Bentley
Advancing Infrastructure

CASE STUDY

CNOOC Pilots 3D Reality Modeling to Improve China's Offshore Oil Operations

Bentley's Integrated Technology Creates a Reality Mesh of an FPSO Platform, Saving CNY 1 Million

TRANSFORMING OFFSHORE OIL OPERATIONS

China National Offshore Oil Corporation is moving to digitalize their offshore operations to lower costs and improve efficiencies of the 200 oil rigs and 18 floating production storage and offloading (FPSO) platforms located in the offshore area of China. Aligned with that initiative, the professionally affiliated CNOOC Energy Development Design and R&D Center (CNOOC) raised demands for digital twin management of key infrastructure and processes. Providing engineering design, consultation, and data services for offshore oil systems, they saw the need to optimize oil field system services and maintenance, as well as transform design and operation of production facilities through digital management of big data for China's offshore facilities.

To remove bottlenecks confronting China's shipbuilding and offshore mining industries, CNOOC piloted a project for one of the FPSO facilities in the South China Sea to create a reality mesh and generate a digital twin that integrates indoor and outdoor data to demonstrate the feasibility of remote digital management. The CNY 30 million project included modeling eight modules, 39 cabins, over 200 pieces of equipment, and 600 pipelines. The team sought to establish an integrated indoor/outdoor 3D reality model to create a digital intelligent data management system, transforming China's offshore oil operations. "[The project] will greatly improve the operating efficiency of various platforms in the offshore oil system, enhance safety, reduce the [amount] of personnel working offshore, and complete the digital simulation monitoring of the entire [offshore oil] lifecycle," said Baoshan Shi, senior engineer at CNOOC.

EXPLORING 3D REALITY MODELING

Located in the deep sea, the large-scale offshore FPSO project presented environmental challenges collecting data to develop an accurate 3D model and establish an intelligent information management system, compounded by office and field integration issues. Routine departures from land to sea to perform surveys and collect asset information were difficult, and once out there, surveyors were often confronted with strong magnetic and oceanic interference with the data collection equipment. To address these conditions, the team had to rely on a variety of means to collect data, ranging from optics and lasers to thermal infrared devices. "In this case the project team needs to rely on a variety of collection means to collect multiple batch results and perform multisource fusion post processing," said Shi.

However, when creating an accessible, intelligent data information system and high-precision 3D reality mesh, the team found it difficult to integrate and display the multisource data. The team explored numerous traditional engineering applications and third-party reality modeling software, but they proved ineffective. They needed to process video, aerial images, and point cloud data into a visual 3D model, and develop a web-based GIS information management system to be used for remote lifecycle offshore platform operations. To achieve their digital goals, they realized that the demand for comprehensive, interoperable 3D and reality modeling technology.

LEVERAGING BENTLEY'S OPEN APPLICATIONS

CNOOC selected ContextCapture to process the multisource data into an accurate 3D reality model of the existing conditions and FPSO infrastructure. They used Descartes to refine the captured real-scene data and Pointools to manage and incorporate 653 gigabytes of point cloud data.

PROJECT SUMMARY

ORGANIZATION

CNOOC Energy Development Design and R&D Center

SOLUTION

Mining and Offshore Engineering

LOCATION

South China Sea, Guangdong, China

PROJECT OBJECTIVES

- To create a 3D reality mesh of an FPSO platform in the South China Sea.
- To establish a digital twin automating control of offshore oil platform operations.

PROJECT PLAYBOOK

ContextCapture, ContextCapture Insights, Descartes, OpenCities® Planner, OpenPlant®, Pointools

FAST FACTS

- CNOOC piloted a project to establish a 3D reality mesh and digital twin for an FPSO platform in the South China Sea that integrates indoor and outdoor data.
- The project required integrated survey and reality modeling technology to process multisource data.
- Using OpenPlant and OpenCities Planner, CNOOC developed a web-based GIS platform for intelligent data management.

ROI

- Leveraging Bentley's 3D and reality modeling applications enabled CNOOC to complete the reality mesh within 150 days.
- CNOOC plan to connect the model to the Bentley iTwin platform to establish a digital twin, automating control of the offshore oil platform.
- The project promotes the use of digital twin technology, setting a benchmark for intelligent industry operations.

"Bentley's ContextCapture software enabled the rapid processing and fusion of multisource data, making reality modeling of indoor and outdoor integration for high-density assets and related facilities possible."

– Baoshan Shi, Senior Engineer, CNOOC Energy Development Design and R&D Center

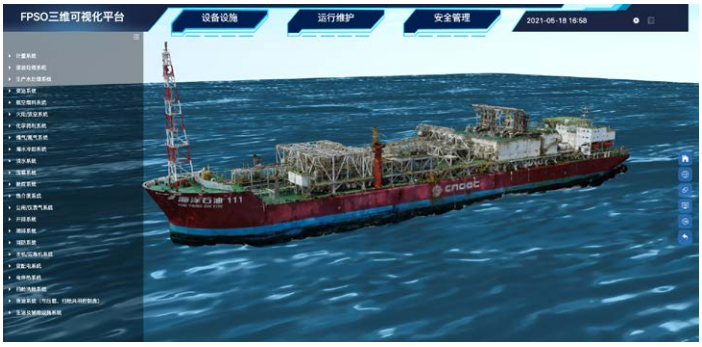
Bentley's collaborative digital solution provided a breakthrough integrating multiple core data sources, including 325 videos, 7,498 images, and 844 point clouds to generate an accurate 3D reality mesh. "[Bentley's] reality modeling software can effectively organize different types of source data for the establishment of reality models," said Shi. Integrating OpenPlant for 3D structural modeling, they superimposed the engineering model with the reality model to determine risk areas and operation and maintenance conditions, ensuring facility safety.

CNOOC relied on Bentley's open 3D and reality modeling applications to generate a 3D reality mesh and digital twin of an FPSO oil platform in the South China Sea.

To develop the web-based GIS platform, they relied on OpenCities Planner, establishing a unified engineering environment and standard database for intelligent information management. The integrated digital solution broke the barriers of visual communication at the data level, facilitating collaboration among the different disciplines and between the field and office, based on secure reliable data. Leveraging Bentley's open applications, CNOOC combined digital twin technology with offshore oil platforms for the implementation of smart lifecycle FPSO management and operations. By establishing a digital representation of their assets, processes, and systems, they have gained a better understanding of their facility and its performance. "Relying on the integrated information intelligent management system developed by our company, we can achieve 'what you see is what you get' for the FPSO," said Shi.

DIGITALIZATION SETS A BENCHMARK FOR INTELLIGENT INDUSTRY PROCESSES

Using Bentley's reality modeling and open 3D modeling applications, CNOOC generated the reality mesh of the facility within 150 days, compared to years if using conventional methods, saving tens of millions of yuan. "This project uses Bentley's reality modeling technology to directly reduce the period of reality modeling from years to months," said Shi. Given the high-shipping costs at sea, the use of 3D modeling technology and digital inspection methods greatly reduce the frequency of personnel going to sea to perform periodic assessments and monitoring of operation and maintenance of offshore oil assets. By digitalizing previous manual processes and relying on the 3D reality mesh, they greatly reduced the number of survey and assessment trips out to sea, reducing transportation costs by CNY 1 million in the short term, expected to reach CNY 10 million long term.



Bentley's integrated digital solution is expected to save up to CNY 10 million in long-term transportation costs.

Bentley's integrated digital solution enabled CNOOC to collect and combine multisource data, creating an accurate 3D mesh of the FPSO platform. The technology facilitates digital workflows, providing the foundation for automated control of the entire offshore platform. The model establishes a solid foundation in industrialization and virtual and mixed reality, effectively promoting the integration and innovation of digital twin technology. CNOOC plans to connect the model to the Bentley iTwin platform and establish an intelligent digital twin to remotely control operations and maintenance of the offshore oil platform, setting a benchmark for smart industry processes. "The next step is to utilize machine learning and AI [or] intelligent algorithms to smoothly connect to the Bentley iTwin platform and provide more reliable services for subsequent engineering companies, operators, oil extraction service providers, and owners," said Shi.