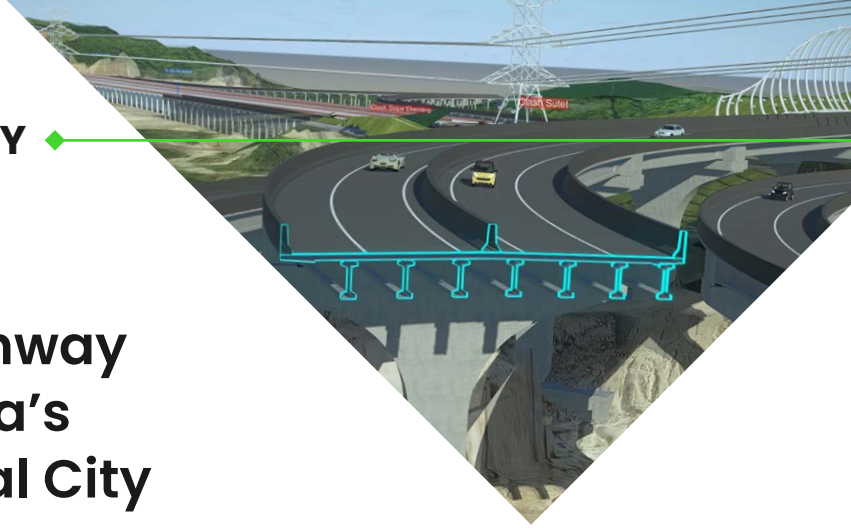
Bentley
Advancing Infrastructure

CASE STUDY



Wijaya Karya Develops Nusantara Road and Highway Connectivity for Indonesia's New Purpose-built Capital City

Leveraging Bentley's Digital Twins Applications Saved over Half a Million Work Hours, Reducing Carbon Emissions by 51,000 Tons

A MODERN CONNECTIVITY MARVEL

As part of Indonesia's strategic plan to improve governance and achieve its 2045 vision of becoming a developed country, Nusantara will become the archipelago's new green capital city. Promoting economic transformation, tourism, smart sustainable transport, and renewable energy, the city's success is largely dependent upon road and highway connectivity. To meet connectivity demands, PT Wijaya Karya (WIKA) has been tasked with delivering several sections of the new highway network. Having already completed their portion of the first phase of the toll road from Balikpapan to Samarindra, WIKA's team is now working to deliver the final 57-kilometer roadway section. Upon completion, the new transport infrastructure will reduce travel times from Balikpapan City to Nusantara's Central Government Core Area (KIPP) from two hours to 30 minutes.

In addition to delivering the toll road, featuring three long-span bridges, two helipads, two toll gates, and a seven-kilometer pile slab, WIKA is also building the East National Axis Road (Axis Road) located at the end of the toll road in the KIPP. The Axis Road includes two bridges and a multi-utility tunnel that will connect the presidential complex to the Mangrove Forest Ecological Park through open, landscaped spaces. It will provide service for integrated public transport, emission-free electric vehicles, and pedestrians anywhere within 10 minutes.

Together, all these connectivity initiatives comprise the IDR 4.5 trillion smart transport infrastructure project that will serve as Nusantara's main access point, integrating the Indonesian community and transforming it into a strategic, innovative, and resilient global economic hub. "This connectivity emerges as a modern marvel with revolutionary features, encompassing everything from continuous charging lanes to the autonomous rail transit," said Rizky Yusuf Ramadhan, BIM infrastructure coordinator at WIKA. To facilitate the safe passage of animals roaming the area, the modernized transport network also has a wildlife corridor.

CHALLENGING TOPOGRAPHY AND MULTIDISCIPLINE COORDINATION

Despite the favorable location of Nusantara in the center of the Indonesian archipelago amid lush rainforest surroundings, the topography and geology consists of hilly terrain with soft soil and clay. "Currently as global warming intensifies heavy rain, this generates risks in slope landslide for soft soil properties," explained Ramadhan. Compounding these site challenges is the existing infrastructure that must be circumvented when designing and constructing the toll road. There are 10 critical transmission towers that had to be avoided along the corridor. At the same time, WIKA needed to orchestrate 33 work packages for the Axis Road and coordinate multiple disciplines and stakeholders.

At the beginning of the Nusantara development, the project teams used software that proved insufficient and misaligned with achieving Nusantara's smart, eco-friendly vision. Given the dynamic nature of the transport design and construction works, WIKA recognized the need for a collaborative, digital, model-based approach. "We realized that we need [an] open BIM and digital twin solution to overcome the significant challenges and gain advantage," said Ramadhan. They wanted to utilize integrated civil engineering applications and establish a connected modeling environment and digital twin to digitalize delivery of the toll road network.

PROJECT SUMMARY

ORGANIZATION

PT Wijaya Karya (Persero) Tbk

SOLUTION

Roads and Highways

LOCATION

Balikpapan, East Kalimantan, Indonesia

PROJECT OBJECTIVES

- To deliver a 57-kilometer Nusantara Toll Road serving as the main connectivity point for Indonesia's new eco-friendly capital city of Nusantara.
- To leverage AI and digital twins to support sustainable city development initiatives.

PROJECT PLAYBOOK

Bentley LumenRT™, iTwin® Capture, iTwin IoT, MicroStation®, OpenBridge®, OpenRoads™, OpenTunnel®, PLAXIS®, ProjectWise®, SYNCHRO™

FAST FACTS

- Indonesia's new purpose-built Nusantara capital city promotes economic transformation, tourism, smart sustainable transport, and renewable energy for the nation.
- WIKA was tasked with constructing a Section 3B within Nusantara Toll Road to support highway connectivity, critical to the success of Nusantara.
- Upon completion, the new Nusantara toll road network will reduce travel times from two hours to 30 minutes.

ROI

- iTwin Capture increased processing speed of 500 hectares of aerial survey data by 100%.
- Using Bentley's open digital technology shortened the schedule by 25% and saved over 8% of work hours.
- The digital twin solution reduced design errors by 80% and CO2 emissions by 51,000 tons.
- Working in Bentley's connected digital ecosystem improved data exchange processes by 80%.

"Bentley's digital delivery approach helps us to achieve the commissioning target by June 2024, shortening the schedule by 25% faster than planned."

– Rizky Yusuf Ramadhan, BIM Infrastructure Coordinator, PT Wijaya Karya (Persero) Tbk

DEVELOPING AN OPEN, INTEGRATED DIGITAL DELIVERY SOLUTION

"WIKA chose Bentley's open solution and its interoperable capabilities, as well as iTwin technology, to develop a digital delivery system," explained Ramadhan. They initiated a collaborative design and construction management strategy, as well as established a connected digital ecosystem and digital twin based on Bentley Infrastructure Cloud—which includes ProjectWise and SYNCHRO—along with iTwin, OpenRoads, OpenBridge, PLAXIS, and OpenTunnel. Working in a cloud-based, connected digital platform supported transparent coordination among all participants and stakeholders throughout the lifecycle of the project.

WIKA was tasked with constructing a Section 3B within Nusantara Toll Road to support highway connectivity, critical to the success of Nusantara.

Using iTwin Capture Modeler, WIKA processed 500 hectares of aerial survey data to create a reality mesh of the existing project area, then used OpenRoads to design the roadway and OpenBridge to manage the massive structural data. With Bentley's iTwin applications, they performed model reviews, developed digital project dashboards and a digital twin, and visually monitored project progress and performance in real-time via sensor data uploaded to iTwin IoT. Leveraging AI and the digital twin, WIKA was also able to monitor the diversity of ecosystems along the corridor to support biodiversity conservation goals. By equipping site engineers with iPads and mobile devices, the on-site crews had visual insight and a better understanding of the design intent prior to beginning construction works. "This work culture will push the project forward, developing new technology and adding new dimensions of BIM and digital twin development across the entire lifecycle," said Ramadhan.

DIGITALIZATION SETS BENCHMARK FOR SUSTAINABLE CITY DEVELOPMENT

Bentley technology enabled WIKA to create alternative engineering solutions to mitigate risk during design review and increase contractual cost through value engineering that improved the commercial impact of the project by 12%. By using iTwin Capture, the team increased the speed, accuracy, and consistency of data processing by 100%, while Bentley's civil applications helped accelerate design iteration by 35% and increase the structural safety factor by 0.231, fulfilling residual safety requirements. OpenRoads helped reroute the alignment to avoid the transmission towers and facilitated aquaplaning assessment to ensure safe and comfortable travel in all road conditions. Working in a collaborative digital environment accelerated workflows by 50% compared to previous methods and facilitated clash detection to reduce design errors by 80%. "With the use of Bentley software, we saved a total of 667,708 or 8.2% work hours," said Ramadhan.

iTwin Capture increased processing speed of 500 hectares of aerial survey data by 100%.

Using Bentley's open BIM and digital twin technology, WIKA created their first standard operating procedure for digital delivery of infrastructure, supporting a sustainable, eco-friendly transport network and a smart, green city. "Based on the iTwin embodied carbon calculation, we saved 51,000 tons of CO_2 emissions, equal to USD 1.6 million in social costs of carbon," stated Ramadhan. WIKA is now developing a structural health monitoring system integrated with Bentley's iTwin IoT software that will be installed across all Nusantara critical infrastructure. The success of Nusantara's highway and connectivity initiatives form a new chapter in technological advancement and sustainability towards Indonesia's Golden Vision 2045. "This Nusantara Toll Road will be a benchmark of digital delivery for next connectivity; Indonesia's first immersed tunnel is in [the] research phase, estimated at IDR 10 trillion [and] 1.5 kilometers long," concluded Ramadhan.