

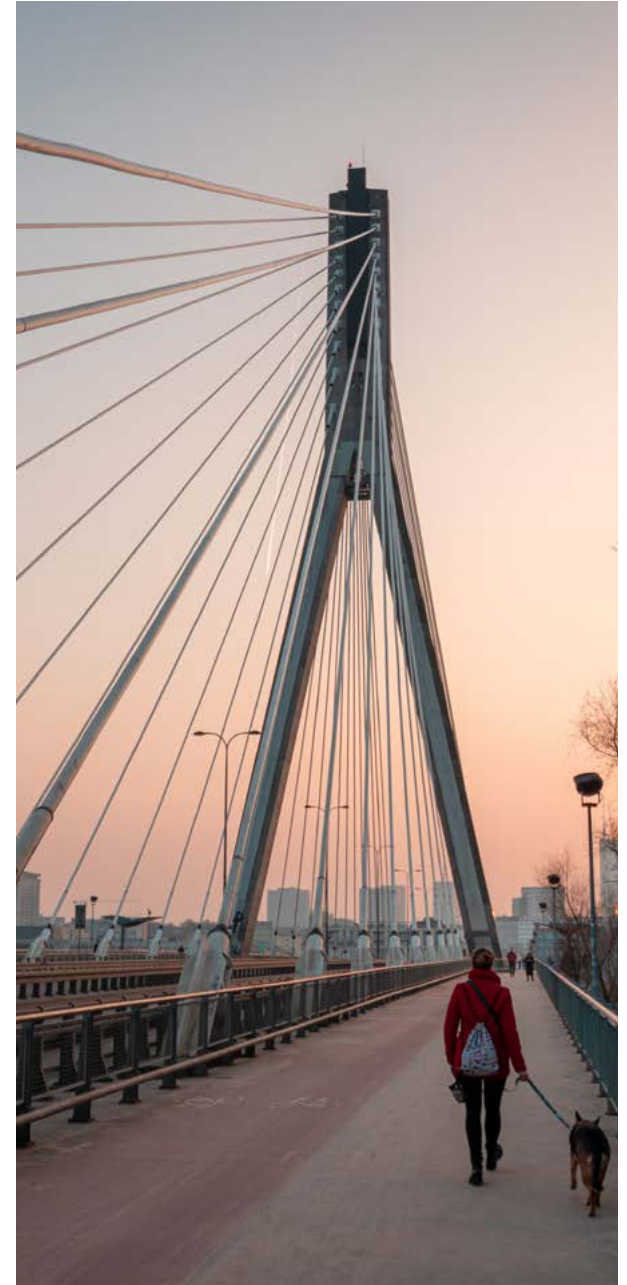


From data to decisions: the power of digital twins for engineering firms

Unlocking efficiency, sustainability, and intelligence in infrastructure projects

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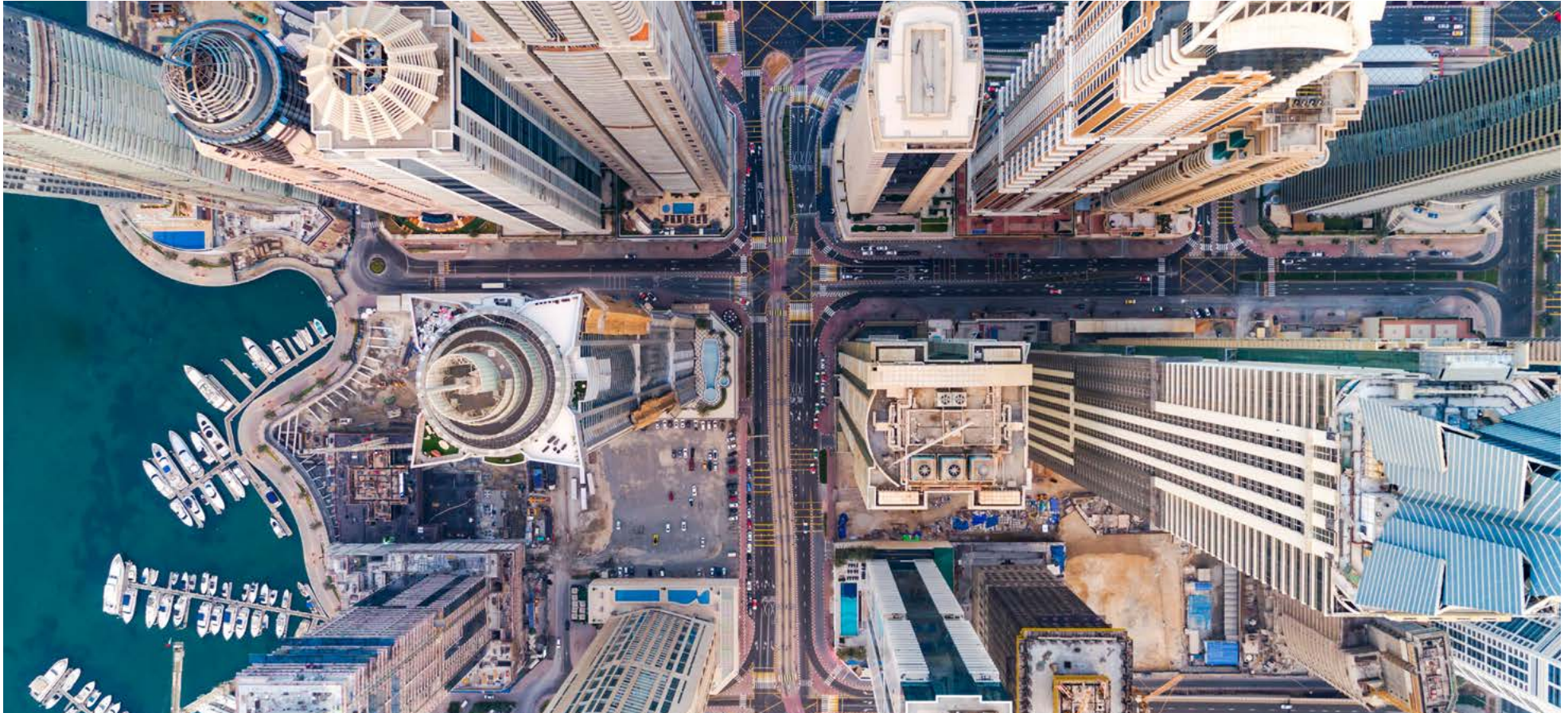




Why digital twins matter

In today's high-stakes infrastructure landscape, engineering firms are under pressure to deliver faster, smarter, and more sustainably while managing fewer resources. The firms that are gaining success aren't just producing higher-quality designs, they are making better-informed decisions.

Infrastructure digital twins provide a competitive edge. These dynamic, data-rich models unify design, construction, and operational data into a single source of truth, enabling faster decisions, fewer errors, and stronger collaboration across the project lifecycle. With Bentley's technology, engineering firms can break down data silos, simulate outcomes before breaking ground, and optimize asset performance long after delivery. As a result, they gain a measurable competitive advantage in winning work, reducing risk, and delivering value at every stage.



Digital transformation

The evolution from CAD to digital twins

In the early days, engineers sat behind glowing monitors, meticulously drafting every line and curve in static CAD environments—blueprints brought to life on screen, but frozen in time. As technology advanced, those once-static models began to breathe. Sensors, data streams, and cloud computing improved them into dynamic digital twins—living, evolving replicas of real-world systems. Now, instead of just designing a bridge, an engineer can monitor its stress levels in real time, predict maintenance needs, and simulate future scenarios. The shift wasn't just technological, it was a reimagining of what it means to design, build, and manage the physical world.

Integrated digital workflows

On major infrastructure projects, teams once worked in silos where designers handed off static files to engineers who then passed them to contractors, with each phase losing context and clarity. But with digital twins, that handoff becomes a handshake. From concept to construction to operations, a single, evolving model carries forward every decision, data point, and design change. The digital twin becomes the project's living memory, ensuring that insights from early planning inform real-time performance and future upgrades. It's not just continuity, it's a conversation across time, where every phase speaks the same digital language.



Image: Courtesy of China ENFI Engineering

Use case

Reimagining urban life through digital innovation

Beneath the tranquil greenery of a public park in China's Xiong'an New Area lies a marvel of modern engineering. A 220,000 square-meter underground waste treatment facility is quietly redefining what it means to build a sustainable city. Faced with the daunting challenge of managing waste for a future population of over six million, city planners turned to digital innovation to create a solution that was as invisible as it was impactful.

Led by China ENFI Engineering, the team embraced Bentley's digital twin technology to design and deliver a facility capable of processing over 3,000 tons of waste daily without disrupting the urban landscape above. Through a

fully integrated 3D digital workflow, they resolved nearly 7,000 design clashes before construction even began, accelerating delivery by 130% and saving millions in costs.

But the transformation didn't stop at efficiency. The facility now powers itself through waste-to-energy conversion, treats wastewater to the highest standards, and reduces emissions by up to 80%, all while remaining hidden from view. As residents stroll through the park above, few realize they're walking atop one of the world's most advanced examples of sustainable urban infrastructure. This is a testament to how digital twins and visionary design can quietly shape the cities of tomorrow.

Use case

Engineering smarter cities—how Pau’s digital twin cut costs by 95%

The Communauté d’Agglomération Pau Béarn Pyrénées (CAPBP) faced a challenge familiar to many engineering leaders: how to modernize infrastructure across 31 municipalities while keeping stakeholders aligned and costs under control. Their answer was bold—a city-wide digital twin built on the Bentley iTwin® platform. By capturing high-resolution data and weaving it into a multiscale reality mesh, CAPBP created a unified digital environment that now powers everything from architectural modeling to stormwater monitoring.

The results speak volumes: immersive video production costs slashed by nearly EUR 200,000 annually, asset data access time reduced to under three minutes, and information access costs cut by 95%. More than just a technical upgrade, the digital twin has become a strategic asset—bridging departments, engaging citizens, and enabling “right first time” construction. For engineering executives, Pau’s transformation is a compelling blueprint for how digital twins can drive efficiency, transparency, and smarter urban planning.

Image: Courtesy of Communauté d’Agglomération Pau Béarn Pyrénées – CAPBP



Sustainability and resilience

Emissions tracking

On road design projects, planners once relied on static models and best guesses to estimate emissions. But with a digital twin in place, engineers can analyze carbon emissions during the design phase. A digital twin gives engineers the opportunity to understand infrastructure in complete context, which allows them to manage compliance and regulatory concerns, and environmental carbon footprint. Incorporating embodied carbon reporting and accounting into the design process helps stakeholders monitor and mitigate emissions effectively.

Now, engineers can assess carbon solutions into daily design work before construction hits the ground. The result is smarter operations, lower emissions, and road networks that not only move people efficiently, but does so with a lighter environmental footprint.

**“With Carbon Analysis,
we can generate accurate
carbon reports much earlier
in the design process and
much faster.”**

-Kelvin Saldanha, Associate Director, WSP





Climate adaptation and scenario planning

In coastal cities facing rising sea levels and intensifying storms, engineering firms are tasked with designing resilient infrastructure that could stand the test of climate change. Instead of relying on historical data alone, they build a digital twin of the entire urban landscape, including bridges, drainage systems, and transit lines. With this living model, they simulate extreme weather scenarios, test flood mitigation strategies, and visualize how heatwaves can impact energy demand. The digital twin becomes their crystal ball, helping them make smarter, faster decisions that balance safety, sustainability, and costs. In a world of uncertainty, it gives them the power to plan with confidence.

Regulatory compliance and ESG reporting

For large engineering firms overseeing complex infrastructure projects, compliance once meant chasing spreadsheets, cross-checking reports, and hoping nothing slipped through the cracks. But with a digital twin in place, every material choice, energy metric, and operational detail is captured in real time—automatically aligned with evolving regulatory standards and ESG frameworks. When auditors request emissions data or project partners demand transparency, the team can quickly view the digital twin. It's all there: traceable, verifiable, and up to date. What was once a burden of reporting has now become a strategic advantage, turning compliance into a story of accountability and progress.



Image: Courtesy of Sabesp

Use case

Engineering excellence meets sustainability: Sabesp's blueprint for urban water resilience

In São Paulo, Companhia de Saneamento Básico do Estado de São Paulo (Sabesp) set a new benchmark for sustainable infrastructure through its Integra 4.0 initiative. Designed to modernize water management across the Tietê River basin, the program leveraged Bentley OpenFlows to create digital twins of complex hydraulic systems. Sabesp digitally modeled 110 kilometers of wastewater infrastructure serving over 3 million residents, reducing analysis time by 90% and identifying key expansion needs with less than a 2% margin of error.

In the coastal borough of Vicente de Carvalho, real-time monitoring stabilized water pressure in high-demand zones, improving service reliability during seasonal surges. These efforts led to a 30% reduction in sewer overflows, 2,800 hours saved in fieldwork, and BRL 3.1 million in maintenance cost avoidance. Sabesp's approach demonstrates how engineering firms can harness digital modeling and real-time data to deliver scalable, cost-effective, and sustainable infrastructure solutions in urban environments.

Use case

From data to decarbonization: how digital twins are driving greener cities

In the heart of Toronto's transit innovation, the Ontario Line is quietly becoming a sustainability success story. As Mott MacDonald and HDR guided the project's complex web of contractors and data, they didn't just build smarter—they built greener. Leveraging Bentley iTwin and SYNCHRO®, the team created a digital twin that allowed them to simulate construction impacts, make better schedules, and reduce inefficiencies long before breaking ground.

This digital foresight is expected to pay off in a big way: once operational, the Ontario Line will remove 28,000 cars from the road and save 7.2 million liters of fuel every year. It's a powerful example of how digital innovation can drive real-world environmental impact—one rail, one model, one decision at a time.

Image: Courtesy of Mott MacDonald



Use case

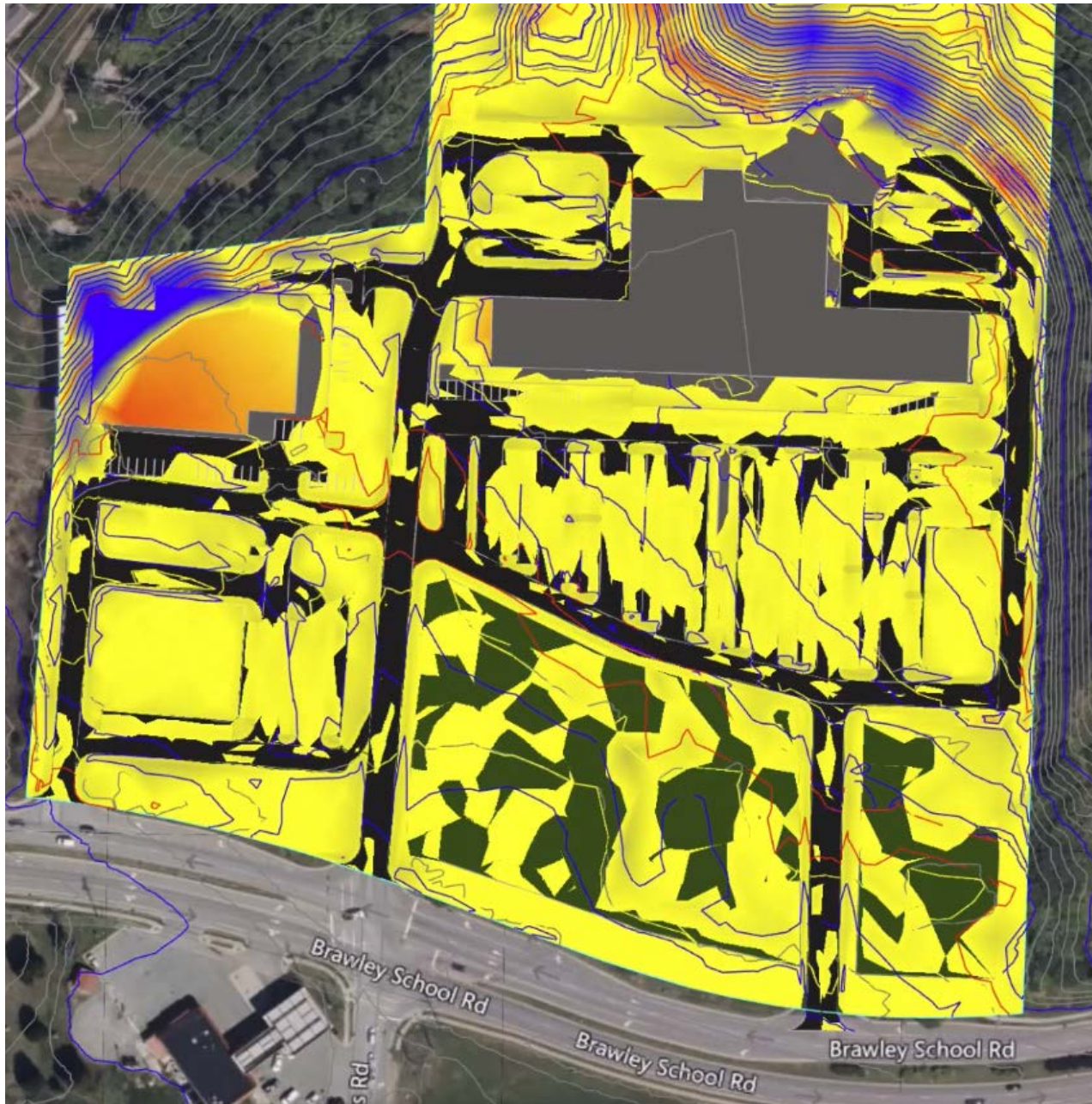
Essential energy cuts costs and carbon

In the heart of rural New South Wales, Essential Energy faced a formidable challenge: delivering reliable electricity across 737,000 kilometers of network with minimal customer density and mounting pressure to reduce costs and environmental impact. At the Brewarrina Substation—a site vulnerable to extreme weather—the team pioneered a transformative approach using Bentley's intelligent digital design system.

By replacing manual surveys with drone-captured 3D reality models and streamlining workflows through Bentley OpenUtilities® Substation and Microsoft 365 integration, they cut design costs by 50% and significantly reduced carbon emissions. This lean, tech-driven strategy not only enhanced safety and efficiency, but also proved that digital innovation isn't just for mega projects. Essential Energy's success story is a blueprint for engineering leaders seeking scalable, sustainable solutions that unlock value across capital portfolios—no matter the size.

Image: Courtesy of Essential Energy





Data-driven insights

Infrastructure AI: Site planning and design

In a world where infrastructure projects grow more complex by the day, Bentley's vision for infrastructure AI is reshaping how engineering firms make decisions. Bentley is committed to helping engineering firms unleash the power of AI across their enterprise with an open data platform, greater context, and control of their data.

Imagine a civil engineer tasked with designing a new development site. Instead of starting from scratch, they use OpenSite⁺, which empowers site engineers to quickly design sites with AI-driven tools, significantly boosting productivity and accuracy. OpenSite⁺ is designed for site engineering and powered by AI to help engineers automate tedious tasks, optimize grading, and deliver projects up to 10 times faster. Infrastructure AI blends generative design, digital twins, and data-driven insights to help engineers reduce risk, cut costs, and make smarter, faster decisions across the entire project lifecycle.

Digital technology

On highway bridges, invisible wear and tear may go unnoticed until it becomes a costly problem. But with a digital twin in place, the story changes. Sensors and drones are used to capture existing conditions and help create a living model that tracks conditions of the infrastructure asset. Engineers can now spot early signs of fatigue, simulate future performance under different traffic loads, and schedule maintenance before issues escalate. Instead of reacting to failures, they can improve performance and extend the bridge's lifespan. As a result, engineering firms save time, money, and ensure public safety.

Use case

Collins engineers sets a new bridge inspection standard

Located in St. Paul, Minnesota, the rainbow arch of the Robert Street Bridge has been an iconic landmark for nearly 100 years. It provides critical access over the Mississippi River, two railways, and a roadway, but it had deteriorated over the decades. To ensure continued operations over the next 50 years, Collins Engineers needed to improve regular bridge inspections while keeping costs under control.

The firm determined they could revolutionize bridge inspection by using drones to capture over 57,000 high-definition images of the bridge from every angle, then use Bentley iTwin Capture and iTwin Experience to create a comprehensive digital twin. As a result, Collins Engineers reduced on-site inspection time by 20% while dramatically improving data quality. AI-assisted defect detection significantly cut labor costs, yielding over USD 90,000 in savings.

“Using traditional inspection data collection methods would be very tedious and expensive, so our team had to find innovative ways to not only be more efficient but also to provide a higher quality deliverable for MnDOT.”

-Barritt Lovelace, Vice President of UAS, AI, and Reality Modeling, Collins Engineers, Inc.



Use case

The future beneath our feet: how digital twins are reinventing urban construction

In the heart of Toronto's historic Distillery District, where modern living meets heritage charm, Monir Precision Monitoring faced a high-stakes challenge: protect the city's busiest rail corridor while excavating for a new 41-story residential tower. With over 300,000 commuters relying on the Union Station Rail Corridor daily, even the slightest disruption could ripple across the city. Traditional monitoring tools weren't enough.

Monir turned to Bentley iTwin IoT to create a digital twin that brought together sensor data, drone imagery, and geotechnical insights in one intelligent environment. This real-time operational intelligence allowed the team to visualize shifting conditions, respond proactively, and reduce on-site hours by 60%. The outcome is safer rail line, a faster build, and over USD 1 million in savings. What began as a proof of concept became a powerful demonstration of how digital twins can transform infrastructure monitoring—from reactive to predictive, from fragmented to fully connected.

Image: Courtesy of Monir Precision Monitoring



Use case

Smarter cities start with data: Perry's model for scalable innovation

In Perry, Iowa, a small-town initiative to meet ADA compliance standards sparked a data-driven transformation with far-reaching impact. The City of Perry partnered with Foth to create a comprehensive digital twin using mobile lidar scans. They captured over 375,000 images and 4.1 terabytes of data, then used Bentley iTwin Capture to create the digital twin.

What began as a sidewalk and ramp assessment evolved into a city-scale model that now informs infrastructure planning, disaster recovery, and historic preservation. With this digital twin, Perry's leadership can simulate future development, assess storm damage with precision, and even plan for autonomous transit. The city expects to accelerate its Comprehensive Plan 2030 by 60%, while improving access to federal funding through compelling, 3D presentations. For engineering executives, the City of Perry's story is a powerful example of how digital twins can shift municipalities from reactive maintenance to proactive, insight-driven decision-making resulting in long-term value from a single scan.

Image: Courtesy of Monir Precision Monitoring



Collaboration and transparency

Breaking down data silos

In infrastructure projects spanning multiple disciplines, including civil, structural, and environmental, teams once worked in isolation, each guarding their own data sets and tools. Miscommunication was common, and rework was costly. But with the adoption of a digital twin, everything changes. Now, all project data lives in a shared, open environment where models, simulations, and updates are accessible in real time.

A structural engineer can instantly see how a design change affects drainage, while an environmental consultant can overlay GIS data to assess impact. The digital twin becomes the single source of truth, breaking down silos and turning fragmented workflows into a synchronized, collaborative effort. Every decision is informed, and every project partner is aligned.

Enhancing public trust

In city council meetings, engineering firms unveil more than just blueprints—they share digital twins of proposed infrastructure projects. With a few clicks, the public could explore 3D models of new transit lines, simulate traffic flow, and even visualize

how green spaces could evolve over time. Questions about noise, safety, and environmental impact are answered not with jargon, but with immersive, data-backed visuals. The digital twin becomes a bridge—not just between systems, but between people—fostering transparency, building trust, and turning passive observers into informed participants in the future of their community.

Real-time collaboration

As part of infrastructure projects, delays once crept in through missed e-mails, outdated files, and siloed updates. But with a digital twin at the core, project teams flip the script. Engineers, contractors, and planners in different locations can all work from the same real-time model—seeing changes as they happen, flagging issues before they escalate, and adjusting timelines with confidence. The digital twin becomes their shared workspace, where 4D simulations, live data, and instant feedback keep everyone aligned. The result is fewer surprises, faster decisions, and a project that stayed on schedule and within budget.

Image: Courtesy of AtkinsRealis



Use case

From bottleneck to breakthrough: how digital twins are transforming infrastructure

Tucked into Colorado's rugged mountain terrain, the Floyd Hill segment of I-70 has long been a bottleneck for travelers and freight alike. To transform this critical corridor, AtkinsRéalis partnered with CDOT on a USD 700 million upgrade. This project demanded not only engineering precision, but seamless collaboration across disciplines, regions, and stakeholders.

With Bentley ProjectWise® and iTwin technology, the team built a shared digital twin that brings together roadway, bridge, and environmental models in one connected environment. Designers could evaluate sight distances, simulate construction impacts, and present immersive 3D visuals to the public and decision-makers alike. This transparency helped build trust, while real-time coordination saved 5,500 hours and over USD 7 million in project costs. From wildlife crossings to new pedestrian trails, every design decision was informed by a shared digital context, which proves that when teams work together in a connected data environment, even the most complex infrastructure challenges become clearer, faster, and more sustainable to solve.

“We could attend meetings with stakeholders and fly around the model to get a sense of what the project will look like.”

-Alan Carter, Project Manager and Roadway Designer, AtkinsRéalis



Use case

Power through collaboration: how Keystone's integrated design approach cut offshore costs by 20%

When Deepwater Wind set out to build the first offshore wind farm in the United States, they faced a daunting challenge: designing durable, cost-effective substructures for turbines in deep ocean waters. Enter Keystone Engineering, whose innovative approach transformed the project. Drawing on offshore oil and gas expertise, Keystone adapted steel jacket foundations for the Block Island Wind Farm's five 6-megawatt turbines.

Using Bentley's SACS™ software, the team collaborated seamlessly with turbine designers, running thousands of simulations to model wind and wave loads, optimize structural integrity, and streamline the design process. The result is a 15% lighter foundation design and a 20% reduction in installation costs. It's proof that smart collaboration and cutting-edge technology can turn ambitious clean energy goals into reality.

Barry Reed, CEO of Keystone Engineering



Use case

From complexity to clarity: WSP's collaborative model sets a new standard for public infrastructure projects

In a landmark collaboration that exemplifies the future of infrastructure delivery, WSP Australia played a pivotal role in the Parkdale Level Crossing Removal—part of Victoria's ambitious initiative to eliminate 110 level crossings by 2030. As lead design consultant within the Southern Program Alliance, WSP faced complex site constraints and high stakeholder expectations. Their strategic decision to adopt Bentley's integrated digital twin technology transformed project execution.

By centralizing data, enabling real-time collaboration, and offering immersive stakeholder engagement tools, WSP accelerated delivery timelines, reduced design rework, and achieved a 30% reduction in carbon footprint. The project not only enhanced safety and connectivity for the community, but also demonstrated how digital innovation can drive sustainability, efficiency, and public trust. For executives seeking scalable, future-ready infrastructure models, Parkdale stands as a compelling case study in how digital collaboration can unlock both operational excellence and long-term value.

Image: Courtesy of WSP Australia Pty Ltd



Getting started with Bentley

Engineering firms looking to future-proof their projects can start realizing the benefits of digital twins today with Bentley's powerful suite of solutions. Whether you're designing a resilient bridge, managing a complex rail system, or planning a sustainable city, Bentley's digital twin technology connects every phase of the project lifecycle—from design and construction to operations and maintenance.

Bentley also provides engineering firms with open software, so you can overcome today's challenges and enable tomorrow's opportunities. These tools make it easier to integrate digital workflows, boost collaboration across disciplines, improve transparency with project partners, and unlock real-time insights from operations. With an open platform you also avoid lock-in, increase collaboration, and leverage all the related data. The result? Smarter decisions, reduced risk, and infrastructure that's built to last.

Digital twins are a strategic imperative for engineering firms. Engineering firms implementing digital firms are gaining the following outcomes:

- Improved productivity and risk reduction with integrated digital workflows.
- Reduction in rework, costs and material waste with sustainable practices.
- Improved schedule performance due to insights from operations.
- Increase collaboration and coordination with open applications.

Speak to an expert today to get started.

