Bentley®
Advancing Infrastructure

CASE STUDY ◆

Citic Heavy Industries Uses Collaborative BIM Technology to Deliver Green, Smart Cement Factory

iTwin® Services Digitalizes Asset Monitoring and Operations Management, Saving USD 2 Million in Equipment Maintenance Costs

TRANSFORMING BUILDING MATERIALS MANUFACTURING

In an effort to promote the transformation of China's building materials manufacturing industry, Fujian Jianfu Cement initiated construction of a first-class, green, smart cement factory with a daily production capacity of 4,500 tons. The USD 135.96 million project required design and layout of the entire equipment system, as well as integrating various process parameters and data related to equipment operations to achieve intelligent plant management.

As one of the world's leading enterprises in the cement industry, Citic Heavy Industries was contracted to provide overall engineering design, procurement, construction, and delivery of the factory. The large-scale, full-process cement manufacturing project included working with multiple engineering disciplines, which presented coordination and technical challenges. They soon learned that conventional design and construction methods would not accommodate the delivery of the smart, energy-efficient factory.

PUSHING THE BOUNDARIES OF CONVENTIONAL DESIGN

To achieve a breakthrough in delivering a green, energy-efficient cement plant, Citic had to consider several factors all at once, including equipment design, construction management, factory operations, and monitoring processes. They sought to push the boundaries of traditional design methodologies to achieve process automation by design, leveraging visualization and digitalization technologies to bring intelligence to large-scaled equipment. They wanted to build a digital plant, synchronizing design, construction, delivery, and operations with the physical plant through 3D parametric equipment design and digital twin technology.

"We needed to deliver a parametric equipment design system, green cement factory system, and an intelligent cement plant system," explained Ruan Jian, BIM director of the innovation institute at Citic. To achieve their deliverables, they required a cloud-based, collaborative platform and integrated BIM applications to coordinate multidiscipline design, generate the equipment models, and incorporate artificial intelligence and the Internet of Things, maximizing data potential for lifecycle operations.

LEVERAGING 3D BIM AND DIGITAL TWIN TECHNOLOGY

Citic used Bentley's collaborative BIM technology to integrate 3D parametric design of the main equipment, perform construction simulation, and generate a full-process, green cement production plant with intelligent controls. "We used Bentley software for the whole collaborative design and construction processes for intelligent delivery of the project," commented Jian. They selected OpenBuildings and OpenPlant for process design, civil engineering, and equipment modeling.

Citic also developed a 3D parametric equipment design system to meet rapid design needs and accommodate the different design specifications. Using ProjectWise as the collaborative engineering platform, they created a 3D digital design and construction management system. The system enabled them to visualize and synchronize design modeling and construction, streamlining workflows to avoid design collisions. They were able to almost completely eliminate on-site construction errors and associated costs, as well as reduce material wastes to protect the environment.

Leveraging Bentley's BIM applications in a connected data environment with iTwin Services, Citic established a digital twin to visually manage equipment and integrate process data related to equipment

PROJECT SUMMARY

ORGANIZATION
Citic Heavy Industries Co., Ltd.

SOLUTION
Manufacturing

LOCATION
Yongan, Fujian, China

PROJECT OBJECTIVES
- ◆ To develop a connected data environment for streamlined design, construction, and operations.

- ◆ To generate a digital twin to achieve intelligent manufacturing production and transform the building materials industry.

PROJECT PLAYBOOK
Bentley Raceway and Cable Management, OpenBuildings® Designer, OpenPlant®, ProjectWise®, ProStructures

FAST FACTS
- ◆ Citic was tasked with delivering a smart, green cement factory, helping transform China's building materials industry.

- ◆ The project included coordinating multiple engineering disciplines and digitalizing previously manual equipment processes.

- ◆ Citic initiated collaborative BIM methodologies to establish a connected data environment and generate a digital twin for intelligent factory operations and management.

ROI
- ◆ Using Bentley applications, Citic performed collaborative 3D modeling and created a digital construction management system, reducing construction time by 7%.

- ◆ Establishing a digital twin with iTwin Services enabled predictive and preventive equipment maintenance, reducing operations and maintenance costs by over 30%.

- ◆ The intelligent, green cement factory significantly is expected to save USD 1.24 million annually and significantly reduce overall energy consumption.

operations. This process facilitated online, intelligent equipment monitoring and diagnostic services, establishing a preventive maintenance system that enhanced operational safety and improved equipment reliability. Through Bentley's integrated, cloud-based applications, Citic produced accurate 3D models of the entire main equipment and can now digitally monitor plant equipment and processes, achieving whole lifecycle BIM management from design through delivery and operations.


Using Bentley applications, Citic created a digital construction management system, reducing construction time by 7%.

DIGITALIZATION YIELDS INTELLIGENT DELIVERY

With Bentley's open BIM applications, Citic achieved a breakthrough from traditional 2D design methods to 3D parametric design and 4D construction monitoring, industrializing the delivery of Fujian Ansha's latest energy-efficient cement factory. Establishing digital collaborative engineering workflows streamlined multidiscipline design, enhancing modeling accuracy and enabling early collision detection that reduced design changes by 80% and design time by one month. Specifically, the collision conflicts among civil engineering and electrical installation during construction were reduced to zero. By creating a digital construction and management platform within a connected data environment, they automated previous manual processes that improved work efficiency, saving three months in construction time and USD 3 million in project costs. Furthermore, the accurate 3D equipment design models reduced equipment costs by 1.5% and enabled pre-installation of equipment prior to factory shipping, shortening on-site assembly time by one third.

Integrating iTwin Services to generate a digital twin, Citic linked the 3D equipment model with intelligent digital data processes, enabling visual monitoring of the cement production process to save over 30% in operations and maintenance costs. By digitalizing equipment management processes, they were able to predict equipment failure and quickly provide operations and maintenance solutions. Via an online management system for spare parts, Citic could rapidly supply necessary equipment components to clients for the first time, avoiding losses caused by factory maintenance or shutdowns. Using the digital twin, they implemented a preventive asset maintenance system that reduced equipment maintenance costs by USD 2 million, compared to a planned, reactive asset management process.
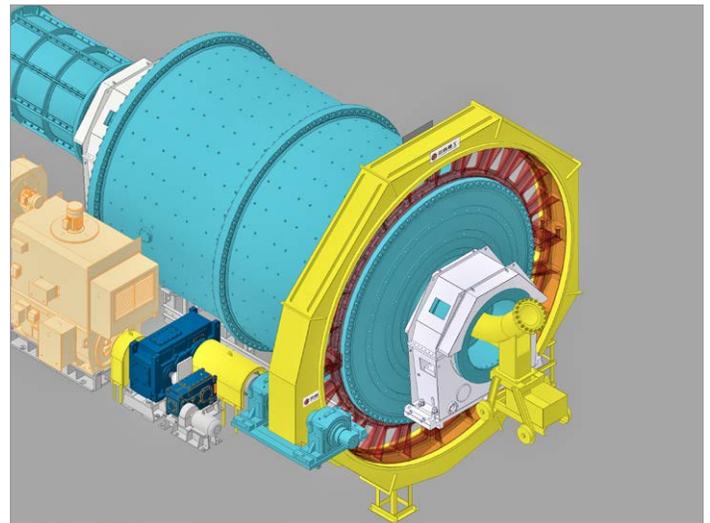
Establishing a digital twin with iTwin Services enabled predictive and preventive equipment maintenance, reducing operations and maintenance costs by over 30%.

Citic expects the digital intelligent, green factory manufacturing processes to reduce annual electricity consumption by 3.5 million kilowatts, saving significant energy consumption costs. Overall, these processes are expected to save Fujian Ansha USD 1.24 million annually. "The 3D parametric equipment design has made a breakthrough in the design automation of equipment, while the digitalization has added an intelligent brain to large-scaled mining equipment," said Jiang Huimin, associate dean at Citic.