

COMPANY
TÜV SÜD

LOCATION
Singapore

SOFTWARE
BIM Collaborate Pro
AEC Collection
Dynamo
BIM 360 Ops
Forge / Dasher

Achieving Lifecycle Success with a Digital Twin at TÜV SÜD

Autodesk solutions optimized design and construction phases of TÜV SÜD's ASEAN headquarters in Singapore, resulting in significant gains for the whole building lifecycle.

"Achieving success from design and construction to operation – that is our main goal within the project's Digital Building Lifecycle Strategy. Autodesk provides an end-to-end solution for all trades, for any use case and for relevant data formats including IFC and COBie.

Thus, Autodesk Technology is an important enabler for us to build a Digital Twin from TÜV SÜD @ IBP to cater to all lifecycle phases."

– **Elise Katharina Mandat**

Internal BIM Manager of 15 IBP,
TÜV SÜD Real Estate & Infrastructure



Image courtesy of TÜV SÜD

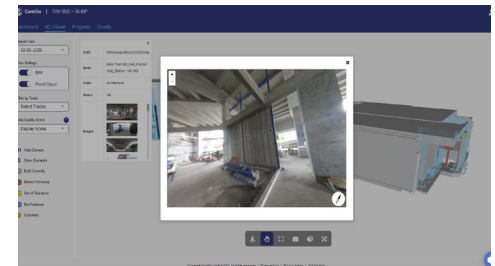
Introduction

TÜV SÜD is a universally recognized brand for safety, security, and sustainability. Reflecting its heritage of German engineering and technical excellence, TÜV SÜD has grown to a globally recognized Digital Transformation expert in the Architecture, Engineering and Construction (AEC) sector, helping governments and industries pace the excellence of buildings across the entire asset lifecycle.

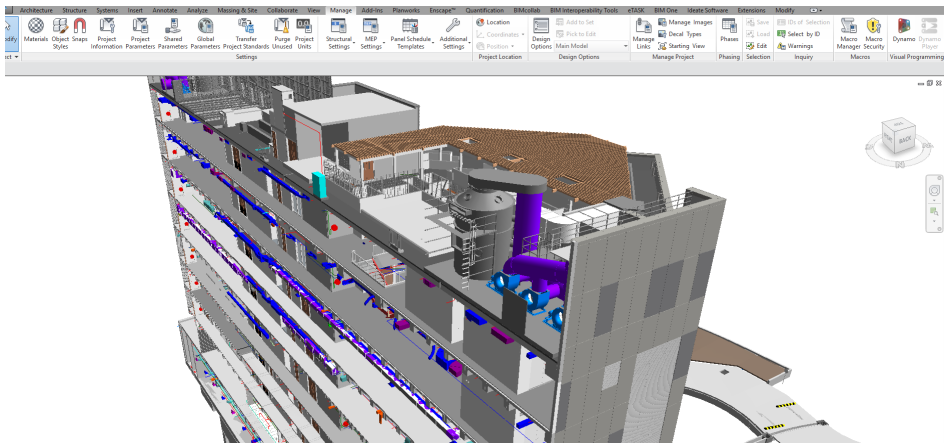
TÜV SÜD is guided by its belief that digitalization across a building's lifecycle clearly focuses on achievements that can be measured in safety, quality, and sustainability gains, as well as in performance and productivity benefits.

TÜV SÜD made a bold decision in 2017: to objectify the importance of Digital Building Lifecycle Solutions in its newly built 18,900 sqm ASEAN headquarters in Singapore, known today as TÜV SÜD @ IBP. This project highlights the impact of digital methods such as Building Information Modelling (BIM), Common Data Environments (CDE) and Computer Aided Facility Management (CAFM) towards both the project and the building.

"We believe that Digital Prototyping and Digital Twin principles are a prerequisite for a successful building lifecycle and for a safe and sustainable asset operation that will last for decades. The design phase is the core of the asset lifecycle to virtually construct, simulate and optimize the building design for construction and operation.



We must ensure that safety, sustainability, technical reliability, and user comfort are clearly integrated while planning the later building. The design stage plays a key role in a technically and commercially successful building lifecycle, and it is when there is the best potential to optimize the Total Costs of Ownership (TCO) of the building," says Tobias Schmidt, Global Manager for Digital Lifecycle Solutions in the Real Estate & Infrastructure division of TÜV SÜD



Going Beyond Known Market Practices

TÜV SÜD @ IBP is a brownfield project located on a structurally difficult area and features a sensitive Electromagnetic Compatible Laboratory that should not have been affected during the project.

Keeping all the relevant stakeholders across all the lifecycle phases located in various countries was one of the most critical prerequisites for the project. That is why TÜV SÜD implemented digital information management with BIM based on ISO 19650 as a standard, by leveraging on Autodesk Construction Cloud as the core project platform.

With this Common Data Environment and the lifecycle-embracing Exchange Information Requirement (EIR), TÜV SÜD implemented all construction and operation relevant use cases into the design stages for both Shell & Core and for the Fitout design.

These requirements included Design for Maintainability (DfM), Design for Building Safety as well as all required energy and sustainability optimizations towards the Singapore Green Building Mark.

The authored Project Information Models in native Revit were also built up to serve as a later resource for the Digital Construction Inspection. This allowed for monitoring of both construction progress and tolerances as well as “Built as Planned” compliance, e.g., through implementing Scan2BIM overlays.

For Facility Management and CAFM tools, the Revit models were also authored

and checked to be the ‘Single Source’ for various As-Built documentations in IFC and COBie format for the later internal and external contracted Facility and As-set Management.

This complexity of use cases for design, construction, and operation, together with the required high maturity of the Revit-based Project Information Models as well as the necessity for excellent export qualities towards IFC and COBie however posed a major challenge as many local Consultants and Contractors were not ready to digitally deliver a project at that level.

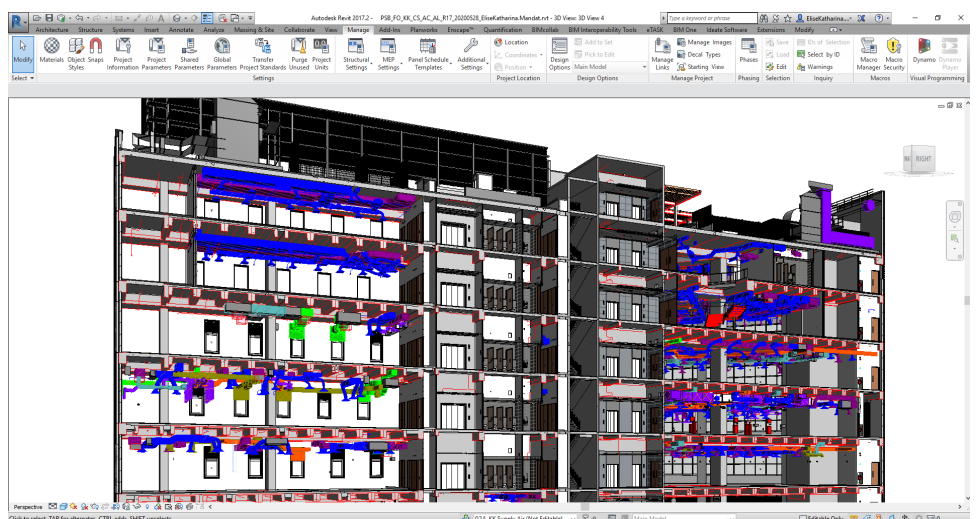
“Many contractors see BIM simply as 3D modelling and as a tool to perform Clash Detections. Often, the market practice is to carry out native design in 2D and to do post-design modelling, translating the 2D drawings into a 3D model with BIM. With this local approach, we forecasted a slow and risky project. As the building owner to carry both the construction costs and the operational expenses, we wanted to see especially the

optimization portion of BIM and CDE for better building safety, sustainability, performance and operation,” explains Gilbert Lau, the Project Manager at TÜV SÜD.

“We wanted to go beyond the locally typical LOD300 BIM model requirement for the project submission, pursue the digital prototyping approach and utilize all measures to order to manage our building project with high efficiency and predictability, as well as sustainability.”

Together with TÜV SÜD’s internal BIM management as well as the Sustainability, Construction and Facility Management experts onboard, Nakano as the nominated contractor integrated all the use cases specified by TÜV SÜD: for the construction design and further use, completely new and sophisticated Revit models had been developed by Nakano as basement for TÜV SÜD experts to integrate the building-related use cases, such as:

- Simulations for structural and thermal layouts, for lighting and aircon / ventilation optimizations
- Model checks for fire safety and local fire compliance as well as for Wi-Fi signal coverage within the building
- Model checks and trade optimizations towards Design for Maintainability, e.g. by using maintenance space models and FM advisory protocols
- Integrated calculations and measures towards Singapore’s Green Building Mark



Building A Digital Twin

From the commencement of the project, Autodesk solutions were adopted as the native ecosystem by the project team that comprised real estate experts, financial specialists, BIM experts, construction experts, and facility managers within TÜV SÜD.

“We chose Autodesk as the most efficient project ecosystem to cover all core trades, such as architecture, MEP and structural engineering being processed in a single native environment,” explains Tobias Schmidt. “Also, Revit is a very flexible core data source and information management basement, e.g. to extract other open formats we needed for simulations, cost counting, construction inspections and facility management, such as IFC, gbXML and COBie.”

TÜV SÜD found that workflows such as Change Management (Request for Changes), the User and Facility Management Involvement, the Integrated Digital Delivery (IDD) and the handling of various deliverables and results can be expedited to complete the entire Building Lifecycle Services without investing any additional time.

Besides using native Revit models, BIM Collaborate Pro as the Common Data Environment towards the essential productivity according to ISO 19650 is the lifecycle embracing data highway to organize and manage not only the project data but communication as well as the quality control of every stage of the project.



Models created in **Revit** took on the essential role of facilitating successful digital prototyping. **Navisworks** was deployed for clash detections, and to run various Design for Maintainability, Constructability and Design for Building Safety tests and checks.

Dynamo was used by TÜV SÜD to run complex Model Checks including As-built Documentation Compliance or towards proper pressure cascades and air ventilation performance in unique spatial settings within the building.

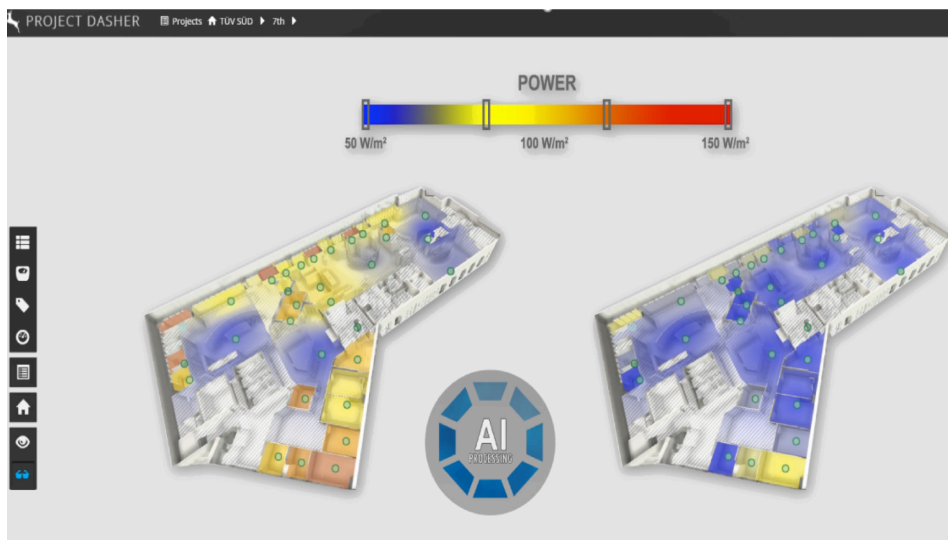
During the construction phase, the BIM models were used to perform the close-meshed periodical ‘Built As Planned’ checks along with tolerance validations and digital progress monitoring: Contio’s Scan2BIM overlays helped to extend the quality and risk management to a combined remote-onsite construction assurance, to dramatically lower onsite

and travel costs for TÜV SÜD’s Construction Inspectors.

The data from Revit models have been also used to review the Building Management System (BMS) layout and construction accuracy.

For the commission and handover to operation, TÜV SÜD utilized **Autodesk Forge** functions and the **BIM 360 Ops** to achieve a fast and accurate ramp up of the internal and external Facility Managers. Also, via Revit-based IFCs and COBie sheets, Nakano and TÜV SÜD delivered the required digital building documentation to set up the building’s Computer Aided Facility Management (CAFM).

As the successful project outcome, TÜV SÜD delivered the planned Building Lifecycle Solutions and optimizations with the interdisciplinary use of Autodesk tools, achieving the following technical KPIs:



- Reduction of the facade’s thermal value: with BIM and BIM-based simulations, an achieved Envelope Thermal Transfer Value (ETTV) of 32.40 W/m², which is even 35% better than Singapore’s current code requirement
- Lighting costs improved by 51% over local code requirements
- Energy savings due to optimized and fully balanced aircon and ventilation systems with energy savings of 17% higher than the code requirements

Optimizing productivity and building performance right from the design phase.

By carrying out the Construction Design directly in Revit, the project team saw design time savings on authoring and coordination level of 70% compared with the market habit of “post-design modelled 2D”, which avoided the design creation in CAD and then translating it into 3D models.

The use of Autodesk Construction Cloud as the project Common Data Environment brought Information Management time efforts of nearly 60%, due to the pre-defined workflows and through the central data drop handling among internal and external experts.

The Revit ‘mother models’ avoided the usual costs for remodelling, e.g. through data errors and re-development of IFC or COBie files, that can easily make up S\$60-150,000 per project, based on TÜV SÜD’s project reviews in Asian markets.

During the pre-construction phase, TÜV SÜD customized Model Checks brought further savings. By implementing Model Checks for code compliance and for the automated BIM model audits, the project saw a reduction in BIM management costs and for Risk Management by at least 50%. This was executed via Navisworks, the customizable Revit In-Built Checker and TÜV SÜD Dynamo scripts, which helped to cut down technical audit time for highly repetitive tasks, such as fire and sprinkler system audits, that manually last e.g. three to five hours, down to just 30 minutes.



The application of Model Checks also brought significant savings for reworking. As many construction errors occur due to raw materials and constructability issues, the comprehensive use of Model Checks helped to avoid the traditional overspending of 30% (local market average) of the construction costs on rework due to undetected design errors, which, in turn, enabled the team to avoid major rework issues.

“By using BIM, we could plan and visualise the entire project during the pre-construction stage. We’ve been able to detect clashes in mechanical, electrical and plumbing (MEP) before construction began, thereby significantly reducing the amount of rework, and mitigating potential risks,” said Kevin Kwan, Project Manager of Nakano.

Through digitally assisted construction related data services, such as Scan2BIM overlays and a digital inspection, saved TÜV SÜD saved travel and freewheel process costs in the six-digit range.

This was especially helpful to the project team as almost 50% of the TÜV SÜD’s project experts were based in Germany. The ability to operate remotely and efficiently meant that they could save on colocation costs.

The Results

Starting building operation by January 2021, TÜV SÜD’s digital prototype has resulted in a ‘touchable’ Digital Twin in Singapore with many use cases across design, construction and commissioning implemented.

Today, TÜV SÜD’s new ASEAN headquarters at 15 International Business Park in Singapore is a testament that digital twin projects combine both the proper specifications and strategies with the right technologies to ensure synergies and value partnerships among all the project stakeholders, meaning TÜV SÜD as appointing party and the Contractors as well as technical experts, can come true. TÜV SÜD has proven that building safety, sustainability and performance do happen with the lifecycle - embracing knowledge into relevant data that help to achieve a building that is truly a better place for working and living.

“Our TÜV SÜD @ IBP represents a true pivotal case study where we harness the full benefits of Digital Building Lifecycle Solutions. Being both the asset owner as well as domain expert, we can leverage our global real estate portfolio to benchmark new technologies and ultimately implement proven best practices on our own premises.

We are truly excited to showcase our ASEAN HQ as a prime example of future digital twins!”

– **Richard Hong**
ASEAN Chief Executive Officer,
TÜV SÜD

