



QS AWARDS 2024

On Projects (Innovation)

Project Background

The existing Shek Wu Hui Sewage Treatment Works (SWHSTW) with design capacity 105,000 m³/day at secondary treatment level will need to be upgraded to Shek Wu Hui Effluent Polishing Plant (SWHEPP) due to the following:

- To cope with the anticipated increase in sewage flows due to potential developments in North District.
- To improve the effluent quality with a view to protecting the water quality in Deep Bay.
- To enhance the environment by minimizing odour and turning a “Not in My Backyard” sewage treatment facility into a public co-use facility.

The upgrading will be implemented in 3 stages to the largest tertiary sewage treatment plant in HK, and will reach the following treatment capacities progressively:

Stage 1	140,000 m ³ /day
Stage 2	160,000 m ³ /day
Stage 3	190,000 m ³ /day

The Stage 1 upgrading works commenced in Q1 2019 via four (4) main construction contracts, having two (2) no. of civil contracts, and two (2) no. of E&M contracts all adopting NEC3 ECC Main Option C Target Cost with anticipated completion by Q4 2025.

Duties and Organization of the Applicant

AECOM is the Engineering Consultant providing one-stop services for Design, Project Management, Quantity Surveying, Contract Administration and Site Supervision for the Project. The Resident Site Staff (RSS) team of **AECOM** comprises 153 no. of professional, technical and general staff including a Resident Quantity Surveying (RQS) team lead by a SRQS comprising 18 no. of QS staff providing support on all financial and contractual issues.

Project Challenges

There are several project challenges from the outset i.e. substantial interface coordination, disruptions under the impact of COVID-19, substantial amount of underground services, live sewage plant in operation, various site constraints, multi-party collaboration and **AECOM** took the following actions to tackle these challenges:

- Leading a 3-tier multi-party collaboration team to instil team spirit and jointly identify risks and opportunities to smoothen project delivery
- Coordinating the sharing of working areas among the 4 contracts for storage of construction materials
- Adopting pre-tender and post-tender interviews to enhance collaboration down to supply chain
- Applying the latest technologies and innovations e.g. **Building Information Modelling (BIM)** and **Blockchain** to resolve conflicts and streamline information workflows



Meanwhile, there are other contract administration and financial management challenges in this Project:

- Adopting an open book type of NEC contract with pain / gain sharing which requires intensive and prompt QS inputs.
- Monthly interim payment (IP) assessment within a tight time frame i.e. three weeks from the assessment date to go through the payment application details for assessing the Price for Work Done to Date.
- Close monitoring of procurement and award of subcontracts (total **565** no. of subcontracts) which requires monitoring the procurement and award of subcontracts, vetting the pre-tender estimates for subcontracts to determine the appropriate procurement arrangement, and vetting the draft final accounts before settlement of the subcontracts by the Contractors.
- Assess the notified compensation events (CE) within a tight period for reply i.e. three weeks which requires the RQS team to assess the cost impact of the CE and consolidate the time impact, if any, advised by the Engineering team, to implement the CE. As of July 2024, **1444** no. CE have been notified with **1223** no. CE (85%) implemented for the 4 contracts.
- Administer 4 construction contracts at a time requires agile project management skills to deal with contractors of different styles and having different in-house company rules.

Vision and Strategic Planning

Hong Kong's construction industry warrants a technological disruption that can resolve its long-standing problems due to its complex stakeholder network, complicated supplier chains and the sheer amount of information exchange. These problems are particularly evident when managing the 4 contracts under the SWHEPP Main Works Stage 1 project.

With the vast amount of records and transactions that come with NEC Option C Target Cost contracts, data integrity and traceability pose great concerns to the RQS team when managing contracts. Project financial management is a fragmented and information-intensive process where different kinds of cost-related information such as material quantities, unit costs and pricing are exchanged among project stakeholders through conventional paper-based systems.

The traditional paper-based practice has been recognized as an error-prone and inefficient way of information exchange with the following drawbacks:

- Poor Traceability
- Poor Data Management
- Every stakeholder has their own system and dataset

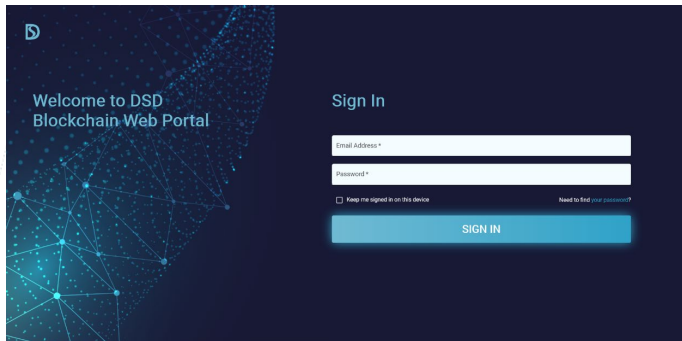
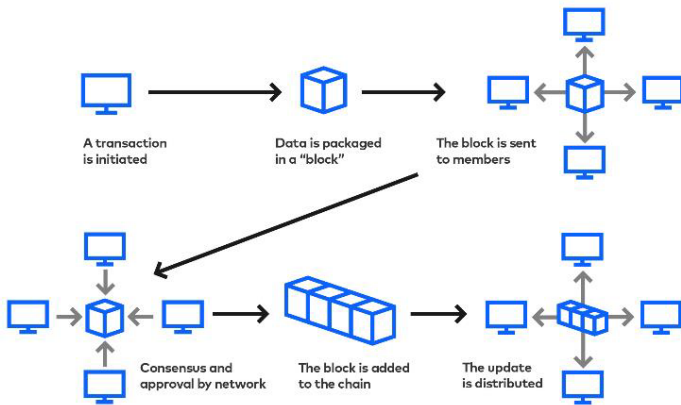
At the outset of this Project, our project team set a vision to plan, develop and adopt innovative technologies in project contract administration and financial management to surmount these inherited problems.

Initiated by the project team in 2020, it is one of the first project in Hong Kong to apply **Blockchain** technology for construction data exchange. This **Blockchain Platform** has been fully functional in late 2022, playing a key part of our promising digital transformation strategy.

A **blockchain** is a distributed database or ledger that is shared among the nodes of a computer network and collects information together in groups, known as blocks, that hold sets of information.

Blocks have certain storage capacities and, when filled, are closed and linked to the previously filled block, forming a chain of data known as the **blockchain**. Each block contains a hash, hash of the previous block, a timestamp, and transaction data.

Our **Blockchain platform** provides immutable and traceable data storage with a decentralized architecture, offering a game-changing solution to issues related to transparency, collaboration and data management. Our project team leverages the digital ledger from **Blockchain** to hold all the necessary contract documents, records, site instructions and sensitive financial information within a secured storage that best suits the RQS team to carry out their day-to-day tasks pertained to contract administration and financial management.



The homepage of SWHEPP **Blockchain** Web Portal

Innovation and Technological Shift

Blockchain Platform

Before launching our **Blockchain platform**, the **Electronic Document Management System (EDMS)** was the sole system for storage and management of documents digitally under the SWHEPP project that does not provide any project workflow management.

Having created a secured and reliable platform for storing and accessing critical documents, the **Blockchain platform** significantly enhances our project team's workflow management in every dimension by combining various construction and project management workflows into a centralized platform for the 4 contracts under the SWHEPP project through different customized modules with **Application Programming Interfaces (APIs)**. The **Blockchain** has brought the following benefits:

- Increase Data Transparency
- Easier Data Enquiry
- Increase Data Traceability
- Centralized Platform for Data Management
- Prevent Data Loss
- Better Collaboration Between Parties

Blockchain platform is compatible with the following construction and project management workflows:

- Electronic Document Management (EDMS)
- Digital Works Supervision System (DWSS)
- Building Information Modelling (BIM)
- Notification of Compensation Event (NCE)
- Safety Performance
- Early Warning & Risk Register

With **block-chained data** as the single source of truth, collaboration among different stakeholders has never been more seamless. Meanwhile, dynamic dashboards and statistics of all 4 contracts can be generated to monitor various works and financial-related KPIs, allowing our RQS team to assess the current financial status of each contract such as risk registers, Project Manager's Instructions, payment certificates, CE assessment at our fingertips which is important for the RQS team from contract administration and financial management perspective.

BIM with CDE and Autodesk Collaboration Pro

The use of **BIM** and a **Common Data Environment (CDE)** with **Autodesk Collaboration Pro** have enriched the design coordination of this Project since all changes made to **BIM** models are traceable thanks to the timestamping in the **CDE**, which in return reduce the conflicts amongst various parties caused by inadequate model version control over of **BIM** models.

Apart from model version control, our **BIM** package also helps the RQS team to carry out quantity taking-offs at ease during the design stage for preparation of cost estimates and for Project Manager's Instructions, CE assessments and payment valuations as changes are detectable and transparent. In addition, the use of **BIM** with **CDE** and **Autodesk Collaboration Pro** also benefit the RQS team in the following ways:

- Better project collaboration
- Visualization of design intents
- Accurate estimation and costing
- Efficient communication

Point Cloud

The use of **Point Cloud** is another innovative tools that helps our project team to carry out their day-to-day tasks efficiently. 3D **point cloud** data obtained from laser scanners is able to provide instant and up-to-dated construction related objects for quality inspection and construction progress tracking. Based on the 3D **point cloud** data checking against with the **BIM**, the RQS team can easily assess the work done progress on site in order to prepare for the payment valuation.

Execution and Achievement

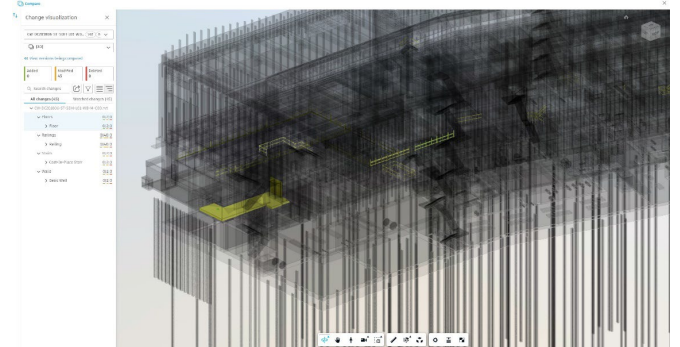
Improved Quality Efficiency

Our **Blockchain platform** inevitably brings tremendous advantages to the Project in terms of time and cost performance, as well as improvement over data quality by providing accurate design and works information. Meanwhile, construction productivity has improved significantly attributed to the enhanced collaboration among all stakeholders of the Project as a result of our trust in immutable and traceable information exchange.

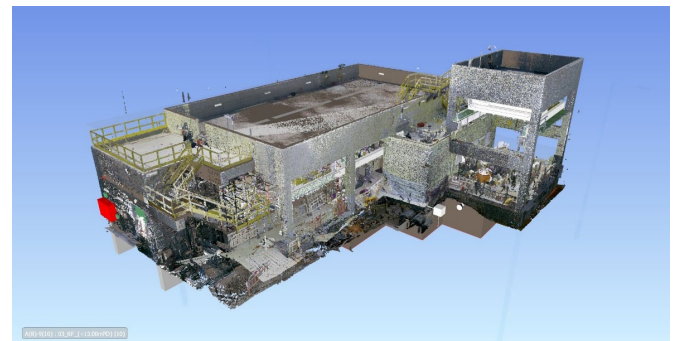
Our **Blockchain platform** is a private blockchain in which only the relevant project stakeholders are allowed to access and validate "blocks" in the blockchain environment. This means that all participants in the private **blockchain** are kept apprised of new and updated information. Last, but not least, our **Blockchain platform** has reduced the project team's administrative workloads on reporting, monitoring and risk management.



The federated **BIM** model for a building in SWHEPP



The function checking two different version of **BIM** models for change visualization



Point cloud data showing for the particular building in SWHEPP for verification

Improved Workflow and Time Efficiency

The use of **BIM** with **CDE** and **Autodesk Collaboration Pro** mitigates changes and delay caused by discrepancies of **BIM** models and conflicts among project stakeholders as all changes to **BIM** models are traceable due to the timestamping feature.

The RQS team can easily trace the changes made to **BIM** models for assessment of CE with historical information records on the **CDE**. As such, the Employer is also apprised of the potential cost implication of the design changes during construction stage. As a result, the workflow and time efficiency can be achieved with the use of **BIM** with **CDE** and **Autodesk Collaboration Pro**.

Improved Transparency and Mutual Trust

Blockchain is visible to everyone who is participating in the platform. Furthermore, the decentralised feature of **blockchain** technology allows the participants to have the same information across the application and this information cannot be deleted.

Therefore, the traceable and immutable records in the platform create transparency for the users. By using the **Blockchain platform**, it gradually increases the mutual trust and hence enhances the collaboration amongst the team members.

Project Achievements

Our excellence in the use of innovative tools and in contract management has been recognized by both local and international associations and has received several prestige awards:

BIM

Silver, Bronze Total 5 nos. of HKIBIM Awards 2020,2021

Honorable Mentions Total 2 nos. of Autodesk HK BIM Award 2020,2021

BIM & Blockchain

Bronze 48th International Exhibition of Inventions Geneva 2023

Contract Management

Winner NEC Water Project of the Year 2021

Winner of Martin Barnes Awards NEC Contract Innovation 2022

Runner-up of Martin Barnes Awards NEC Consultant of the Year of the Year 2023

Impact on QS Discipline and Industry

Innovative technologies especially **Blockchain** and **BIM** with **CDE** have great potential to revolutionize the construction industry, in particular for the project contract administration and financial management functions performed by the QS discipline with the following benefits:

- Creating a common platform to monitor multi-contracts progress and performance;
- Digitizing and developing systematic workflows such as NCE module incorporated with **Blockchain platform** for efficient payment valuation, cost estimating and CE assessment;
- Establishing proven standards for user and functional requirements under the **Blockchain platform** in the forthcoming contracts.

With the vision of adopting more and more innovative technologies, the SWHEPP Project will continue to streamline the workflow, contract administration and financial management functions in the contract of Main Works Stage 2 of SWHEPP for the further development on smart contract application as next step.

