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Advancing Infrastructure



## Project Summary

### Organization

Mass Rapid Transit Corporation

### Solution

Rail and Transit

### Location

Kuala Lumpur, Malaysia

### Project Objectives

- Design and construct the Klang Valley Mass Rapid Transit Sungai Buloh-Serdang-Putrajaya (SSP) metro line.
- Implement a collaborative BIM strategy to support the entire project and asset lifecycles.

### Products Used

AssetWise™, ContextCapture, ComplyPro, MicroStation®, OpenRail™ Connected Data Environment®, PLAXIS®, ProjectWise®, STAAD.Pro®

### Fast Facts

- The SSP line will improve transportation in Kuala Lumpur and the Klang Valley region of Malaysia.
- MRT Corp monitors and coordinates more than 20 disciplines during design and construction of the line.
- MRT Corp's OpenRail CDE facilitates design collaboration, improves construction feasibility, and delivers accurate as-built information.
- MRT Corp's implementation of digital BIM workflows is driving innovation and BIM adoption throughout the Malaysian construction industry.

### ROI

- MRT Corp's OpenRail CDE enabled seamless sharing of accurate information in real time increasing productivity by 35 percent.
- Bentley software enables the integration of design and asset information with MRT Corp's CMMS to ensure optimal asset lifecycle performance.
- Bentley software enables early validation of asset data and improved accuracy of tag registration to avoid late changes.

## Mass Rapid Transit Corporation Mandates BIM Level 2 Methodology to Deliver Kuala Lumpur's Metro Project

Bentley's BIM Technology Provides a Connected Data Environment to Reduce Rework and Improve Productivity by 35 Percent

### Metro Mega Project Adopts BIM Level 2

An urban agglomeration of over 7 million people, the Greater Kuala Lumpur-Klang Valley region is among the fastest-growing metropolitan regions in Southeast Asia in population and economic development. To support these increases, Malaysia's Ministry of Finance set up Mass Rapid Transit Corporation (MRT Corp) as a special purpose vehicle to deliver the Klang Valley Mass Rapid Transit (KVMRT) project, a planned three-line modern railway system to improve transport and reduce traffic congestion in the region. With the first line completed in July 2017, MRT Corp is pushing its deliverables for the second line, the Sungai Buloh-Serdang-Putrajaya (SSP) line, beyond meeting time and budget constraints, to increasing productivity and reducing on-site construction changes related to design discrepancies.

Spanning 52.2 kilometers, of which 13.5 kilometers are underground, with 35 stations, the MYR 32 billion SSP line is a complicated project with enormous amounts of data and globally dispersed consultants and stakeholders, amounting to more than 20 different disciplines exchanging and sharing information. To optimize control and accuracy of project data, and improve design collaboration, construction feasibility, and accuracy of as-built information, MRT Corp initiated a BIM Level 2 strategy. MRT Corp established a connected data environment using Bentley applications as its foundation to capture, share, and exchange information throughout the project lifecycle.

### Establishing a Connected Data Environment

To achieve BIM Level 2, MRT Corp is using Bentley's OpenRail Connected Data Environment (CDE) and is mandating that all project stakeholders and design consultants on the SSP line collaborate and exchange data, design models, and asset information via the platform. Stated Poh Seng Tiok, director, planning and design at MRT Corp, "The Bentley CDE platform provides a seamless solution for MRT Corp in our BIM Level 2 workflow and supports sharing project information throughout the entire project lifecycle." Using Bentley's federated platform hosted on Microsoft's Azure cloud-based services enabled over 1,500 users to collaborate on approximately

7,500 models and more than 280,000 documents and drawings corresponding to 2.3 terabytes of project data in a controlled environment. The teams leveraged ProjectWise for real-time information sharing, design visualization and coordination, virtual design reviews, and distribution of drawings, schedules, and equipment lists.

Given the complexity of linking all the new stations with existing stations and infrastructure, including the monorail, MRT Corp needed to determine how these stations interact with one another. Using design visualization and federated modeling the teams could see and navigate through the models to design the entrances, underground spaces, tunnels, and the complicated MEP system in an integrated manner. During bi-weekly virtual design reviews conducted through the CDE, teams can check the status of the designs and look for any issues, extracting the information required to ensure optimal interaction within and among the different stations.

Working in a cloud-based CDE enabled seamless synchronization and data exchange among all stakeholders, internal and external, allowing every project discipline to work dynamically using the federated models to coordinate the design. This collaborative BIM solution improved design efficiency and significantly reduced design clashes, avoiding the numerous on-site construction changes experienced during the delivery of the initial SBK metro line. It facilitated accurate information sharing to reduce design rework and increased productivity by 35 percent.

### ContextCapture for Design Accuracy and Construction Monitoring

To verify design accuracy, the team used 3D photogrammetry in ContextCapture, importing point clouds into the 3D construction models to reference existing conditions. Integrating the BIM models with the point cloud, as well as with MRT Corp's award-winning GIS platform, enabled the team to visualize the Titiwangsa train station, for example, in context with the monorail, existing station, and the surrounding buildings. Using the software, engineers could verify that the structural model is accurate and located correctly before reviewing the design to optimize future connections.

*“The Bentley CDE platform provides a seamless solution for MRT Corporation in our BIM Level 2 workflow and supports sharing project information throughout the entire project lifecycle.”*

*– Poh Seng Tok, Director,  
Planning and Design,  
Mass Rapid Transit Corporation*

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*Using ContextCapture for 3D photogrammetry of existing site conditions helped verify design accuracy.*

Once a month, engineers capture photographs from inside each station site and generate a 3D reality model using ContextCapture to monitor construction progress and alleviate any potential costly issues on-site. The interoperability of Bentley software allowed the team to link the ContextCapture model to iModels in MicroStation and overlay the design information with the as-constructed on-site condition. This helps to visually determine whether the guide walls or pile walls are in the right location. Incorporating reality modeling into this digital BIM workflow not only facilitated design accuracy but also helped enable 4D construction planning by digitizing the construction environment to streamline construction.

### **Pushing the Limits of BIM Data**

Consistent with a BIM Level 2 approach, MRT Corp is moving beyond 3D modeling and 2D drawing production by enabling handover of digital information to downstream activities. Through the provision of trusted information via its CDE, MRT Corp's contractors are leveraging digital engineering models for 4D construction planning and 5D quantity takeoffs.

Responsible for orchestrating the launch of the tunnel boring machines (TBMs) to construct the underground sections, MRT Corp linked the 3D models in its connected data environment to activities in the construction program. This process helped to facilitate planning, coordinate the reception and assembly of TBMs on-site, and work with site works' teams optimal construction sequencing.

Furthermore, with all models being shared in the CDE in an interoperable format that can be accessed by other applications, MRT Corp could extract material quantities for concrete volumes, floor areas, and finishes. Using the models facilitated accurate quantity takeoffs to compute material costs and assess tenders.

From the outset, MRT Corp was committed to using the BIM data for asset lifecycle management and maintenance, and integrated Asset Lifecycle Information Management in the CDE to fulfill that aspiration. Leveraging Bentley technology

allowed MRT Corp to bridge the gap between asset information collected during construction and that stored in its computerized maintenance management system (CMMS), and use that data to operate and maintain the railway.

The project team developed its own iteration known as the KVMRT classification standard so all rail facilities are using common convention, enabling users to easily locate facilities data and use the BIM models as a gateway for lifecycle information and asset management. The innovative Bentley-based solution integrated design and asset information with the CMMS to ensure optimal asset performance throughout the metro line's lifecycle.

### **Leading Innovator of BIM Processes**

Consistent with its goal of being a leader in BIM processes, not just on its project but in the marketplace, MRT Corp, with the help of Bentley personnel, is developing training and education programs in Malaysia to promote BIM processes as a standard on future national projects. As the first metro project in Asia to adopt BIM Level 2, KVMRT SSP is an example of how cloud-based collaboration and information management can streamline workflows and improve efficiency, productivity, and asset lifecycle performance.

Using Bentley's OpenRail Connected Data Environment, which incorporates ProjectWise and AssetWise, MRT Corp implemented a BIM solution that demonstrates the power of working in an integrated information management and collaboration platform. With Bentley-based applications linking construction data to asset management, MRT Corp captured sustainable information that can be used for operations and maintenance throughout the lifecycle of the metro line.

By integrating digital BIM workflows, GIS, reality modeling, and asset information, MRT Corp is driving innovation in the Malaysian construction industry. The KVMRT SSP project will serve as a case study for the nation on how the industry can deliver projects using a BIM Level 2 strategy based on the standards and processes adopted by MRT Corp.