COMPANY
Drainage Services Department, HKSAR Government

PROJECT
Adoption of Knowledge-based Building Information Modeling for E&M Asset Management Supplemented with Mobile Technology - A Case Study in Public Sewage Pumping Facilities

LOCATION
Ma On Shan Area 108 Sewage Pumping Station, Sai Sha Road, Ma On Shan, Shatin, Hong Kong

TYPE
Knowledge-based BIM-integrated E&M Asset Management

SCHEDULED TIME OF COMPLETION
Nov 2014 to May 2016

"We have discussed what the model should include, with maintenance staff - there are lots of workflows, and we need to compromise and streamline the process by merge & convert approach so they will be happy to use BIM-integrated platform."

—**Dr. Jeff H. Tse**
Electrical & Mechanical Engineer, Drainage Services Department
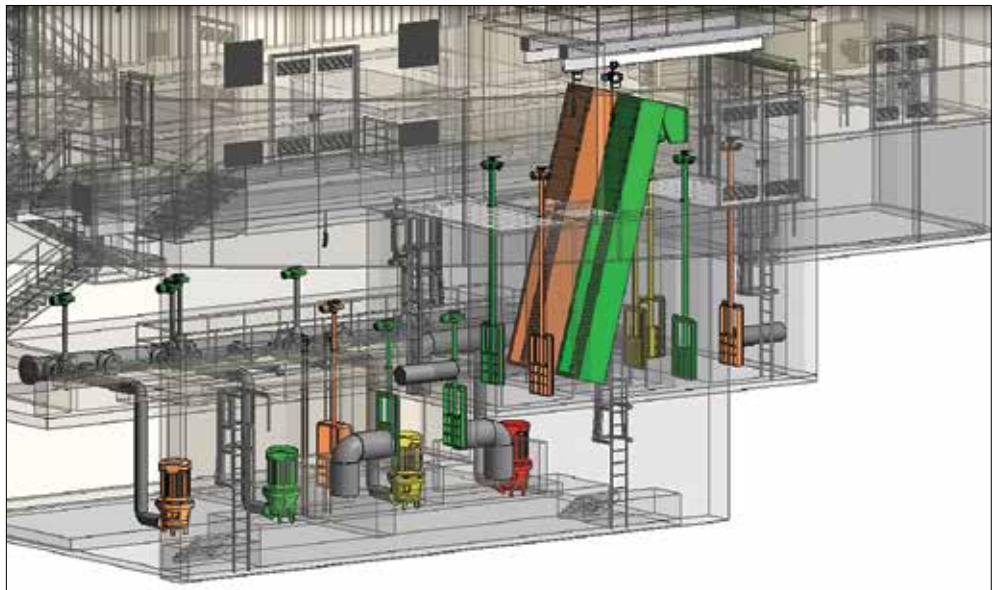
Drainage Services Getting Pumped About BIM

Color-coded asset health index in BIM model
Image courtesy of Drainage Services Department, HKSAR Government

Hong Kong's Drainage Services Department discovers BIM can deliver benefits for asset management in trial study of sewage pumping station.

The Hong Kong Drainage Services Department is adopting BIM technology with mobile solutions in an in-service three-storey Ma On Shan Area Sewage Pumping Station, for BIM-integrated maintenance of 15 types of E&M assets. This is the first trial study in the department by in-house staff to implement BIM technology in E&M asset management of an in-service sewage pumping station.

BIM to resolve a data tsunami

"BIM has a lot of different functionalities, but while a lot of stakeholders use it for things like minimising clashes and construction sequencing, we are more concerned about employing digital data for asset management," says Dr. Jeff H. Tse, Electrical & Mechanical Engineer, Drainage Services Department. "We want to learn how to manage this kind of big data, and resolve our problem with a data tsunami."

This data includes information on around 360 types of E&M asset system in 290 nos. sewage handling and treatment facilities.

While the emergence of BIM could help to create updated digital asset data for long-term data storage and management, there is no role model for E&M-related BIM data standards. "The problem we had to resolve at the start of the modelling work is that the BIM model fundamentals may not be well defined and standardised in design stage, potentially leading to digital asset information loss when progressing between different life cycle stages," says Dr. Tse.

A key focus in the study was setting up the standardisation process in creating digital AM-compatible asset numerical and textual data to tally with the department's ISO 55001 specific classifications, fulfilling the parent-child relationships among different model elements. The data would be stored in COBie structured format, and the project team have drafted an internal BIM guide for department use.

BIM model for the pilot plant

The project team began by building the BIM model from LOD (Level of Development) 100 up to LOD 500 for the Ma On Shan sewage pumping station. They also configured the BIM model with AM-compatible asset data mapping.

The digital asset information embedded in each model element
Image courtesy of Drainage Services Department, HKSAR Government

The team also adopted a somewhat streamlined version of asset management, with five common workflows that are normally executed during construction and O&M stages: site management tracking; site safety/environmental inspection; defect reporting and management; equipment functional testing/inspection; and material-on-site inspection.

Friendly user interface

"We can provide a friendly user interface, and have learned how to employ digital data so it can be used by O&M staff," says Dr. Tse. "This in turn means they can help the management become more informed for making decisions."

Without BIM, the O&M staff can perform many inspections, recording the data in paper form. This in turn leads to a mass of information in paper form, which is time consuming to search through. But through the project, the staff will be able to integrate a BIM assisted workflow into asset management.

"We have discussed what the model should include, with maintenance staff - there are a lot of workflows, and we need to compromise so they will be happy to use BIM, and record information electronically through the BIM platform," says Dr. Tse. Introducing BIM can supplement the in-service maintenance and management system for asset health monitoring, with the knowledge domain embedded in BIM.

Fault tree concept

The project team adopts a fault tree concept, in which data on identifiable fault symptoms on critical E&M assets
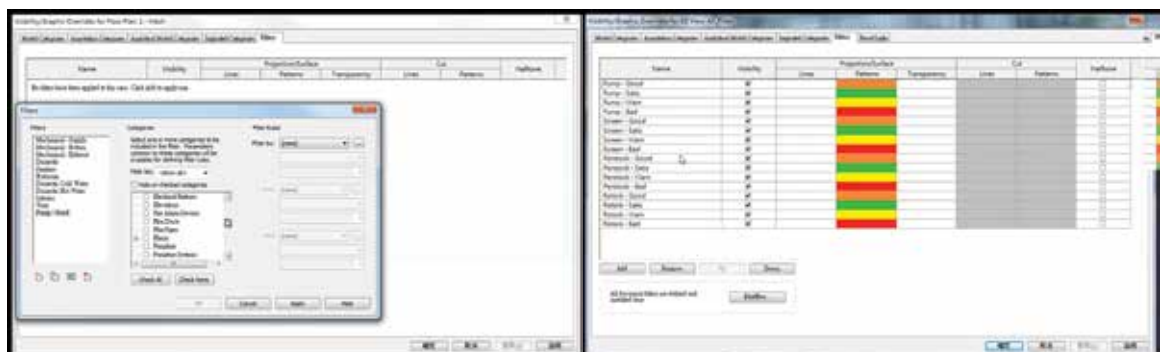
Filtering criteria values with required color patterns in Autodesk Revit software
Image courtesy of Drainage Services Department, HKSAR Government

can be consistently recorded through BIM-integrated mobile applications using the predefined electronic asset inspection form. This enables a combination of digital information and the operations staff's expert knowledge.

With sewage pumping stations, the maintenance staff know the types of critical incidents to avoid. "For instance, they have to avoid sewage bypass, and which key assets may contribute to such an incident," says Dr. Tse. "If we know there can be two or three faults, we can digitise these to e-form, integrated in the BIM model, and then gather statistics on failure rates. The data can then help with more informed maintenance decisions."

Faster with BIM

"I think the O&M staff are happy to use BIM if their work routines could be streamlined and digitalized," says Mr. Kim C.H. Lai, Technical Officer, Drainage Services Department. "They can use BIM-integrated mobile application and see the BIM model. They don't want too many drawings on hand, but can click on the iPad, and find information on an item of equipment."

To help filter the wealth of information in BIM, the team are turning to visual presentations, like colour coding for asset conditions of equipment. This is collected from fault-tree derived monthly asset inspection e-form through mobile solutions during their site inspection work, and different colors can be used depending on the predicted condition of a critical asset, ranging from orange for "good", to red that indicates it should be replaced. "For instance, if an asset has a life of 20 years, there can be a count down, and if there are just two years of remaining life the colour can alert or early warning to maintenance staff that it should be replaced - they needn't drill into details to discover this," says Dr. Tse.

"DSD developed a department roadmap in July 2014 to implement BIM pilot projects in new construction / upgrading of sewage treatment works; construction / upgrading of sewage and stormwater pumping stations as well as construction of underground stormwater storage tanks," says Dr. Tse. "We will migrate BIM into O&M."

Chinese-version asset inspection form used by front-line staff through BIM-integrated mobile applications
Image courtesy of Drainage Services Department, HKSAR Government
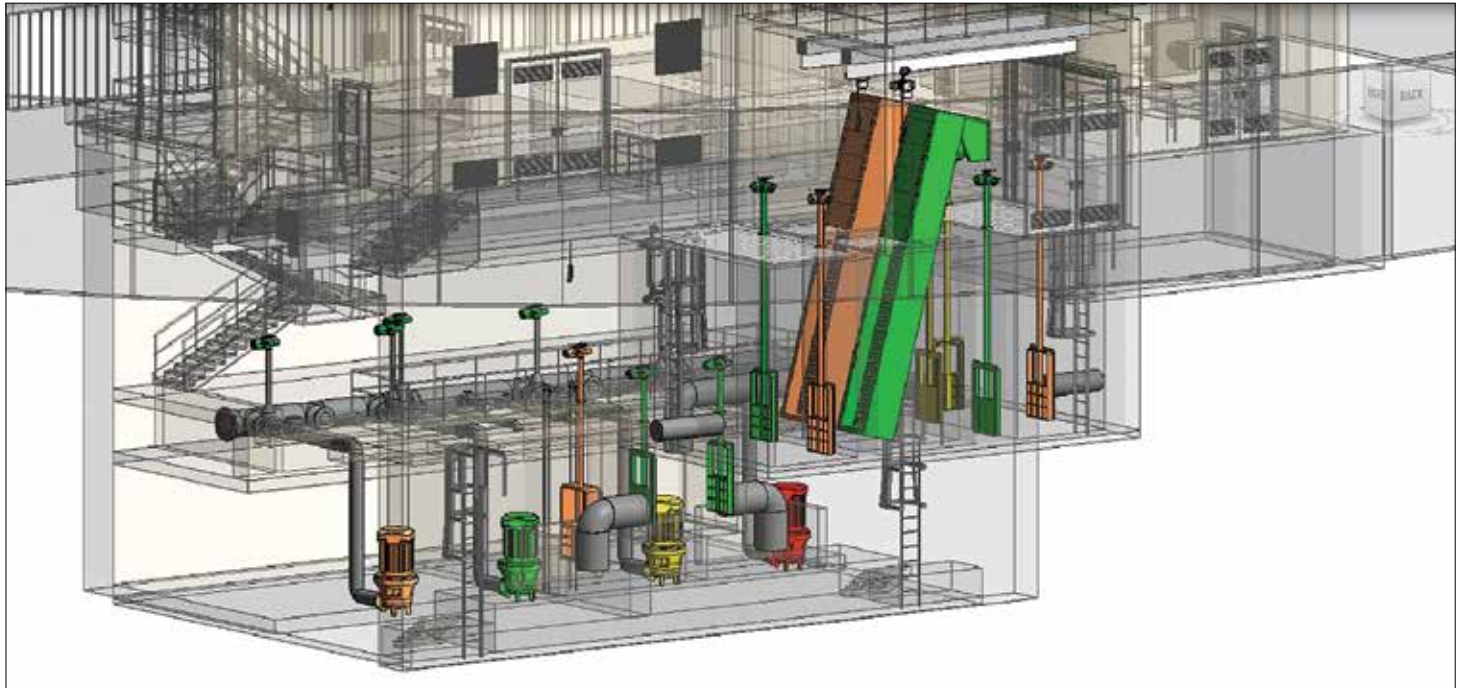
Color-coded asset health index in BIM model
Image courtesy of Drainage Services Department, HKSAR Government

About Drainage Services Department, HKSAR Government

The Drainage Services Department (DSD) is a department of the Government of the Hong Kong Special Administrative Region responsible for drainage and sewerage. DSD was established in September 1989 with vision to provide world-class wastewater and stormwater drainage services enabling the sustainable development of Hong Kong. DSD has made good progress in both sewage treatment and flood prevention in five major areas: First, to design and construct green architectural features of the sewage treatment plant, sewage pumping stations, drainage & flood control facilities; Second, to operate and maintain sewage-related equipment, use renewable energy, and energy-efficient equipment; Third, clean channel, remove plants impeding the flow of the river and clean up the sludge; Fourth, to implement strategic replacement and rehabilitation plans of underground drains, sewers, rising mains, manholes and the like widely spread over the whole territory; and Fifth, to implement strategic plans to relocate sewage treatment plants into caverns.