# Going Digital Awards in Infrastructure

## Bentley Systems' 2021 *Year in Infrastructure* Conference

During the 2021 *Year in Infrastructure* and Going Digital Awards virtual event, Bentley Systems showcased its Going Digital Awards in Infrastructure winners on December 2, 2021. Katriona (Kat) Lord-Levins, Chief Success Officer at Bentley, announced the winners, which recognize the extraordinary work of Bentley software users advancing infrastructure design, construction, and operations throughout the world. Sixteen independent jury panels selected the 57 finalists from nearly 300 nominations submitted by more than 230 organizations from 45 countries encompassing 19 categories.

In addition, the recently launched Bentley Education program helps students develop the digital skills that are critical for building a qualified talent pipeline for infrastructure. As part of this initiative, Bentley Education established the Future Infrastructure Star Challenge, which encouraged students to develop a concept or idea for how they can change the world with infrastructure. Lord-Levins announced the winners of the Judge's Choice and the People's Choice from 144 submissions.

The Judge's Choice winner, which included a $5000 prize, went to Elif Gungormus Deliismail from the Izmir Institute of Technology in Turkey. On her project, "Mini-Modular Plant for Digitized Sustainable Campus," Deliismail used ContextCapture and drone technology to create a three-dimensional (3-D) model of a rural academic campus to illustrate how a mini-modular plant coupled with smart centralized energy management and low-carbon fuel sources can transform energy performance.

"It makes me so proud that my project was recognized by such a leading company," Deliismail said. "Self-sustaining buildings are next-generation, environmentally friendly architecture, which will hopefully be a significant issue for infrastructure development for [future] generations."

The People's Choice winner, which included a $2000 prize, went to Rodman Raul Cordova Rodriguez from the Pontifical Catholic University of Rio de Janeiro, Brazil, for his "Innovative Dam and Hydroelectric Project." He examined how to improve water supply capabilities and hydroelectric operations through the lifespan of a multipurpose dam.

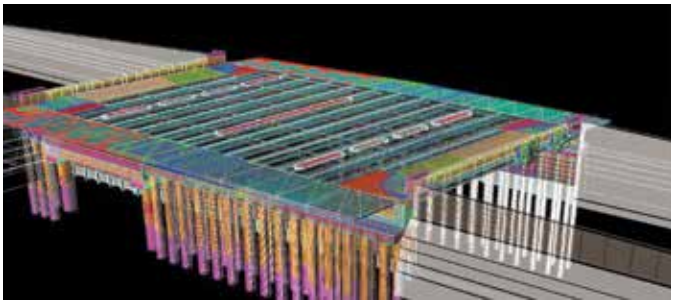
"I was concerned about the alarming facts about energy crisis and water supply worldwide," he said. "So, I took the opportunity to join the challenge and develop a creative, innovative, and sustainable idea in order to help solve the world's real problems with the use of technology and recyclable materials."

The winners of the 2021 Going Digital Awards in Infrastructure are:

### Bridges

#### East 138th Street over the Major Deegan Expressway, New York City, NY, USA, by New York State Department of Transportation (NYSDOT)

Originally built in 1938, the existing East 138th Street Bridge is being replaced to eliminate vertical clearance issues and optimize vehicle and pedestrian traffic demands. NYSDOT wanted to use a digital twin as the primary



**East 138th Street Bridge** *(image courtesy of NYSDOT)*

construction document. With the project located in a heavily congested area, the team needed to create the construction sequencing plan and accommodate existing utilities. They needed a hybrid modeling approach to generate a digital twin of the complex superstructure and pedestrian components.

Already familiar with Bentley applications, they used OpenBridge Modeler, OpenRoads Designer, and ProSteel to generate an accurate 3-D model. iTwin Design Review provided a central platform for over 180 reviewers. Bentley's integrated technology helped identify and resolve costly issues prior to construction. SYNCHRO 4D facilitated visual, dynamic construction sequencing and traffic control planning for better project coordination. The digital twin is a tool for asset management and bridge inspection.

## Buildings and Campuses

### High-Tech Multifunctional Medical Complex, Yukki, St. Petersburg, Russia, by Volgogradnefteproekt, LLC

A high-tech multifunctional medical complex is being developed to improve the quality, diversity, and accessibility of medical care to residents throughout Russia. The large-scale project presented technical and coordination challenges, compounded by a short 3-year timeline. Volgogradnefteproekt wanted to streamline workflows and collaboration among the contractor, designer, and client. The team needed interoperable digital technology to integrate scheduling, facility design, and construction management.

They selected OpenBuildings and ProStructures to generate a 3-D model and construction documentation for the entire facility, using ProjectWise to manage the design and approval processes. The solution improved and accelerated decision-making and issue resolution by 20%, allowing the team to overcome a 2.5-month delay in the delivery schedule. By avoiding delay costs, they saved an estimated 30 million USD. Using ContextCapture and four-dimensional (4-D) modeling enhanced efficiencies managing construction by 30%. The digital twin helped with asset management during operations.

**High-Tech Multifunctional Medical Complex** *(image courtesy of Volgogradnefteproekt, LLC)*

## Digital Cities

### Ezhou Huahu Airport Project, Ezhou, Hubei, China, by Hubei International Logistics Airport Co., Ltd.; Shenzhen S.F. Taisen Holdings (Group) Co., Ltd.; and Airport Construction Engineering Co., Ltd.

Situated in the eastern part of Ezhou, Ezhou Huahu Airport is a new international airport and aviation logistics port, as well as Asia's first professional cargo airport. Covering 11.89 $km^2$ (4.59 square miles), the project required integration of many process systems, presented complex geological challenges, and had an extremely tight schedule. With no existing civil aviation building information modeling (BIM) standards and 25 million model components, the design team needed a digital platform capable of supporting large volumes of multisourced data and intelligent life-cycle operations.

They selected Bentley's BIM applications to develop a 3-D airport model, shortening model delivery by 90 days. Using the Bentley iTwin platform, the team resolved 6000 issues to reduce costs by CNY 200 million. Bentley's solution reduced the construction period and promoted smart construction in China's civil aviation industry.

## Digital Construction

### SeaTac Airport International Arrivals Facility, Seattle, WA, USA, by Clark Construction Group, LLC

The SeaTac Airport International Arrivals Facility is the most complex capital development project in the history of

**Ezhou Huahu Airport Project** *(image courtesy of Hubei International Logistics Airport Co., Ltd.; Shenzhen S.F. Taisen Holdings (Group) Co., Ltd.; and Airport Construction Engineering Co., Ltd.)*

the 69-year-old Seattle airport. The project included constructing a three-story building, an elevated sterile corridor, and the world's longest pedestrian walkway over an active airport taxi lane. Clark Construction was responsible for the design and construction. Challenges included remotely assembling a 3 million lb (1.3 million kg) pedestrian bridge with a 320 ft (97.5 m) center span and then transporting it to the project location.

By leveraging BIM and reality modeling technology with Bentley's SYNCHRO 4D, Clark Construction developed a digital twin that was used to fully visualize the construction sequencing. They used the application to enable precise planning and execution to safely install and fit the iconic walkway within 3/8 in. (9.5 mm) without causing airport disruptions. The digital twin will be used by the Port of Seattle for facilities management purposes.

## Geotechnical Engineering

### Geological Survey of Water Conservancy and Hydropower Engineering, Tibet, China, by China Water Resources Beifang Investigation, Design and Research Co. Ltd.

Located in the high-altitude alpine region of Tibet, this hydro-complex for a water conservancy initiative is focused on irrigation, power generation, and improving the regional water supply. Knowing the importance of subsurface findings, the survey and design team faced challenging terrain and extreme environmental conditions that traditional survey methods could not accommodate. They explored digital data acquisition and 3-D modeling of geological data but found that many software products lacked integration and the ability to maximize data potential.

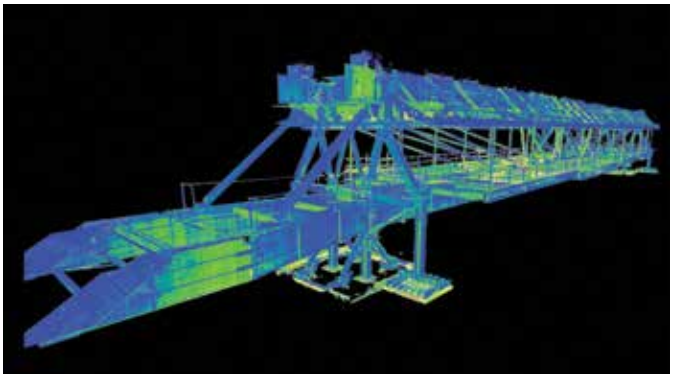
They selected Bentley's open, vendor-neutral ecosystem to produce solutions that would digitalize the production process. Using ContextCapture to process data for geological visibility and ProjectWise for multidisciplinary collaboration, new reusability of data for smart engineering evolved. The solution saved CNY 400,000 in survey costs and over 50% in survey time, improving data accuracy by over 10% and work efficiency by over 15%. Establishing a digital twin enhanced project management by 10%.

## Land and Site Development

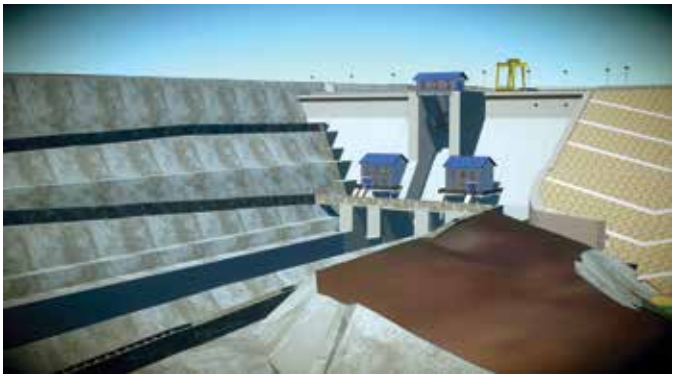
### Dongtaizi Reservoir Project, Chifeng, Inner Mongolia, China, by Liaoning Water Conservancy and Hydropower Survey and Design Research Institute Co., Ltd.

The Dongtaizi Reservoir Project is a large-scale water conservancy initiative scheduled as part of China's 13th 5-year Plan period. The project's engineering, survey, and

**Geological Survey of Water Conservancy and Hydropower Engineering** *(image courtesy of China Water Resources Beifang Investigation, Design and Research Co. Ltd.)*



**SeaTac Airport International Arrivals Facility** *(image courtesy of Clark Construction Group, LLC)*



**Dongtaizi Reservoir Project** *(image courtesy of Liaoning Water Conservancy and Hydropower Survey and Design Research Institute Co., Ltd.)*

design unit Liaoning Water Conservancy and Hydropower Survey and Design Research Institute faced technical, geological, and coordination challenges. They realized that traditional design methods were insufficient and that they needed an integrated 3-D BIM approach to accommodate the geology, excavation, and dam design.

The team used ProjectWise as the collaborative design management platform, providing a connected data environment for the multiple disciplines. OpenBuildings and OpenRoads facilitated 3-D modeling and visualization that helped resolve difficulties designing the ecological fishway and complex concrete dam structure. Using Bentley's integrated applications, they completed the engineering design 2 weeks earlier than expected and reduced design errors by an estimated 90%. The digital models were handed over for construction monitoring, operations, and maintenance to achieve a full life-cycle BIM application.

## Manufacturing

### Converter-Based Continuous Casting Project of Jinnan Steel Phase II Quwo Base Capacity Reduction and Replacement Project, Quwo, Shanxi, China, by WISDRI Engineering & Research Incorporation Limited

Jinnan Steel Group invested in the Quwo Group (a merger of two steel production plants) to optimize the plant's industrial layout and achieve higher production quality, efficiency, and sustainability. As the general contractor, WISDRI faced technical and coordination challenges, compounded by limited space and a tight schedule amid COVID-19. They sought to streamline workflows and identify risks in advance through collaborative design and construction simulation technology.

They selected ProjectWise and Bentley's open modeling applications to digitally unify design among 16 different disciplines, reducing ambiguity and improving design quality. By performing collision detection, they eliminated 66 clashes, saving approximately CNY 1.7 million and reducing rework. Through construction simulation in SYNCHRO 4D, they cut construction by over 30 days and saved an additional CNY 3 million. The integrated digital approach minimized the impact of the pandemic and facilitated the development of a modern steel plant.

## Mining and Offshore Engineering

### Construction of the Blagodatnoye Mill-5, Krasnoyarsk, Krasnoyarsk Krai, Russia, by Polyus

To increase gold production at the Blagodatnoye deposit, Polyus decided to build an additional service complex and Mill-5, a new gold processing plant. The project included the design, construction planning, and field supervision of two buildings and related infrastructure. Facing a complex design and construction modeling works among a team of over 100 employees, Polyus needed an integrated digital technology solution to implement data-driven, collaborative design and construction workflows.

They selected Bentley applications to establish seamless workflows, using 3-D models to link the construction schedule and generate reports to the field. Using ContextCapture reduced engineering design time by 22%. Working in a connected data environment with ProjectWise improved design communication by 12%. Performing construction simulation and developing cloud-based workflows optimized construction and installation works, reducing the time to facility commission by 42 days.

## Power Generation

### The World's First 60 MW Subcritical Blast Furnace Gas Power Generation Project, Changshu, Jiangsu, China, by Capital Engineering and Research Incorporation Ltd.

The Jiangsu Longteng special steel 60 MW project is the world's first ultra-high-pressure, subcritical gas generator set with the smallest installed capacity. Capital Engineering and Research Incorporation Ltd. undertook design and construction and faced technical and coordination challenges compounded by a short timeline and limited space. To prevent clashes and simultaneously construct the physical factory and its digital twin, they needed to use open modeling applications in a connected data environment.

They used Bentley applications to establish a collaborative design platform and perform construction simulation. With Bentley's openness, they built a digital model of the entire factory with an engineering data center to achieve digital delivery based on full life-cycle information, establishing the foundation for intelligent plant operations.

## Project Delivery Information Management

### HS2 Phase 1 Main Civil Construction Works, London, UK, by Mott MacDonald/SYSTRA JV with Balfour Beatty Vinci

Mott MacDonald/SYSTRA JV was awarded the design-build contract for Phase 1 northern sector civil works of the High Speed 2 railway network (HS2). They had to manage over 1000 people working from 30 locations across more than 18 disciplines. The project required standardized processes and new technology for effective data management, change control, and transparent communication.

Already using ProjectWise, they integrated the Bentley iTwin platform, accelerating model access by 95% to save an

expected GBP 200,000 annually, as well as reducing data extraction time from 2 weeks to only hours. They streamlined new deliverable creation with automatic metadata retrieval, reducing manual entry by 75%. Integrating advanced work packaging drastically reduced reporting times and streamlined information sharing, accelerating the project schedule.

## Rail and Transit

### Transpennine Route Upgrade, Manchester/Leeds/York, UK, by Network Rail + Jacobs

The Transpennine Route Upgrade is a GBP multibillion railway enhancement program to double capacity, reduce carbon emissions, and cut journey times on commuter routes between Manchester, Leeds, and York. When completed, the 100 km (62 mile) route upgrade will improve connectivity and provide economic benefits to the North of England. To bring together the large volume of data and disciplines involved, Network Rail tasked Jacobs with implementing a route-wide digital twin.

Realizing paper-based processes and Excel spreadsheets introduced unnecessary risk and inefficiency across the team, Jacobs used the Bentley iTwin platform with ProjectWise, ContextCapture, and other integrated applications. Using the digital twin allowed over 1300 staff to track, contribute, and analyze design data and asset information in real time. Improved access saved the team 20,000 hours in the first 6 months, worth an estimated GBP 1 million. Overall, the digital twin will save approximately GBP 15 million.

## Reality Modeling

### Diablo Dam Digital Twin Modeling, Whatcom County, WA, USA, by HDR

After the overtopping of the dam in Oroville, CA, USA, Seattle City Light initiated major safety reviews of its six dams, including Diablo Dam on the Skagit River. To improve survey safety and efficiency, as well as minimize risks associated with inspecting the 160 ft (49 m) high dam amid a global pandemic, HDR's team was asked to provide aerial drone services to supplement physical inspections. A key goal was to use the captured data to create a digital twin model of the structure.

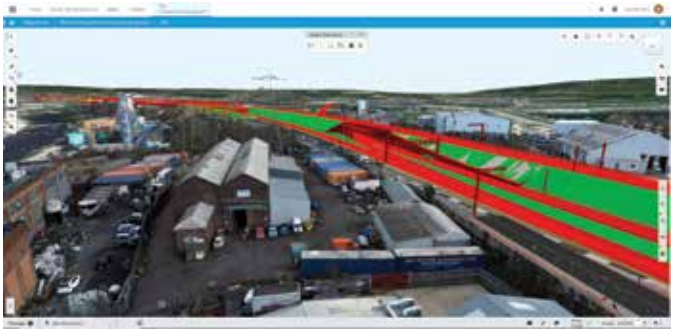
They selected ContextCapture and the Bentley iTwin platform to create a digital twin, accurate within 20 mm (0.8 in.), from over 82 million survey points. The team could merge architecture, engineering, and construction data with artificial intelligence across the life cycle of the structure, identifying current and future maintenance and repair needs to ensure safety. The digital twin provides a single reference point for the owner to understand the structure and reduces project costs, while increasing surveyor safety and facilitating decision-making.

## Road and Rail Asset Performance

### Stone Arch Bridge Rehabilitation, Minneapolis, MN, USA, by Collins Engineers, Inc.

Collins Engineers was tasked with inspecting and designing the rehabilitation of the iconic Stone Arch Bridge in Minneapolis, ensuring that it remains a valuable asset. With its age and size, they faced challenges when developing repair plans that traditional data collection could not accommodate. When they had used reality modeling, it lacked the quality required for inspecting and modeling complex structures. To collect sufficient data and accurately model the bridge, they needed an integrated survey, modeling, and inspection solution.

Collins Engineers selected ContextCapture to generate a high-fidelity 3-D model from over 13,000 images, improving the quantity and quality of data. Using iTwin applications facilitated real-time model access, saving 20% of field time. The solution is expected to save 10 to 15% in construction costs due to improved project and bid data. They will use digital twins throughout the bridge's life cycle for future planning and maintenance decisions.



**Transpennine Route Upgrade** *(image courtesy of Network Rail + Jacobs)*

**Diablo Dam Digital Twin Modeling** *(image courtesy of HDR)*

## Roads and Highways

### Trans Sumatera Toll Road Project Section Serbelawan-Pematangsiantar, Pematangsiantar, Sumatera Utara, Indonesia, by PT Hutama Karya (Persero)

PT Hutama Karya is responsible for constructing the Trans Sumatera toll road, spanning 2800 km (1740 miles) across Sumatra Island in Indonesia. The Serbelawan to Pematangsiantar section is a 28 km (17 miles) expressway projected to shorten travel time by 50%. Located in a remote and dense forest, the project presented data acquisition challenges while working with numerous disciplines and software platforms. Having experience using various BIM platforms, they sought interoperable digital modeling technology to accommodate large files and improve project collaboration.

They selected ContextCapture to deliver an accurate reality mesh of the remote project area in 28 days, compared to the 120 days it would have taken using conventional survey methods. Using OpenRoads and OpenBridge streamlined data and workflows, shortening coordination and approval time by up to 34 days, while PLAXIS helped avoid potential critical failure due to soft soil conditions. Bentley's integrated digital solution resolved compatibility issues and clashes, provided data continuity, and optimized collaboration to save 2.18 million USD.

## Structural Engineering

### The Pavilion at Penn Medicine, Philadelphia, PA, USA, by HDR and the PennFIRST Team

The Pavilion at Penn Medicine is a 16-story, state-of-the art hospital with a subterranean parking garage and a 1.25 million ft$^2$ (116,000 m$^2$) high-rise building with four pedestrian sky bridges. HDR provided structural design services and faced engineering and coordination challenges when ensuring the structural integrity of the irregularly shaped building on a narrow, urban site. To design and analyze the complex steel and concrete connections and supports on a short timeline while accommodating a large project team, they needed integrated structural modeling software.

HDR selected RAM Structural System and RAM Elements to create an integrated project model to analyze and ensure load and geometry accuracy. This single-model approach optimized coordination, reduced errors, and minimized risks when designing a high-quality, economical structure, while also saving time and money. Using Bentley's applications, they completed the foundation and superstructure design in less than a year. The design is environmentally conscious and includes construction and operational plans that support the client's commitment to sustainability.

## Utilities and Communications

### Suixian and Guangshui 80 MW Ground-based Photovoltaic Power Project of Hubei Energy Group, Guangshui, Hubei, China, by PowerChina Hubei Electric Engineering Co., Ltd.

When PowerChina Hubei Electric Engineering was hired as the engineering, procurement, and construction contractor to deliver an 80-MW, ground-based photovoltaic power station, they faced several challenges, including a short 10-month schedule with a requirement to realize a life-cycle digital twin application.

**Trans Sumatera Toll Road Project Section Serbelawan-Pematangsiantar** *(image courtesy of PT Hutama Karya [Persero])*

**The Pavilion at Penn Medicine** *(image courtesy of HDR and the PennFIRST Team)*

PowerChina Hubei selected OpenBuildings Designer and OpenRoads for 3-D modeling, as well as ProjectWise for collaborative design management. With Bentley, they developed photovoltaic design software for mountainous photovoltaic power projects. The solution optimized the design scheme, reducing land occupation and avoiding 40 potential rework scenarios to save more than CNY 800,000. Integrating SYNCHRO 4D accelerated construction by approximately 30 days. They used the Bentley iTwin platform to automatically generate digital twin models, avoiding approximately CNY 1 million in costs had the digital twins been developed during the operation stage.

## Utilities and Industrial Asset Performance

### Asset Data Lifecycle Program, Fort McMurray, AB, Canada, by Suncor

Canadian energy company Suncor saw an opportunity to improve asset information management at its largest and most complex facility. To improve data reliability and integrity, they sought to shift from a document-centric approach to an asset-centric program, requiring a cloud-based technology solution to achieve their goal.

They selected AssetWise ALIM as the basis for their Asset Data Lifecycle Program, streamlining asset information management capabilities and providing data that is simpler, more reliable, and more accessible. Working in a cloud-based environment, they are decommissioning their on-site IT infrastructure, reducing related support costs. The technology solution has the potential to save approximately CAD 12.4 million over a 5-year period, and the enhanced data will help improve asset performance.

## Water and Wastewater Treatment Plants

### Khatan Group of Villages Water Supply Scheme (Surface Water Treatment), Khatan, Uttar Pradesh, India, by Larsen & Toubro (L&T) Construction

The government of Uttar Pradesh initiated a water supply project to provide safe drinking water to a rural population of over 14 million people across 388 villages. L&T Construction was retained to design and construct the 160 million L (42 million gal.) per day water treatment plant, facing challenges designing and analyzing 200 different structures and over 3500 km (2175 miles) of piping amid a strict 6-month timeline. They realized that traditional applications were time-consuming and error-prone, requiring an integrated digital modeling and analysis solution.

They selected Bentley applications for hydraulic modeling and structural analysis, automating design works for the pipeline network and retaining wall. Engineering of the entire project took 6 months, compared to 8 months using manual methods. They reduced resource hours for network analysis by 50% and the structural design of 121 overhead tanks by 45%. Working in a connected data environment streamlined and automated workflow processes to achieve a sustainable supply of high-quality water.

## Water, Wastewater, and Stormwater Networks

### Contingency Plan to Ensure Supply in the Event of Drought, Joinville, Santa Catarina, Brazil, by Companhia Águas de Joinville (CAJ)

The city of Joinville experienced its worst water crisis in 30 years. Responsible for supplying water and sanitation services to approximately 600,000 residents in the municipality, CAJ Water Company initiated a project to develop a contingency plan to maintain water supply during worsening drought conditions. They evaluated three alternatives in the preliminary study. However, their initial solution yielded insufficient flow transfer, water shortages at the weakest points in the supply system, and a reduction in water transport efficiency. As a result, they needed to implement a more comprehensive study of the municipality's entire network.

CAJ Water Company used OpenFlows WaterGEMS to create a digital twin of the distribution system, modeling 285 km (177 miles) of network. Using the hydraulic model to simulate a new contingency plan, they determined an optimal solution that guaranteed supply in the event of a severe drought, while saving approximately BRL 4.5 million compared to their original proposal.

Visit **https://yii.bentley.com/en/Winners** for more information.