Bentley®
Advancing Infrastructure

Leveraging Digital Twins from Concept to Operations in the Road Industry

Digital twins are becoming one of the most important technology trends for transportation infrastructure. They have the potential to improve design, enhance collaboration, and increase asset reliability and performance. Digital twins are becoming the backbone of infrastructure decision-making as they provide up-to-date information about projects, their status, and their potential risks. Civil engineers can use digital twins to visualize assets across their entire lifecycle, tracking change and performing analysis that optimizes asset performance.

WHAT IS A DIGITAL TWIN?

A digital twin is a digital representation of a physical asset, process, or system, as well as the engineering information that allows us to understand and model its performance. Contractors, construction firms, and road and bridge owner-operators can leverage digital twins to allow project teams to gain more visibility into the design. Digital twins also allow management and owners to understand the implications of design decisions early in the process and help them achieve improved performance across the asset lifecycle.

Digital twins become most valuable during operations. Owner-operators gain insight when data from Internet of Things (IoT) connected devices, such as drones that deliver continuous surveys, add to the digital representation with real-time tracking of asset changes in real-world conditions. This transparency helps owner-operators prioritize and improve maintenance or upgrades.

ROAD AND BRIDGE DIGITAL TWINS IN ACTION

Bentley's users are going digital with digital twins, advancing digital workflows, using intelligent components, and harnessing digital context to improve project delivery and asset performance, every day and all around the world. ***Here are a few real-world examples.***

FOTH USES DIGITAL TWINS TO DELIVER ROADWAY REVITALIZATION PROJECT IN CEDAR FALLS, IOWA

Foth Infrastructure and Environment was retained to develop a comprehensive transportation plan, from preliminary engineering through final design and construction, for a busy road corridor in Cedar Falls, Iowa. The city's goals were to improve traffic flow and safety, provide bicycle and pedestrian access and mobility, and facilitate commercial access, all while minimizing capital investment and operational costs. To address the city's priorities, Foth introduced innovative design elements rarely seen in the state, including roundabouts, a lane reduction, and a complete streets approach to accommodate multimodal travellers.

Having a single 3D model improved the accuracy and efficiency of the design process, seamlessly integrating designers and consultants from a global network. The 3D model also helped improve the construction phase. Foth established the 3D model as a digital twin, with data flowing to and from the model as field personnel identified and resolved potential issues on site. Beyond construction, the engineering information contained in the digital twin will provide significant value to future operations and asset management as these digital assets can intelligently convey critical information for performance improvements to the city.

Saving time in the design phase dramatically reduced the overall project schedule, allowing Foth to meet construction and city schedules while delivering a high-quality project. Working in an open, connected data environment with Bentley's applications improved project deliverables across all phases, maximizing collaboration and productivity between mobile and dispersed teams, as well as optimizing communication with the city, utility companies, and community stakeholders. https://www.bentley.com/en/goingdigital/foth

Foth's digital twin of their roadway revitalization project improved the accuracy and efficiency of the design process.

BIM, REALITY MODELING, AND GIS DATA DELIVER DIGITAL TWINS FOR HIGHWAY IN MALAYSIA

Malaysia's Pan Borneo Highway is a 1,060-kilometer, four-lane dual carriageway that spans undulating terrain through existing communities and protected reserves in the state of Sarawak. Lebuhraya Borneo Utara (LBU), the project delivery partner, and Reveron Consulting, a Bentley channel partner, were selected by the government of Malaysia to implement Bentley solutions for the highway's design, construction, and operations.

LBU digitalized planning, design, and construction of the project, accommodating government standards to deliver best value. Having leveraged Bentley applications throughout construction and construction monitoring, the next phase focused on operations, maintenance, and asset management to ensure the highway meets its current and future functional requirements.

Digitalizing the planning, design, and construction of the Pan Borneo Highway ensures optimal maintenance and asset management.

Capitalizing on reality modeling, as well as digital processes and workflows, a digital twin approach was used as the basis for operational decisions. Bentley's integrated applications, along with its connected data environment, provide a complete technology solution that enables the creation of a digital twin. Digital twins were used to integrate a road information system, a bridge management system, and a maintenance management system that are specifically designed to include development of nonconformance reports. The digital twins use Bentley technology to combine BIM, reality modeling, and GIS data to provide immersive visibility and analytics for timely decision-making and improved infrastructure asset performance. https://www.bentley.com/en/goingdigital/roads/malaysia

ITALFERR USES DIGITAL TWINS TO BUILD PERGENOVA VIADUCT IN GENOA, ITALY

The Pergenova Consortium Company chose Italferr to design an emergency replacement for the 1,182-meter Morandi Bridge over the Polcevera River in Genoa, Italy. The collapsed bridge closed three rail lines and added 120 kilometers to road travel. Consequently, rebuilding it as quickly as possible was critical for the city's long-term economic and cultural health—and construction would need to begin as the design progressed.

To ensure the accuracy of the design while staying on schedule, Italferr used Bentley's BIM methodology and created a digital twin of the viaduct to streamline workflows throughout the design phase. To achieve this goal, Italferr incorporated detailed information for construction and operation into the model, as there was little time to significantly alter the model after the design phase. The organization also established a connected data environment to promote collaboration among the multidiscipline project team and ensure a single source of truth. Bentley applications also helped Italferr define standards, templates, and basic criteria to create a digital twin and a unified 3D information model that forms the basis for design, construction, and operations.

Leveraging BIM and creating a digital workflow with Bentley applications allowed Italferr to visualize the design with a much higher degree of quality and speed than traditional 2D designs. Using Bentley's BIM solutions and digital twins, Italferr reduced design costs, improved decision-making, increased accuracy, and improved multidiscipline communication. https://www.bentley.com/en/project-profiles/2019/italferr_new-viaduct-polcevera-river

Creating a digital twin helped Italferr streamline workflows and replace a collapsed bridge as quickly as possible.

BIM METHODOLOGIES AND DIGITAL TWINS OPTIMIZE DESIGN AND CONSTRUCTION OF CHINESE EXPRESSWAY

The Meitan-Shiqian Expressway is a key project in the 13th Five-Year Plan for Transportation Development in China's Guizhou province. It is the first expressway in China that applies BIM methodologies for construction and management in large quantities and in all disciplines. Located in a very mountainous area, the expressway is 113 kilometres long with numerous bridges, elevated highways, and tunnels.

Developers relied on digital twins to improve construction quality for an expressway project in a very mountainous area.

The project leveraged digital twins to improve the quality of expressway construction and implement the concept of full lifecycle management. Unmanned aerial vehicles were flown to survey the existing site and Bentley's reality modeling software was used to create a 3D reality model. Having this reality context helped the team accelerate and optimize the design, shortening the construction period by 89 days.

The introduction of virtual design and construction technologies has transformed the traditional construction lifecycle on this project. The project team identified issues in the design stage that would not have been found and solved until the construction stage using previous methods. Identifying issues early in the design stage saved half of the estimated time, improved construction quality, and reduced construction costs. The BIM models collected during the project were used to establish a digital twin, which provided the foundation for maintenance and for modeling and predicting future asset performance. https://www.bentley.com/en/project-profiles/2019/chongqing-traffic-institute_meitan-shiqian-expressway

SUMMARY

Digital twins enable you to visualize infrastructure assets across the entire asset lifecycle, track changes, and perform analyses to optimize asset performance. Bentley's infrastructure digital twins combine engineering data, reality data, and IoT data for a holistic view of infrastructure aboveground and belowground. Immersive visualization, visibility, and analytics help you achieve a deeper understanding of your infrastructure assets so that you can improve your decision-making for improved outcomes. To learn more https://www.bentley.com/en/goingdigital/roads/going-digital-in-roads