



# POWERCHINA Huadong Develops Digital Twin Solution for Shaoxing Urban Rail Line 1

Bentley's Open Applications and iTwin Technology  
Digitalize Data and Workflows to Save CNY 12 Million

## DEVELOPING A REGIONAL TRANSPORTATION HUB

As a part of China's national strategy to implement smart urban rail construction, the city of Shaoxing is initiating railway works to modernize its transportation system, establishing itself as a metropolitan city and regional transportation hub in the Yangtze River Delta. The Shaoxing Urban Rail Transit Line 1 is one of the backbone lines in the city's network initiative that supports regional integration, connecting with Hangzhou and Metro 5 via the Hangzhou-Shaoxing Intercity Railway. It is the largest infrastructure project in the history of Shaoxing with a total length of 34.1 kilometers, featuring 24 stations, 25 sections, a depot, a car park, two main substations, and a control center. POWERCHINA Huadong Engineering Corporation (HDEC) was hired to digitally engineer the entire Line 1, including project management, overall consultation, survey, design, construction, and handover to operations and maintenance.

The CNY 24 billion railway is mainly underground, requiring the proposed design to pass through a confined sub-surface envelope. Complex hydrogeological conditions where soft soil is relatively thick also meant that there was the potential for leakage within foundation pits during construction. The scope of the work required integrating with existing infrastructure assets to meet the line's dual function of serving commuter passengers within the city and connecting with the city of Hangzhou along the Hangzhou-Shaoxing inter-city line. Because the railway passes through Shaoxing's old town—featuring narrow roads with large traffic flows, river courses, 26 bridges, two railways, and cultural and historical protection zones—planning and traffic organization proved difficult. These challenges were compounded

by issues with integrating the numerous technical interfaces used by the multiple design and construction disciplines, as well as the governmental departments in Shaoxing and Hangzhou.

## DIGITALIZING DATA AND WORKFLOWS

HDEC recognized that the project's high level of complexity amid the tight deadlines and coordination requirements required a more streamlined approach, compared to traditional IT consulting processes. To overcome these challenges and meet project deliverables, it was critical to consider ways to improve efficiency, productivity, and quality of design, construction, commissioning, plus handover of the rail line to operations. With more than 20 data sources and over 260 engineering risks, they needed to automate data collection and integrate workflows, which required advanced technology. "The construction of the rail and transit project in Shaoxing faces many challenges, which means advanced technological means must be adopted," commented Shi Chen, level 2 project manager at HDEC.

Driven by the new wave of technological revolution and industrial transformation within the industry, HDEC desired to implement intelligent design, construction, operations, and maintenance processes. They sought to maximize data potential and adopt advanced digital workflows by establishing an urban rail and transit engineering data center and unified construction management platform to digitalize all assets and processes throughout the project lifecycle. To achieve this goal, they needed open technology applications to generate a digital twin in a connected data environment.

## PROJECT SUMMARY

### ORGANIZATION

POWERCHINA Huadong Engineering Corporation Limited

### SOLUTION

Rail & Transit

### LOCATION

Shaoxing, Zhejiang, China

### PROJECT OBJECTIVES

- ◆ To develop a unified construction management platform.
- ◆ To establish a digital twin for full lifecycle digital railway management.

### PROJECT PLAYBOOK

Bentley Raceway and Cable Management, ContextCapture, iModel.js™, iTwin® Services, LumenRT, MicroStation®, OpenBuildings® Designer, OpenRoads™ Designer, OpenUtilities® Substation, ProjectWise®, ProStructures

### FAST FACTS

- ◆ Shaoxing Urban Rail Transit Line 1 is the largest infrastructure project in the history of the city.
- ◆ The CNY 24 billion project presented a confined sub-surface envelope with complex hydrogeological conditions, technical, coordination, and integration challenges.
- ◆ HDEC was tasked with digitally engineering the entire line from planning through to handover to operations and maintenance.

### ROI

- ◆ Based on Bentley's modeling applications, HDEC developed BIM technology that shortened the design cycle by 20% and saved CNY 12 million.
- ◆ Integrating survey, geology, and pipeline models with 3D design of the railway planning model saved over 800 hours of field survey time.
- ◆ Integrating multisourced data, HDEC established a construction management platform and digital twin that saved 5% in construction costs.

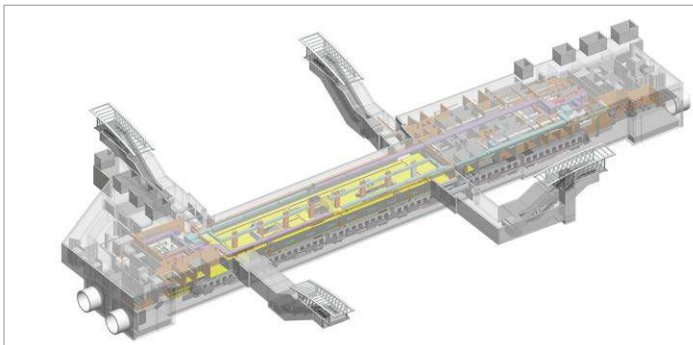
To improve the information and digital management for this project, we introduced Bentley's 3D platform and built an engineering data center throughout the full lifecycle of this project.

-Yexing Zhang, Executive General Manager, POWERCHINA Huadong Engineering Corporation Limited

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## FACILITATING SOLUTIONS WITH A DIGITAL TWIN

Leveraging Bentley's open, collaborative design applications and iTwin technology, HDEC digitalized data and workflows to establish a digital twin. They used aerial photography and ContextCapture to create a 3D reality grid enabling them to more realistically visualize the landscape conditions, architecture, and road network that comprise the city.



*Integrating Bentley's iTwin technology allowed HDEC's digital twin to consume static and dynamic data in the digital construction management system.*

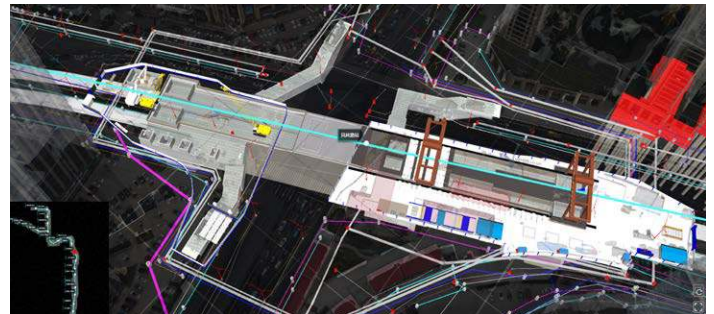
Based on Bentley's integrated survey, design, and construction modeling and analysis applications—including Descartes, MicroStation, OpenRoads Designer, and OpenBuildings Designer—they developed their own 3D geology software to create an integrated BIM model of the railway route. The technology solution provided valuable insight into the complex design and engineering of subway crossings, as well as for modeling existing subsurface pipelines. Where the railway line passes through or is adjacent to key buildings and structures, HDEC relied on iModels generated from the digital twin to integrate BIM models created by the numerous disciplines with various third-party applications.

With ProjectWise as the foundation, they built an engineering digital collaboration and construction management platform that included all project data and models, providing a unified collaborative environment to manage and coordinate more than 20 participating units. Integrating Bentley's iTwin technology allowed their digital twin to consume static and dynamic data in the digital construction management system. "We applied iModel and iTwin technology to establish a construction platform that integrated not only model information and measurement data, but also multisourced dynamic data, such as IoT," explained Yexing Zhang, executive general manager, Zhejiang Huadong Engineering Digital Technology, at HDEC. Working in a cloud-based environment using Bentley applications improved

information and digital management, including construction scheduling and quality, safety, and cost management throughout the project lifecycle.

## DRIVING SMART RAILWAY MANAGEMENT

Integrating reality and BIM technologies in a single unified platform facilitated urban spatial data collection and visual planning of the surroundings, saving 800 hours in field survey time and over CNY 3 million in resources. The comprehensive collaborative modeling solution allowed HDEC to complete exploration of the route, establish the location of the stations, and organize civil construction works amid the tight space in a way that minimized the impact on the citizens of Shaoxing. Adopting advanced digital workflows in an open connected data environment facilitated synergetic design, shortening the design cycle by 20% and saving CNY 12 million in design costs. By digitalizing design processes, HDEC has almost completely eliminated its traditional methods, resulting in design productivity across disciplines to increase by a factor of two, as well as design review efficiency to improve by a factor of four.



*The team used Bentley applications to develop their own 3D geology software to create a BIM model of the route.*

Combining BIM data with automated monitoring and iTwin technology, HDEC's digital twin allowed them to analyze construction in real-time, resolving more than 100 potential issues that could have negatively impacted the construction schedule and the cultural heritage of the city, all while reducing construction costs by 5%. HDEC was able to automate data processing and integration. By leveraging cloud computing, artificial intelligence, the Internet of Things (IoT), and virtual reality in a connected data environment, HDEC has realized the full value and potential of its data to support improved decision-making. Through seamless integration and transfer of digital assets, they have laid the foundation for use of the digital twin throughout operations and maintenance, driving smart subway management. "The engineering digital solutions and successful experiences of this project can be replicated and applied to rail and transit construction in other lines and even other cities," stated Zhang.

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