



Reducing Duration of Tender Process by 50% through inclusion of BIM as part of the Contract Documents

PUB'S EXPERIENCE WITH BIM HANDOVER IN TUAS WATER RECLAMATION PLANT

EXECUTIVE SUMMARY

As part of Singapore's Deep Tunnel Sewerage System (DTSS) Phase 2 project, PUB, Singapore's National Water Agency, has embarked on the construction of the Tuas Water Reclamation Plant (WRP).

Positioned as a world-class mega infrastructure project, ambitious Integrated Digital Delivery (IDD) targets spanning across the project's lifecycle were established from the outset. This included the planning, design, construction, project management and asset management stages (see Annex A for project information).

To achieve the targets, PUB undertook many transformative initiatives. One of which involved transitioning from traditional 2D drawings to including BIM as an integral part of the contract documents. This was done to ensure that coordinated BIM models were used as the definitive Single Source of Truth (SSoT) throughout the project delivery cycle.

Project

Tuas Water Reclamation Plant

Location

71A Tuas Nexus Drive, Singapore

Typology

Infrastructure

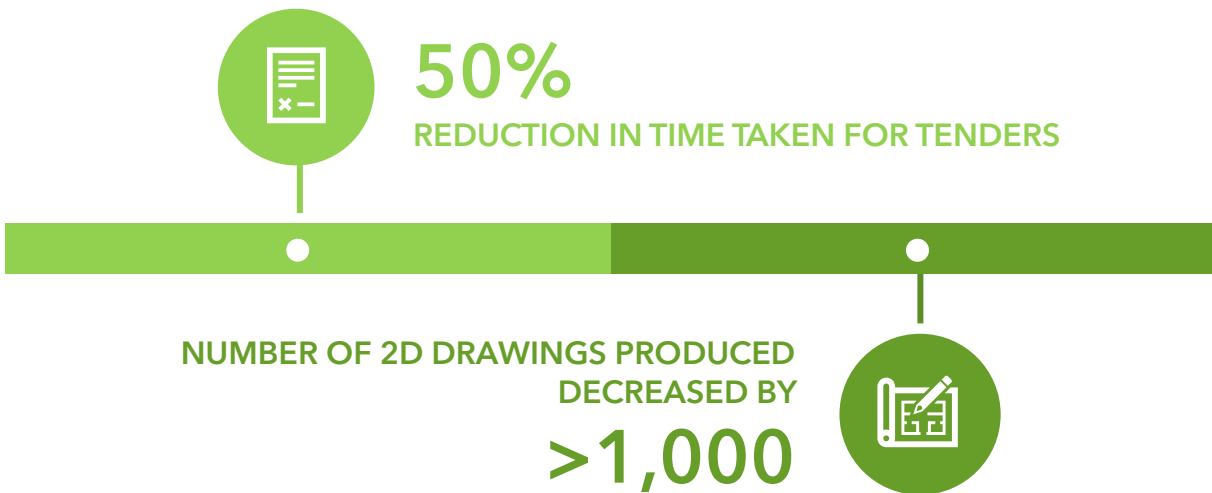
Developers

PUB, Singapore's National Water Agency

Design Consultant and Project Management

Jacobs International Consultants Pte Ltd

Several benefits resulted from this change, most notably a 50% reduction in tender time and a decrease in the number of 2D drawings produced by more than 1,000.



STRATEGIES UNDERTAKEN TO ENSURE SUCCESSFUL IMPLEMENTATION

PUB implemented a comprehensive approach comprising three key components to ensure that making BIM as part of contract documents resulted in successful and meaningful outcomes.

1. CLIENT TAKING THE LEAD

PUB advocates for smart transformation and emphasizes the need for close collaboration between the client, consultants and contractors to effectively advance BIM from being just a reference to a collaborative and useful tool.

As such, PUB has taken a proactive role in using BIM as the SSoT to establish a shared

understanding of project goals, scope and requirements during the tendering process. This approach has helped mitigate the differences in interpretation often associated with traditional 2D drawing-based tender processes.

2. CLEAR SPECIFICATION OF REQUIREMENTS

PUB had made it clear that BIM was to be the core element of the Tuas WRP project for both the Consultancy Agreement and many Construction Contracts. They also explicitly specified that BIM models were to constitute the contract documents.

In addition, PUB also clearly defined the following requirements in the Construction Contracts:

- (a) The list of BIM models supplemented by 2D details that form part of the contract documents;
- (b) the file format/s in which the BIM models and 2D details were to be issued; and
- (c) how tenderers could make use of the models to derive 2D layout plans and prepare tenders.

The Building and Construction Authority (BCA) has worked with industry stakeholders to develop sample clauses for BIM Handover.

The clauses can be viewed at <https://go.gov.sg/sample-bim-handover-clauses>.

“ (c) The MEICA (Mechanical, Electrical, Instrumentation, Control and Automation) designs included in the BIM Tender model and Drawings provide a reference design to allow the Contractor to appreciate the general arrangement of the plant and equipment. However, it is the Contractor's responsibility to provide all Works to meet all Specification requirements. The tender design/ layout information is not intended accurately to describe the detailed design of the equipment/ systems and does not in any way absolve the Contractor from meeting his contractual obligations.

(d) Designs of items which are subject to re-measurement for payment, may be modified or added to by the S.O as necessary as provided for in the Conditions of Contract.

(e) The dimensions and positions of the openings and pipe penetrations shown on the structural drawings are indicative only and are for the purposes of conveying to Tenderers the locations and nominal opening/ penetration sizes. At the time of Tender, the BIM model shall take precedence over the 2D Drawings. The Structural drawings shall be read in conjunction with the Architectural, MEICA and process drawings. After award, the Contractor is required to ascertain the actual dimensions and position of openings and pipe penetrations to suit the equipment within the Contractors scope and to interface with other Contractors to determine equipment requirements.

(f) At the time of Tender, the BIM model shall take precedence over the 2D Drawings for the Structural elements of the works except for Piling (refer to Particular Specification P3)

”

Extract of clauses specified in one of Tuas WRP's Construction Contracts

3. ESTABLISHING PROPER MODEL HANDOVER PROCESS

PUB recognized the importance of a proper handover process to enable downstream stakeholders to fully utilize the BIM information. The following outlines the key measures implemented by PUB to ensure this.

(i) **Model Validation by Consultants**

PUB ensured that the consultant had developed the BIM models up to detailed design for CSA (Civil, Structural and Architectural) and preliminary design level of details for MEICA (Mechanical, Electrical, Instrumentation, Control and Automation)/BS (Building Services) respectively.

The consultant also had to ensure that the essential model content (i.e. essential BIM elements) and its corresponding attributes were provided in the models, and all of them were coordinated before issuing to the tenderers.

(ii) **Model Briefing during Tendering stage**

A model briefing session was conducted by PUB and the consultant for tenderers to explain how the BIM models were structured.

The briefing featured fly-through and simulation models for improved visualization and understanding of the scope of works. The models incorporated geo-spatial data to ensure that complexities and interfaces between different contract packages were understood from the outset. The software vendor also participated in the session to provide training on navigating the software and extracting quantities from it.

(iii) **Issuance of Change Log at Final Tender Addendum and Corrigendum**

The consultant had to capture design changes in BIM models with a Change Log that was issued at the final tender and corrigendum.

Tenderers who had submitted a Letter of Intent (LOI) received all contract documents, including up-to-date BIM models.

(iv) **Handover Requirements following Award of Contract**

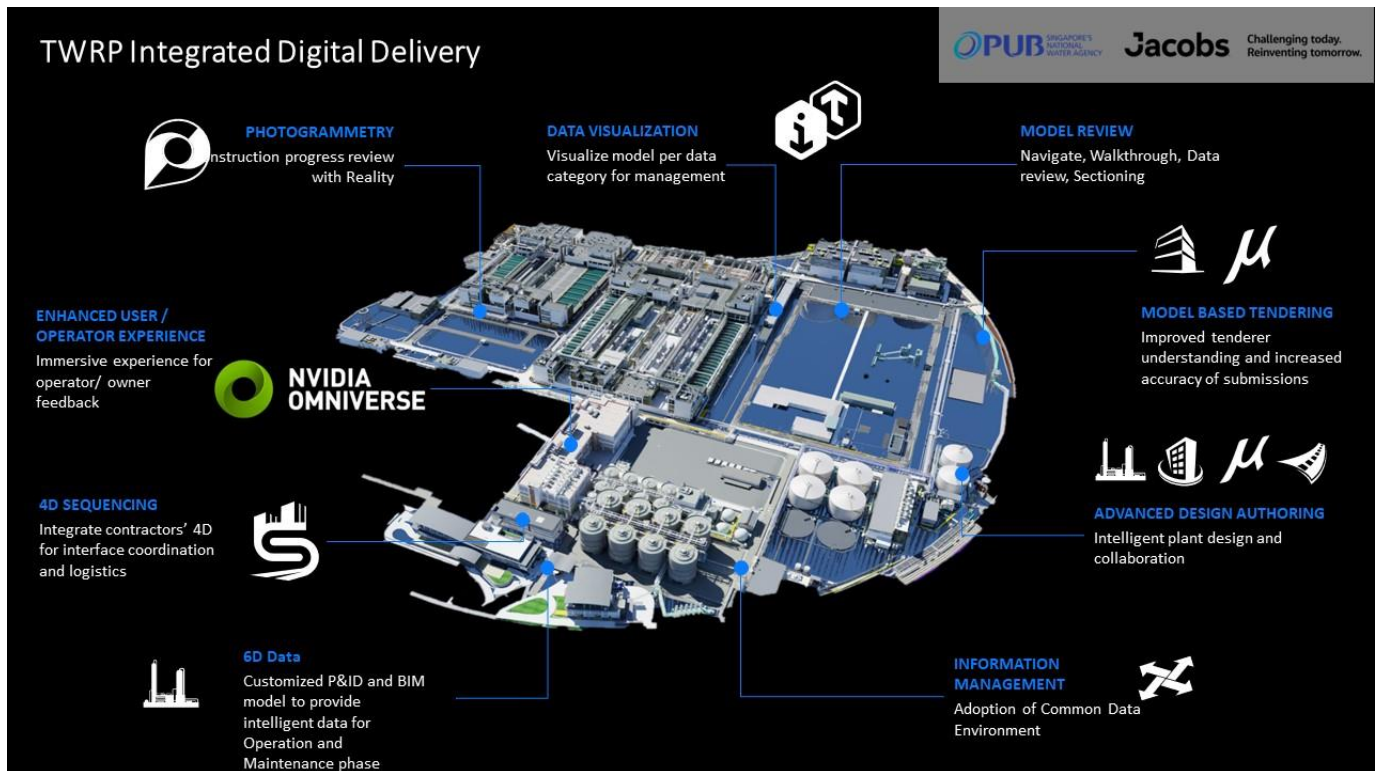
The consultant had to prepare a BIM Handover Package, comprising documents such as model/drawing list, native BIM models, to be issued to the successful tenderer upon Contract Award.

The consultant also conducted a BIM kick-off meeting to brief the successful tenderer (i.e. contractor) on the updated BIM models, the BIM Handover Package and BIM deliverables, including the necessary QA/ QC and coordination logs during the construction stage.

The contractor was required to further develop the issued models with

construction details for use during construction and downstream processes.

The contractor also had to update the BIM Execution Plan in consensus with all project stakeholders and in compliance with PUB's requirements before commencing work.



BIM as the Single Source of Truth for Collaboration

THE BENEFITS

TENDER TIME
REDUCED BY

50%

by leveraging BIM for
quantity take-offs and
scheduling studies



DECREASE
PRODUCTION OF 2D
DRAWINGS BY

>1,000

as use of BIM to extract
drawings minimised
inconsistencies and
need for reworks

MORE
**COMPETITIVE
BIDS**

as issued models allowed tenderers
to better understand design intent
and scope of works

MORE TIME FOR
**DETAILED INTERFACE
COORDINATION**

with other Tuas WRP contracts, as
contractors saved time by developing
construction models directly from
issued models without recreating
them from 2D drawings

BETTER AND FASTER
**DATA-DRIVEN
DECISIONS**

arising from digital models and data
collected on site, which in turn
helped to enhance project delivery
and outcomes.

FACILITATE DELIVERY OF
**DIGITAL ASSET
INFORMATION**

for future operations and
maintenance through utilizing
integrated BIM models as SSoT for
various IDD processes

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By harnessing the power of data-rich BIM to manage a complex project with multiple interfaces, we can establish a Single Source of Truth (SSoT). This approach revolutionises collaboration and integration, as well as streamlines processes and reduces inefficiencies.

In doing so, the Tuas Water Reclamation Plant (WRP) project will set new standards for excellence and innovation throughout its entire life cycle.

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Mark Wong
Chief Engineer (Tuas WRP), PUB

CHANGE MANAGEMENT STRATEGY

Like any change, the transition to incorporate BIM within the Contract Documents presented its own set of challenges. PUB observed that tenderers encountered difficulties in comprehending and using the BIM models effectively.

To address this, PUB and its consultant, Jacobs, set out to provide more in-depth briefings to assist tenderers in navigating the BIM models and locating information within them. As a result, most tenderers were able to acquire the essential skills to effectively leverage BIM models during the tender process.

In addition, PUB and Jacobs also worked with a software solution provider, Bentley System, to deliver digital training for subsequent tenderers, ensuring that they were equipped with the necessary knowledge to fully leverage the benefits of using BIM as an integral part of the Contract Documents.

CONCLUSION

Making BIM as part of Contract Documents is increasingly prevalent in construction tenders. This necessitates an open-minded approach from project stakeholders. More importantly, clients need to take the lead by specifying clear handover requirements, provide training for tenderers and contractors, and facilitate a collaborative working environment among all project stakeholders.



Tuas WRP Project Team

For more information on adopting BIM as part of Contract Documents, please refer to the [BIM Handover Technical Guide](#) and [Sample BIM Handover Clauses](#), developed by BCA in consultation with industry stakeholders.

Annex A - Tuas Water Reclamation Plant Project Information

Tuas Water Reclamation Plant (WRP) is a key component of the Deep Tunnel Sewerage System Phase 2 (DTSS2) project.

Used water flows from the western part of Singapore is conveyed by gravity via the deep tunnels to Tuas WRP to be treated. The treated used water effluent is further purified into ultra-clean, high-grade reclaimed water called NEWater, while excess treated effluent discharged to the sea. When completed, Tuas WRP will be the largest facility of its kind in the world, with a treatment capacity of 800,000 cubic meters per day, enough to fill over 320 Olympic-sized swimming pools.

Given the scale and complexity of this mega project, Tuas WRP will be constructed through 16 major contract packages.

Jacobs International Consultants was appointed by PUB in 2017 to provide design and project management consultancy services. This included preliminary design review, detailed design, tendering, project management, construction management and supervision, and integrated commission leading up of handover of the plant.

