Transforming Waste Management: 4D Simulation and Reality Capture Transform WKTS Upgrade

COMPANY
Environmental Protection Department, the Government of the Hong Kong Special Administrative Region
AECOM Asia Company Limited
China Harbour Engineering Company Limited

PROJECT
West Kowloon Transfer Station (WKTS) Second Follow-On Contract

LOCATION
West Kowlonn Reclamation Area, Kowloon District, HK

TYPE
Infrastructure

SCHEDULED TIME OF COMPLETION
2033

"It is a humbling honor to receive the 2025 Autodesk Hong Kong BIM Award for the West Kowloon Transfer Station project. This recognition reflects the diligent use of 4D simulation and Operational Reality Capture through BIM, with invaluable support from the Supervising Officer and Client, AECOM and EPD. Deep gratitude goes to the committed team and collaborators for overcoming challenges. Looking forward, there is quiet hope to continue advancing BIM innovation for the benefit of future projects."

–Kenny YU
Project Manager,
China Harbour Engineering Company Limited

BIM PARTNERS
AtkinsRealis Asia Limited
SMEC Asia Limited Hong Kong

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Autodesk Construction Cloud®
Autodesk® Navisworks® Manage
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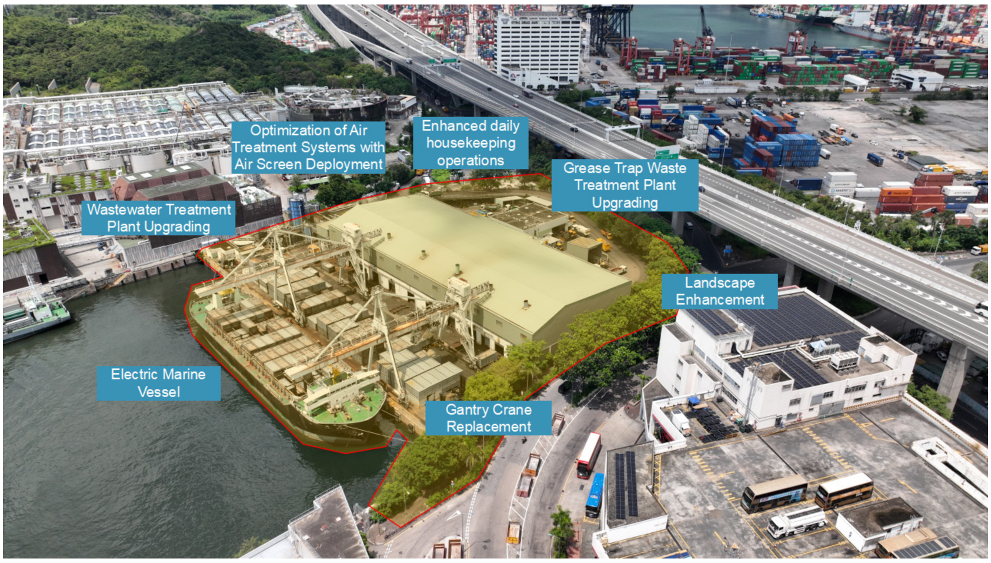


Scope of WKTS Second Follow-on Contract
Image Courtesy of Environmental Protection Department, the Government of the Hong Kong Special Administrative Region & AECOM Asia Company Limited & China Harbour Engineering Company Limited

BIM Development of the Project

The adoption of Building Information Modeling within the West Kowloon Transfer Station (WKTS) Second Follow-On Contract marks a significant evolution tailored to the project's unique demands. Initiated alongside the project's start in August 2023, BIM implementation was prompted by the need to address a 30-year-old facility's upgrade while maintaining daily operations. The process began with assessing the site's incomplete as-built data from 1997, leading to the introduction of Operational Reality Capture to establish accurate baseline models. This technology, distinct from standard 3D scanning, involved capturing real-time site conditions, which proved essential given the station's complex waste processing systems and unrecorded modifications. To further enhance this, training was provided to the operation team, enabling them to contribute directly to the capture process and ensure the models reflected practical on-site needs. This collaborative element helped bridge gaps between design intentions and operational realities, fostering a more integrated approach from the outset.

BIM development progressed through distinct phases of the building lifecycle. During the design stage, 3D modeling in Revit laid the foundation for planning upgrades to the wastewater treatment plant (WWTP), grease trap waste treatment plant (GTWTP), gantry crane replacement, and other components across the site. The construction phase saw the integration of 4D simulation using Navisworks to schedule critical tasks, such as the crane replacement, under strict operational constraints. By the operation stage, 6D asset handover via COBie ensured long-term facility management, supporting the transition to a higher daily capacity from the original level. Collaboration among multidisciplinary stakeholders, spanning civil, structural, architectural, MEP, and processing teams, was facilitated through a Common Data Environment (CDE) hosted on Autodesk Construction Cloud (ACC), with coordination meetings held to align efforts. This phased approach, driven by the project's Phase 1 deadline and budget, quietly transformed a challenging upgrade into a model of efficiency.

The Value of BIM to the Project

BIM brought substantial value to the WKTS project, addressing its operational, financial, and innovative needs. In terms of return on investment (ROI), the technology appears to have reduced design errors through early clear detection, potentially saving costs in construction. This efficiency stemmed from the ability to identify and resolve conflicts, such as those between structural and MEP elements, before on-site work began, minimizing rework. The project duration also benefited, with 4D simulation seemingly shortening critical phases like the gantry crane replacement by optimizing schedules around tidal conditions and barge timing.

Innovation stands out as a key value, with BIM introducing novel workflows. Operational Reality Capture provided a reliable method to verify as-built conditions, reducing reliance on outdated records and enhancing design accuracy. The 4D simulation offered a dynamic view of the crane replacement process, ensuring minimal disruption to the station's daily waste handling capacity during upgrades. Additionally, micro-facility replication allowed physical models to be tested for feasibility, quietly setting a precedent for DBO projects in Hong Kong. These advancements not only met the project's goal of maintaining operations but also elevated the standard for future infrastructure upgrades, demonstrating BIM's potential to balance functionality with sustainability.

The BIM Project Management

The success of the WKTS project can be attributed to its meticulous BIM management strategy, thoughtfully designed to meet the project's foundational needs. The primary goal was to sustain daily operations while adhering to the Phase 1 deadline, a critical imperative given the station's round-the-clock waste processing obligations and the complexities inherent in a legacy facility with incomplete historical data. A secondary objective was to enhance long-term efficiency, ensuring the upgrade process established a durable framework for future operational management. These aims were driven by the necessity to navigate the dual challenges of maintaining service continuity and overcoming the limitations of outdated documentation.

The BIM process followed a structured and adaptive workflow, commencing with Operational Reality Capture to establish accurate site conditions, followed by 3D modeling in Revit for detailed design, 4D scheduling in Navisworks for construction planning, and 6D asset management via COBie for operational preparedness. The process began with comprehensive site scans to document the existing state, particularly focusing on areas like the GTWTP and jetty area. Coordination was supported by regular meetings, where multidisciplinary teams, covering civil, structural, architectural, MEP, and processing roles, aligned efforts through the Common Data Environment (CDE) on Autodesk Construction Cloud (ACC). This platform served as a hub for sharing models, tracking changes, and resolving discrepancies in real time. Change management was facilitated through iterative model updates, allowing adjustments to design plans as new site data emerged, while risk management addressed uncertainties like weather variability, tidal influences, and stakeholder differences through simulated scenarios and collaborative reviews. This framework ensured the process remained flexible, adapting to the project's evolving demands across its lifecycle.

Performance evaluation relied on Level of Development (LOD) progression from 300 to 500, tracking the increasing detail and reliability of models from conceptual design to operational handover. Clash detection within Navisworks acted as a critical metric, identifying and resolving conflicts, such as spatial overlaps between new and existing systems, during coordination sessions. The approach effectively addressed major hurdles, including aligning upgrades with live operations and compensating for outdated records through enhanced data capture. However, challenges like unpredictable weather impacts on crane replacement timing suggest potential for refinement. Further enhancements could involve integrating more sophisticated weather modeling into 4D simulations, offering a pathway for improved scheduling precision and risk mitigation in future phases.

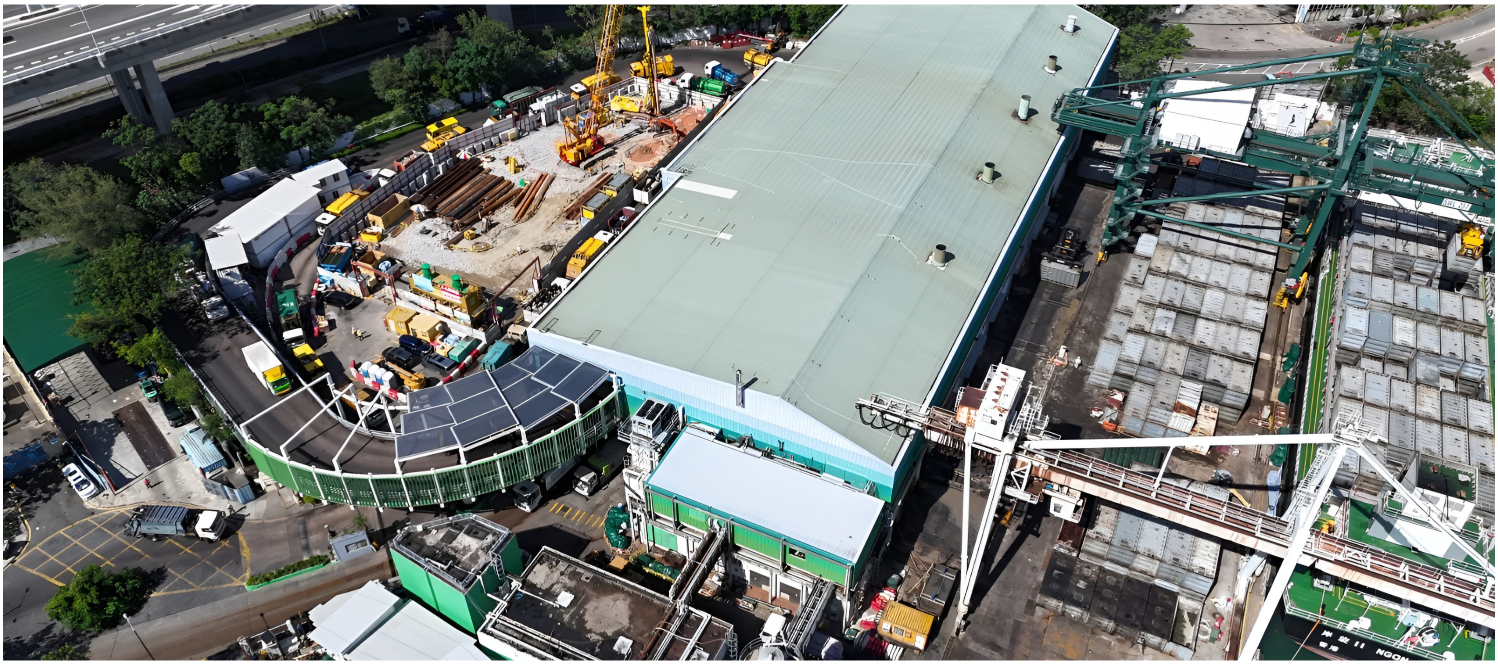
Enhancing Current Practices with BIM Technology

Traditionally, the project depended on 2D drawings and manual site inspections, which frequently resulted in delays and discrepancies due to the station's outdated records and unrecorded changes accumulated over decades. This traditional method struggled to adapt to the live operational environment, often leading to misalignment between design intentions and site conditions. For instance, during the GTWTP upgrade, manual checks failed to capture hidden piping modifications, while the crane replacement faced uncertainties due to uncharted structural supports, making planning labor-intensive and prone to errors.

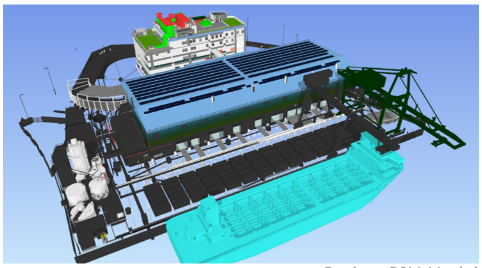
The introduction of BIM technology ushered in transformative practices that redefined this process. 3D scanning via Operational Reality Capture delivered precise as-built data, aligning designs with current site realities from the planning stage by mapping every detail, from equipment layouts to underground utilities. Real-time collaboration through the CDE enabled multidisciplinary teams to address issues swiftly, fostering a shared understanding across civil, structural, and MEP disciplines. 4D simulations provided dynamic scheduling to reduce operational disruptions, offering a virtual timeline that adjusted to tidal cycles and work-hour restrictions. For example, virtual walkthroughs of the GTWTP upgrade uncovered integration challenges, such as ductwork conflicts, early, enabling pre-construction adjustments that smoothed the workflow. This evolution enhanced reliability and efficiency, establishing a contemporary benchmark for upgrading legacy infrastructure under active use, and demonstrated how BIM could turn historical limitations into opportunities for precision.

Innovative/ Intelligent Workflow

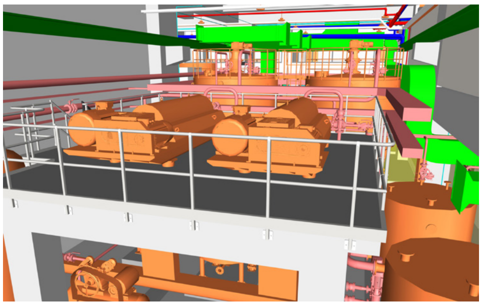
The project offers valuable insights for the industry through its innovative workflows, providing a model for tackling complex upgrades. The combined application of Operational Reality Capture, 4D simulation, and micro-facility replication delivered a robust solution for the gantry crane replacement, effectively managing constraints like barge scheduling, tidal conditions, and night-time work windows. Operational Reality Capture mapped the site's existing crane foundation and surrounding infrastructure, ensuring the new design fit seamlessly. 4D simulation sequenced the removal and installation process, visualizing barge movements and crane lifts to avoid daytime operations, while micro-facility replication tested the new crane's base assembly in a controlled setting, validating structural integrity before on-site work. This method minimized disruption to the station's waste handling capacity and holds potential to guide other infrastructure projects, especially those requiring operational continuity during construction. The understated success of these techniques highlights their relevance to Hong Kong's evolving DBO landscape, encouraging broader BIM adoption for smart, sustainable development. By sharing this approach, the project contributes to a growing knowledge base, suggesting how tailored BIM strategies can address the unique demands of live operational environments.



Overview of WKTS
Image Courtesy of Environmental Protection Department, the Government of the Hong Kong Special Administrative Region & AECOM Asia Company Limited & China Harbour Engineering Company Limited

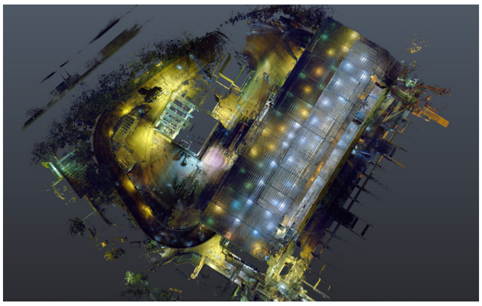


Project BIM Model
Image Courtesy of Environmental Protection Department, the Government of the Hong Kong Special Administrative Region & AECOM Asia Company Limited & China Harbour Engineering Company Limited



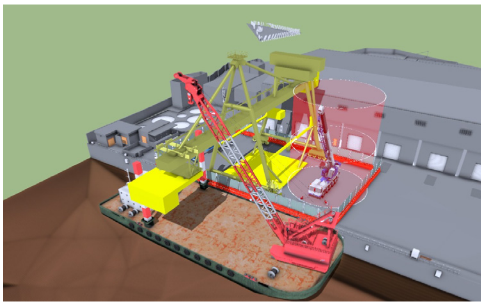
Clash Analysis
Image Courtesy of Environmental Protection Department, the Government of the Hong Kong Special Administrative Region & AECOM Asia Company Limited & China Harbour Engineering Company Limited

Panoramic image capturing for gantry crane dismantling and installation
Image Courtesy of Environmental Protection Department, the Government of the Hong Kong Special Administrative Region & AECOM Asia Company Limited & China Harbour Engineering Company Limited



3D Scanning by UAV and laser scanner
Image Courtesy of Environmental Protection Department, the Government of the Hong Kong Special Administrative Region & AECOM Asia Company Limited & China Harbour Engineering Company Limited

Drone shot used for progress tracking
Image Courtesy of Environmental Protection Department, the Government of the Hong Kong Special Administrative Region & AECOM Asia Company Limited & China Harbour Engineering Company Limited



4D Simulation for removal of gantry crane
Image Courtesy of Environmental Protection Department, the Government of the Hong Kong Special Administrative Region & AECOM Asia Company Limited & China Harbour Engineering Company Limited