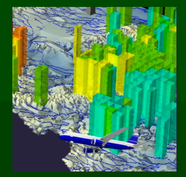
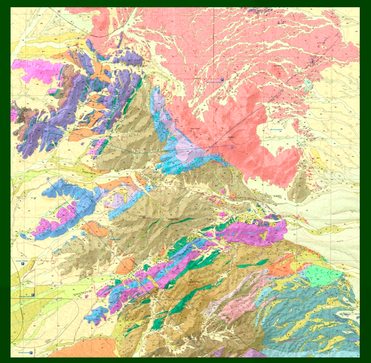
The geographic approach is essential for addressing our world's greatest challenges. Creating the future that we want to see requires the thoughtful work of AEC and GIS professionals collaborating closely with all the internal and external stakeholders their work impacts.

The geographic approach uses science and collaboration through GIS to address the environmental, economic, and societal impacts of sustainability issues:



GIS–Delivering value

Location intelligence and GIS not only how projects and assets are delivered in geospatial context. **GIS transforms the way we plan, design, build, and operate in the built and natural environment:**

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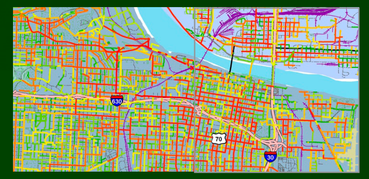

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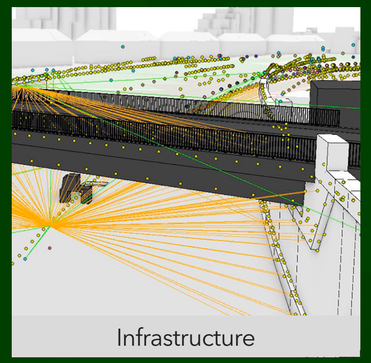
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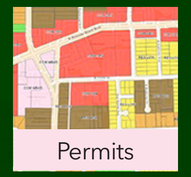
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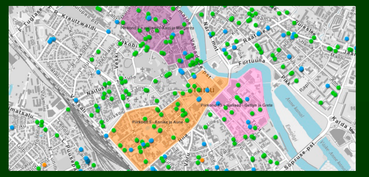
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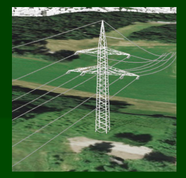
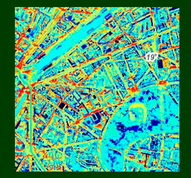
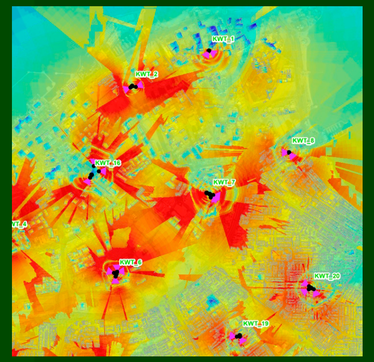
Networks



Sustainable Land Use

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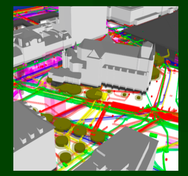
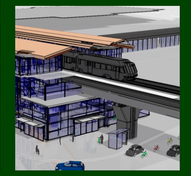
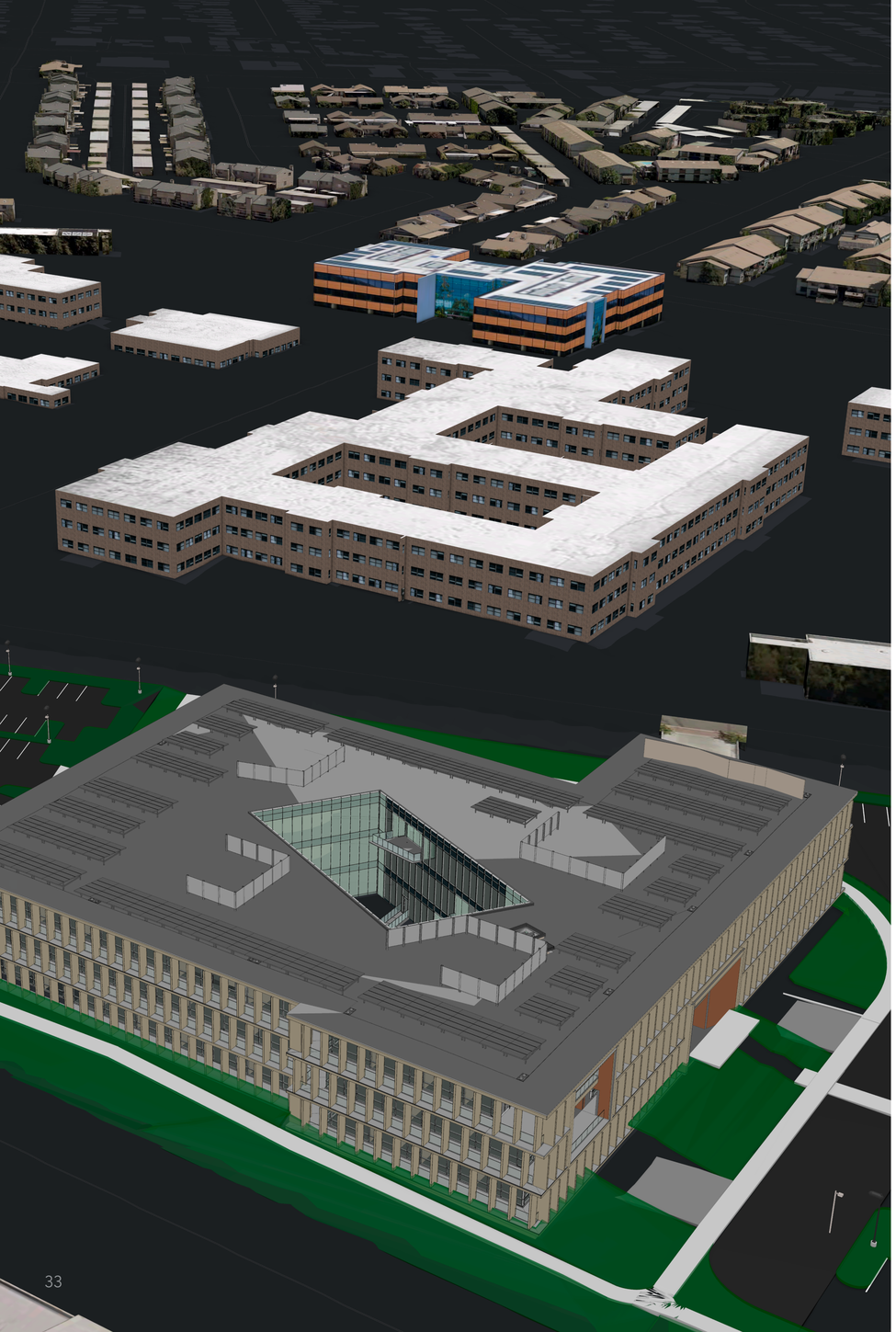


3D Cities




Digital Twins


Proposal



About Esri

Esri, the global market leader in GIS software, offers the most powerful mapping and spatial analytics technology available.

Esri, the global market leader in GIS software, offers the most powerful mapping and spatial analytics technology available. Since 1969, Esri has helped customers unlock the full potential of data to improve operational and business results. Today, Esri software is deployed in more than 350,000 organizations including the world's largest cities, most national governments, 75 percent of Fortune 500 companies, and more than 7,000 colleges and universities. Esri engineers the most advanced solutions for digital transformation, the Internet of Things (IoT), and location analytics to inform the most authoritative maps in the world.

For more information, visit
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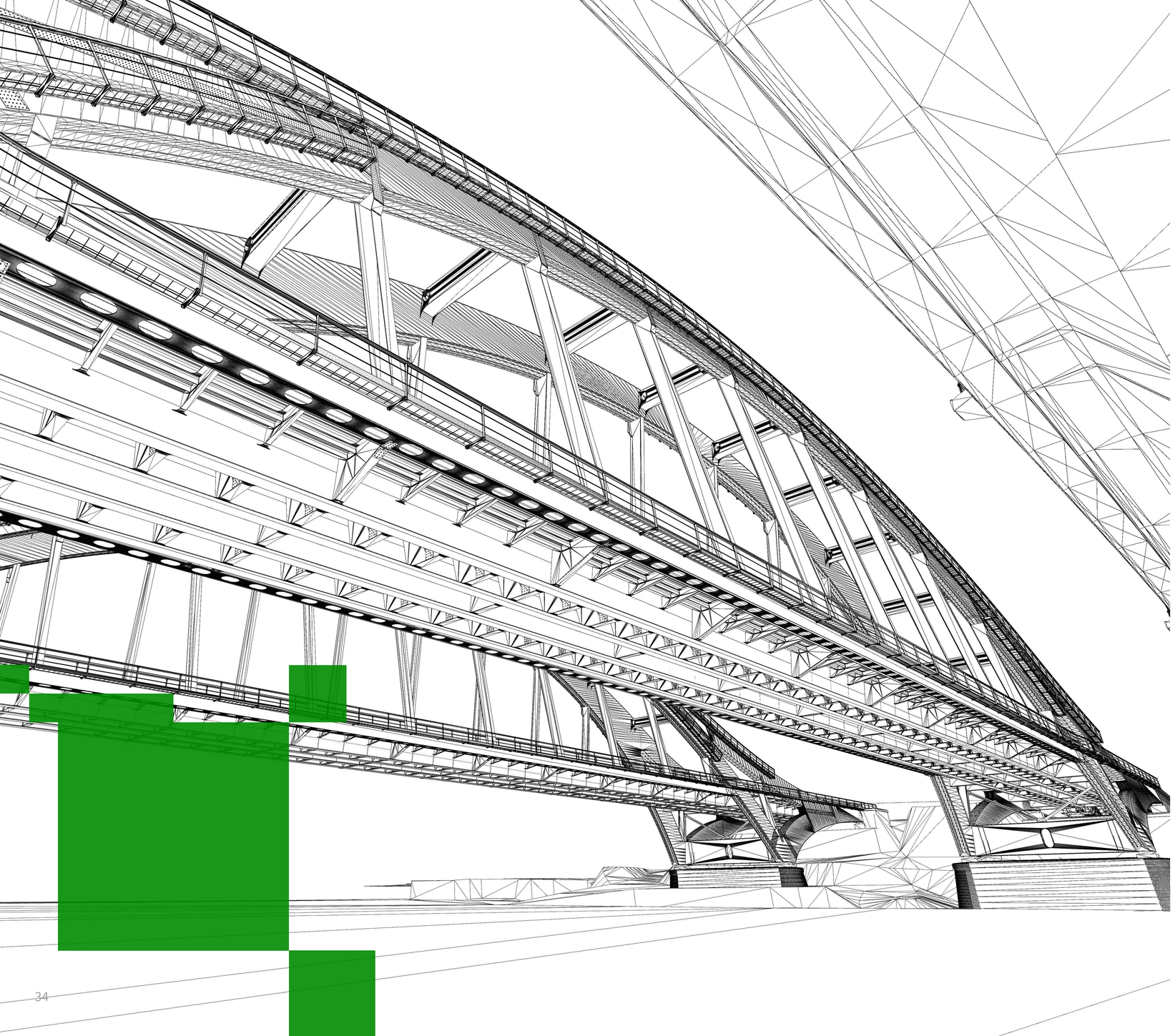

References

Esri, Autodesk (2022), GIS and BIM Integration:
A High-Level Global Report, Geospatial World.
www.geospatialworld.net/consulting/reports/gis-and-bim-integration.

Esri (2022), Digital Twin.
esri.com/en-us/digital-twin/overview.

Autodesk (2021), Zwolle-Herfte Railway Expansion:
On the Digital Transformation Track.
damassets.autodesk.net/content/dam/autodesk/www/pdfs/VolkerWessels-rail-expansion-CSS-FINAL.pdf.

Autodesk (2021), VolkerWessels | Zwolle-Herfte rail extension.
www.autodesk.com/customer-stories/volkerwessels-zwolle-herfte-railway.

Esri, Autodesk (2022), GIS and BIM Integration:
A High-Level Global Report. Geospatial World.
www.geospatialworld.net/consulting/reports/gis-and-bim-integration.

Esri (2022), AEC Customer Success Stories.
aec-customer-success-stories-arcaec.hub.arcgis.com.

Esri (2022), MOOC (Massive Open Online Course):
Transform AEC Projects with GIS and BIM.
esri.com/training/catalog/6257059de00e450c2a24e4e7/transform-aec-projects-with-gis-and-bim.

Esri (2022), ArcGIS: The Foundation for Digital Twins—An infrastructure ebook.
esri.com/en-us/lg/industry/infrastructure/arcgis-the-foundation-for-digital-twins.

Esri (2022), GIS and BIM Integration:
A global report for sustainable design and construction.
storymaps.arcgis.com/stories/48fabc58109c41c49cfaccd3e76f43f8.

Esri (2022), BIM and GIS.
learn.arcgis.com/en/paths/bim-and-gis.



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