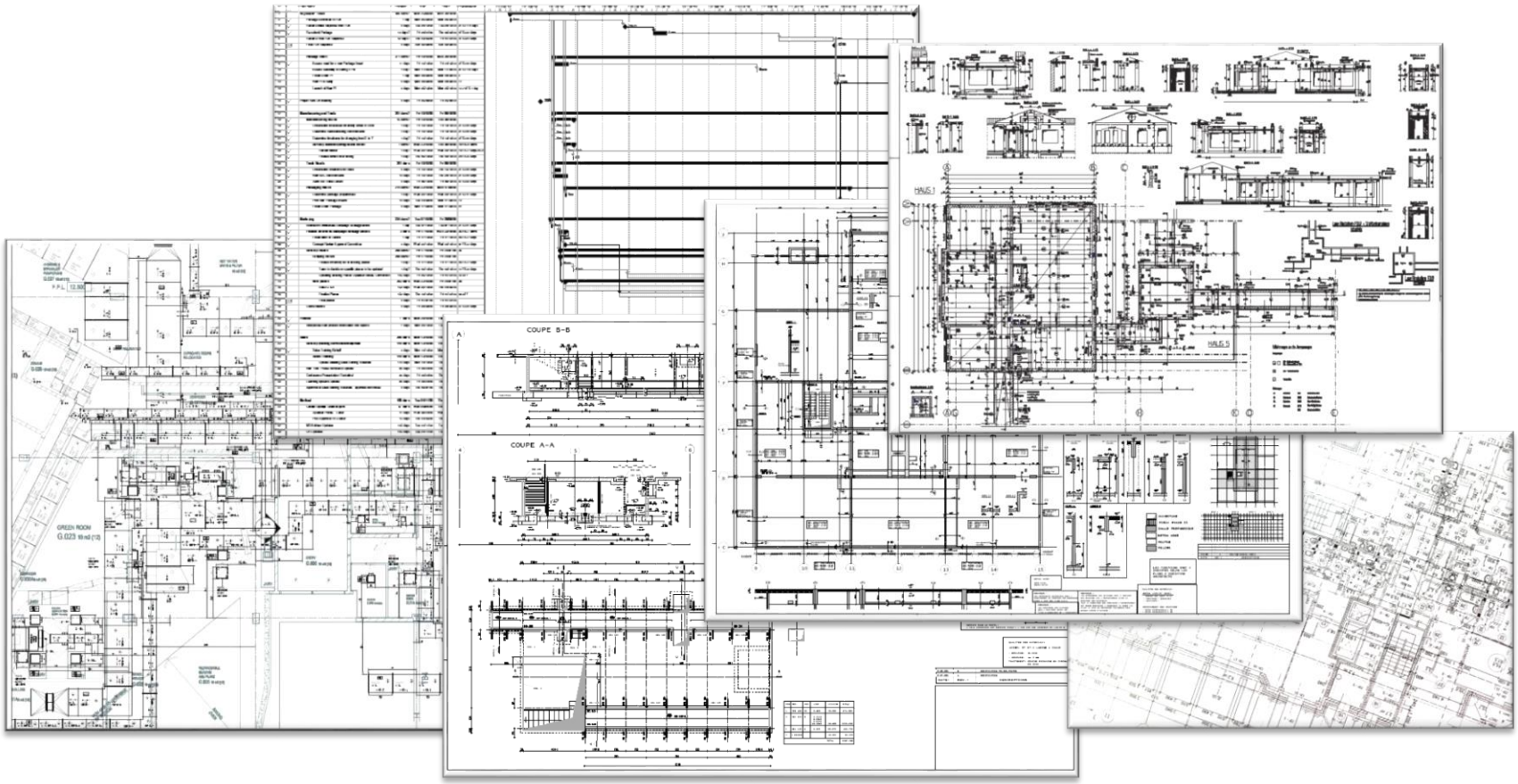
Building Information Modeling – Digitizing the construction industry

Prof. André Borrmann
Chair of Computational Modeling and Simulation
Technical University Munich

Planning and building today



Planning and building today

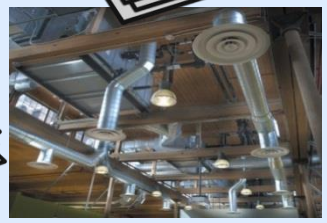
Client

Planning

Architect

Structural Engineer

Electrical Planning



Building Systems

Surveying

Construction

Facility Management

Problems

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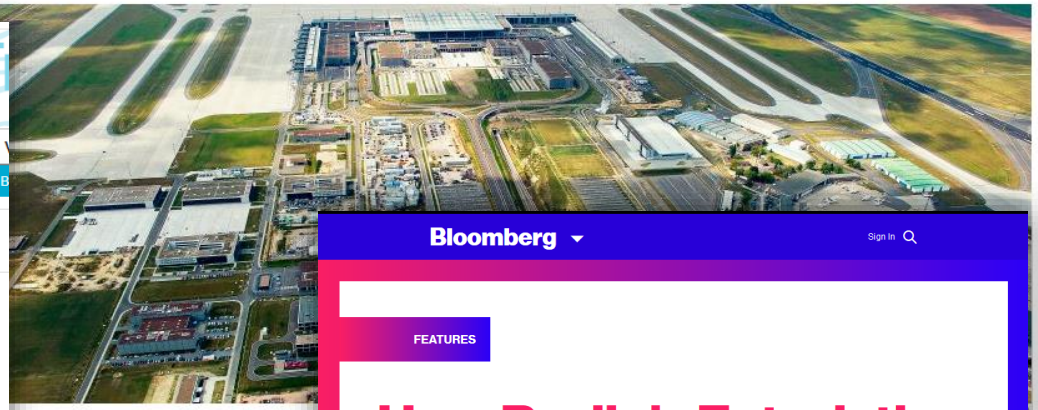
English Site > Germany > Berlin Airport > 5 Billion Euros: Costs Increase Again for Berlin Brandenburg Airport

ANZEIGE

Cost Explosion: Price Tag for New Berlin Airport Keeps Rising



...lin Brandenburg Willy Brandt Airport ha...

...eemingly neverending story of t...
...-delayed project is expected to ...
...ing a return to the airport's sup...

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From The Web

And you thought the Germans were efficient! Yet more problems for Berlin's €5.4BILLION white elephant airport as engineers declare the new roof 'too heavy'

- **Fans were originally installed in 2012, but found to be over weight limit**
- **Latest in a long-line of problems that has dogged the futuristic airport**
- **The lights can't be switched off and the wrong trees were planted**

By JOHN HUTCHINSON FOR MAILONLINE

PUBLISHED: 14:13 GMT, 22 September 2015 | **UPDATED:** 14:37 GMT, 22 September 2015

Share 205 shares 21 View comments

The long-running saga surrounding Berlin's Brandenburg Airport took another turn for the worst when construction was halted over fears the roof is too heavy and could collapse.

Originally scheduled to open for business in 2011, the airport was supposed to be state-of-the-art -and eventually merge with the city's other two operating sites, Tegel and Schönefeld.

It was to be a sign of Berlin's transformation from Cold War confrontation line to world class capital of Europe's economic powerhouse. Instead it has become a symbol of how, even for this technological titan, things can go horribly wrong.

Bloomberg

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FEATURES

How Berlin's Futuristic Airport Became a $6 Billion Embarrassment

Inside Germany's profligate (Greek-like!) fiasco called Berlin Brandenburg

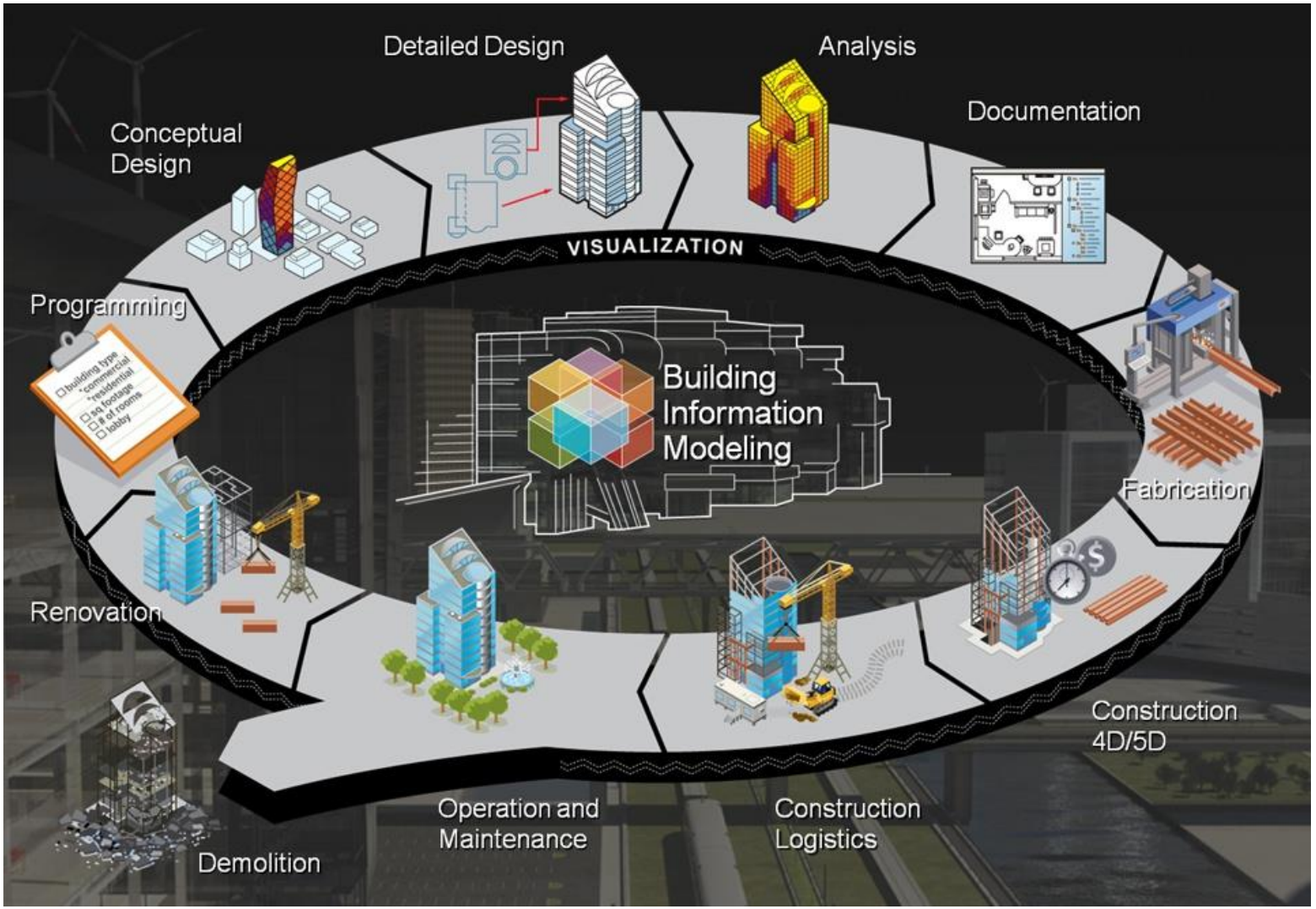
July 23, 2015

by Joshua Hammer
from Bloomberg Businessweek

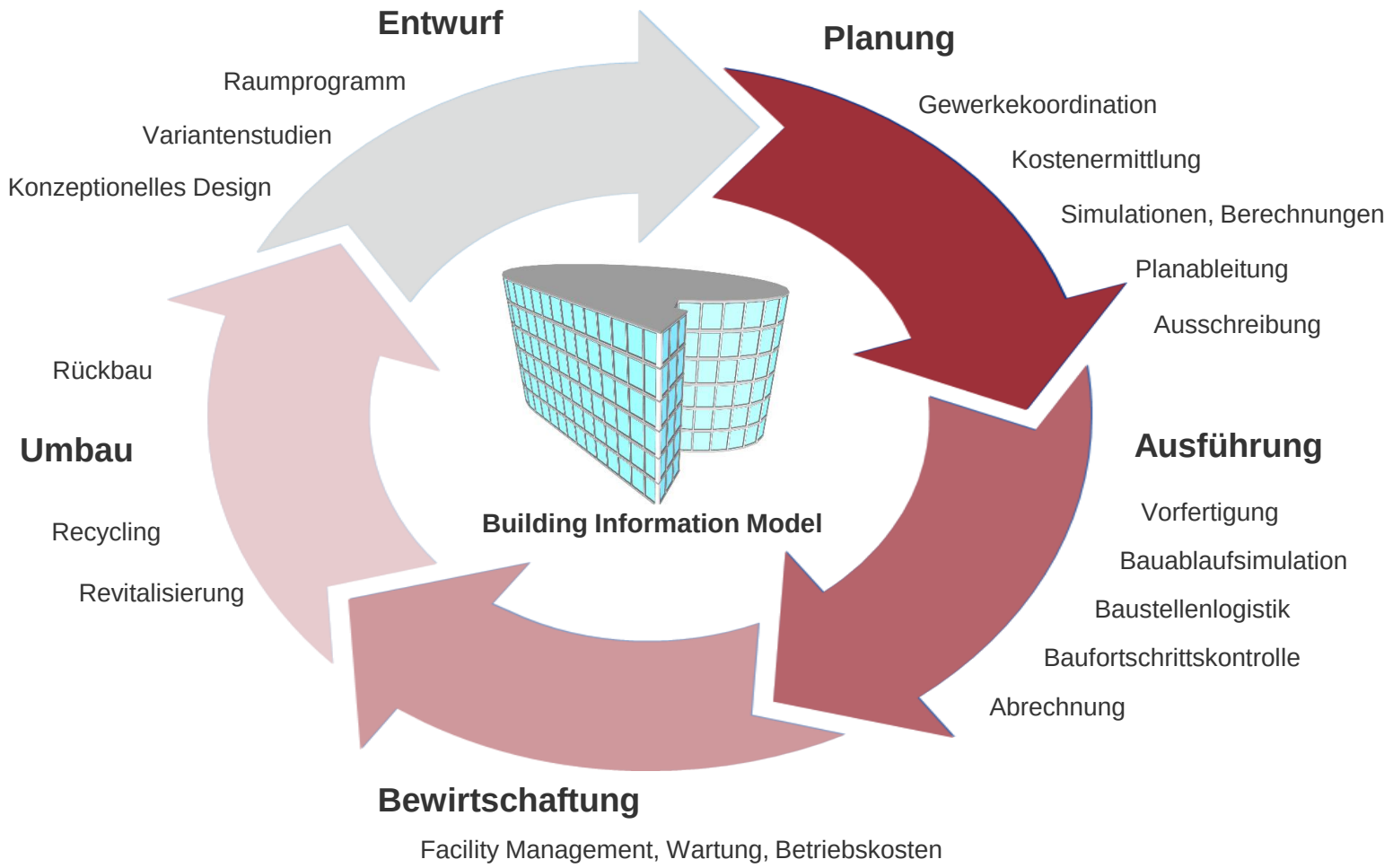
Reprints

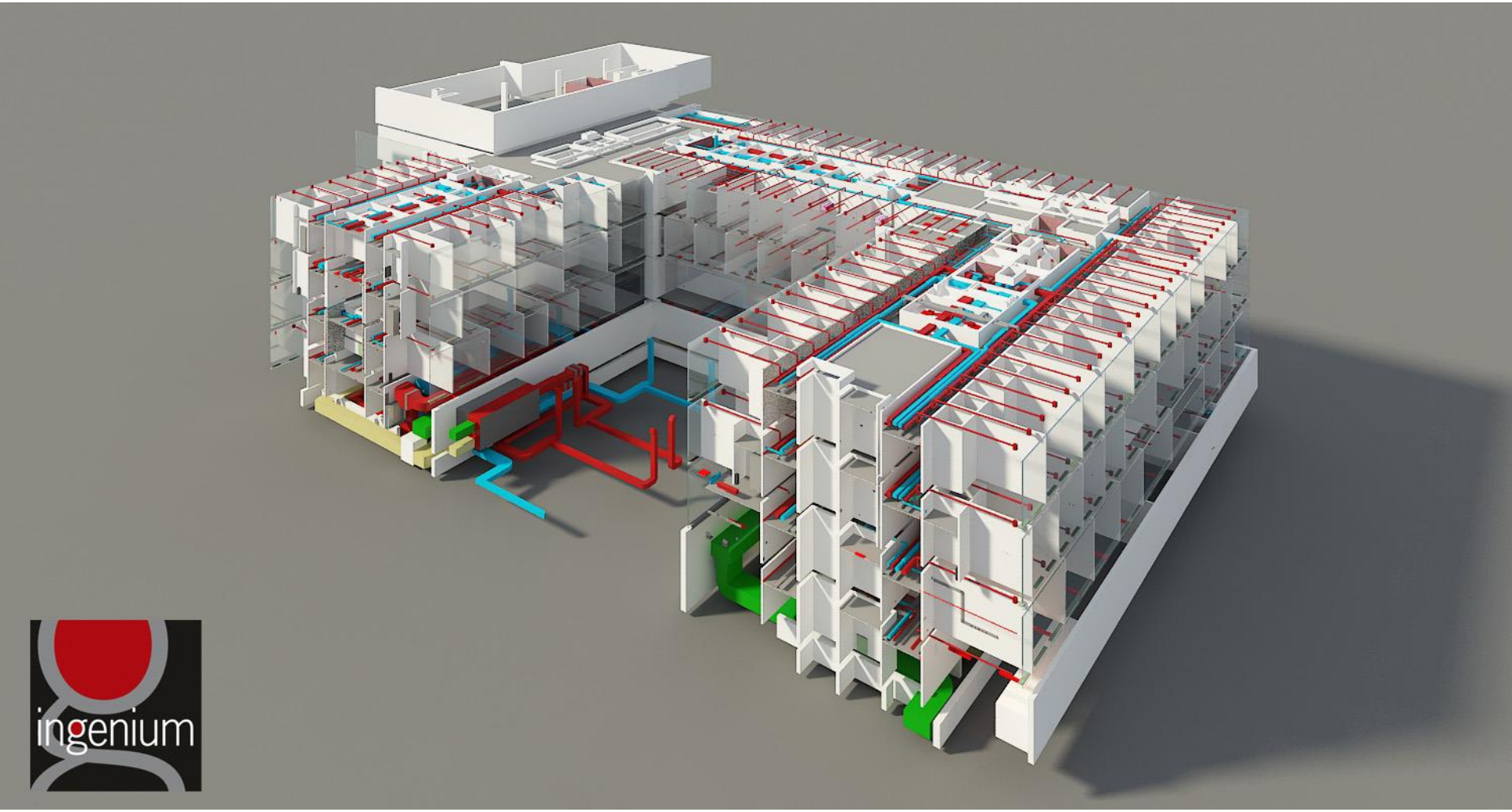
Automotive industry

BMW



BIM im Hochbau

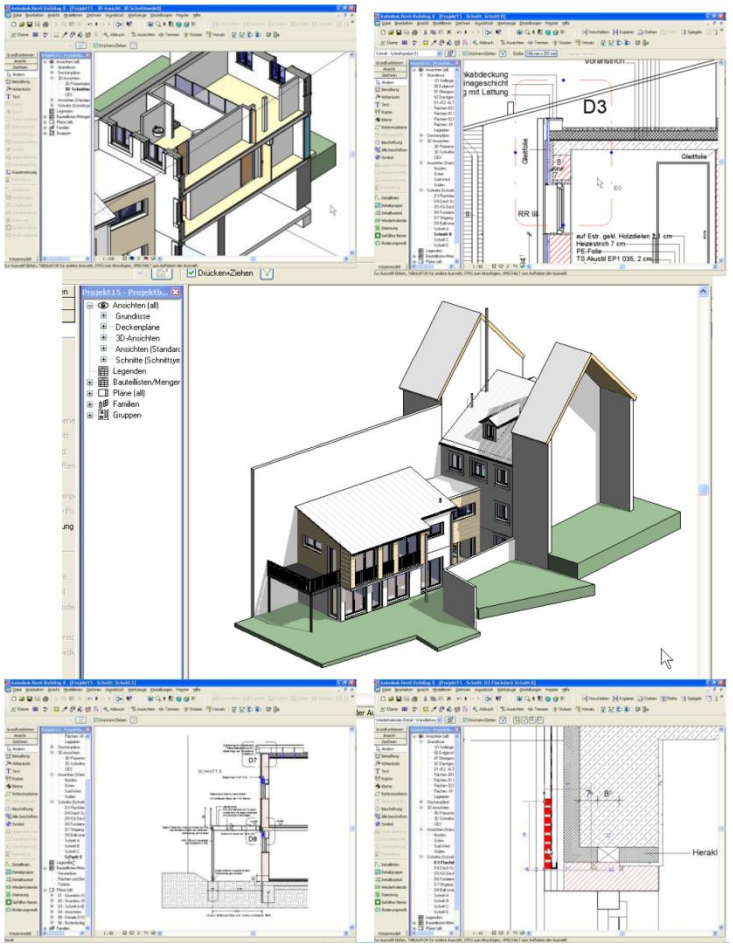




Building Information Model

Most important characteristics

- three-dimensional geometry
- pre-defined construction-specific objects
  (walls, doors, windows, columns, etc.)
  → derive code-compliant drawings
  → quantity take-off
  → analyses und simulations
- linked with additional information
  → material parameters (density, elasticity, etc.)
  → relationships (elements, spaces)
- comprehensive digital representation of the building
- usage for analyses and simulations

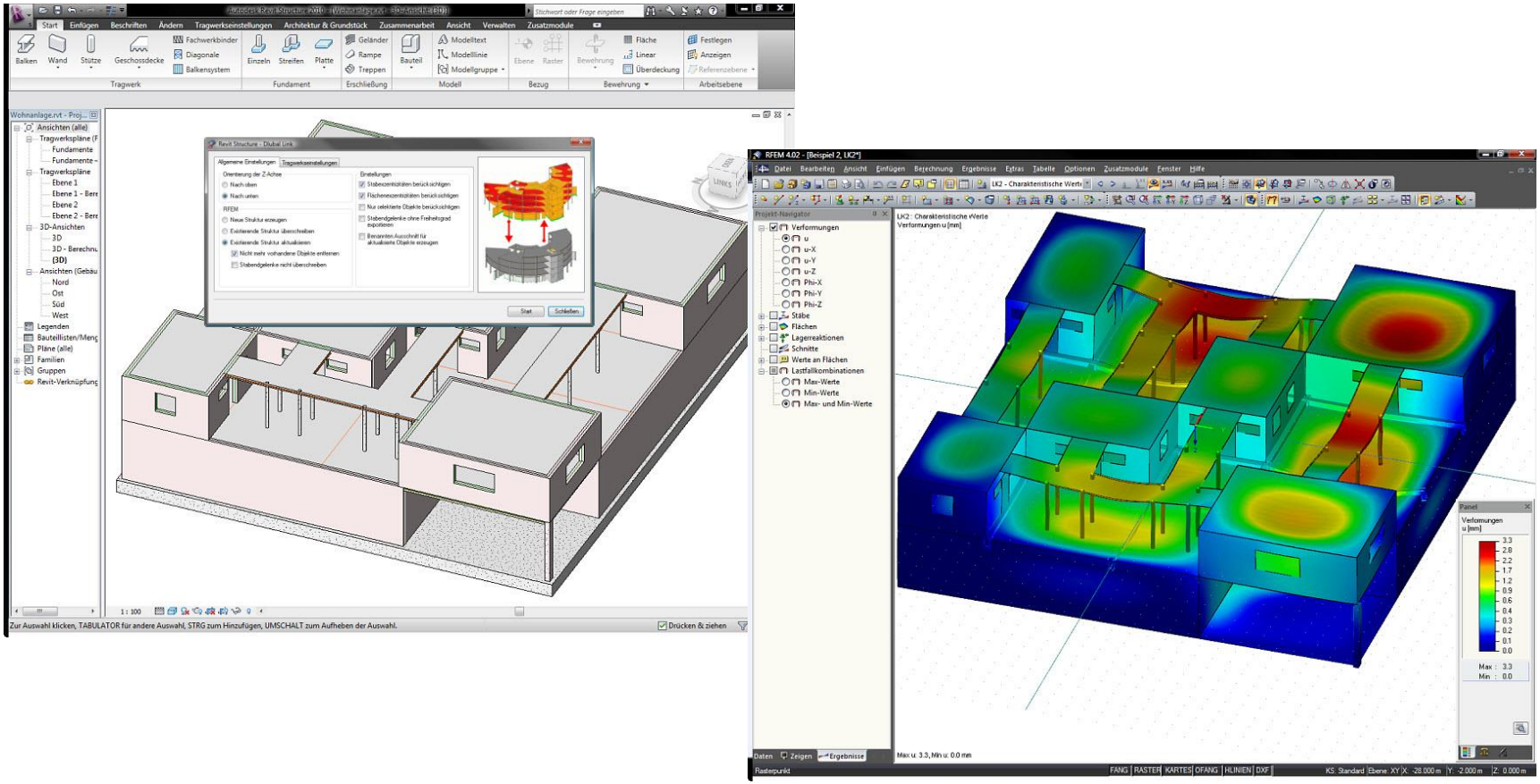


Autodesk Revit

BIM-based visualisation

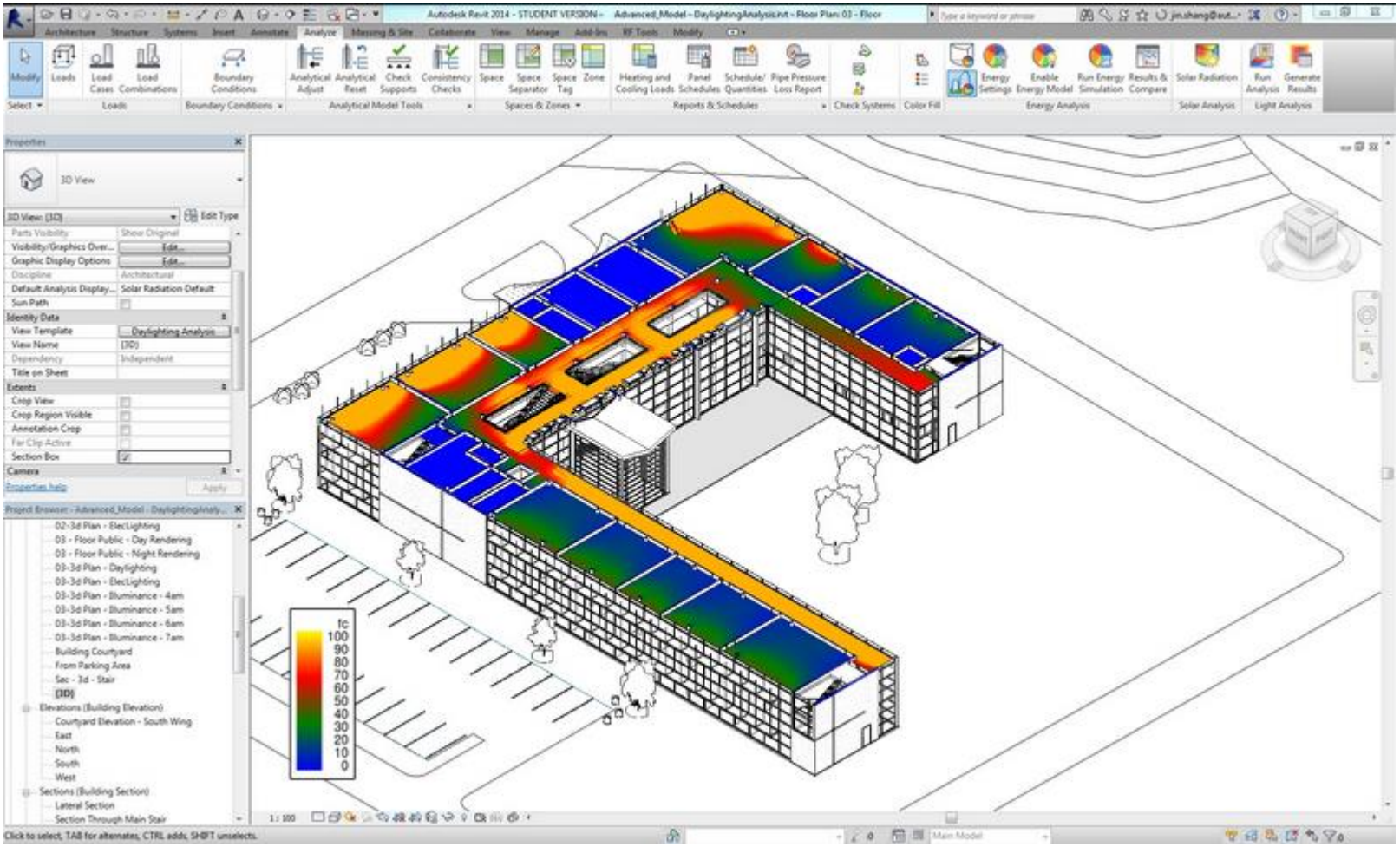
Artlantis rendering by Thierry Tutin

BIM-based structural analysis

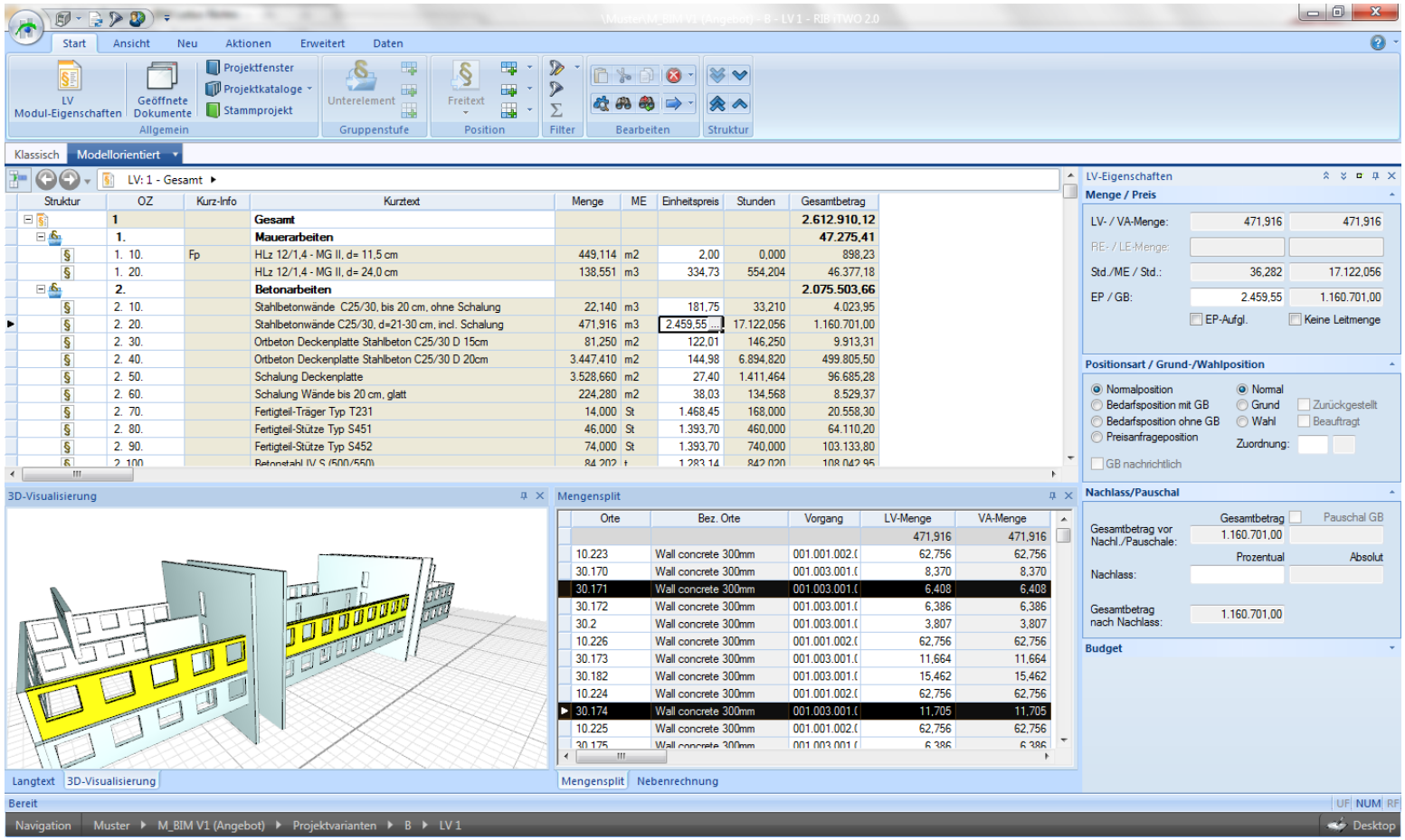


Dlubal RFEM

BIM-based energy analysis



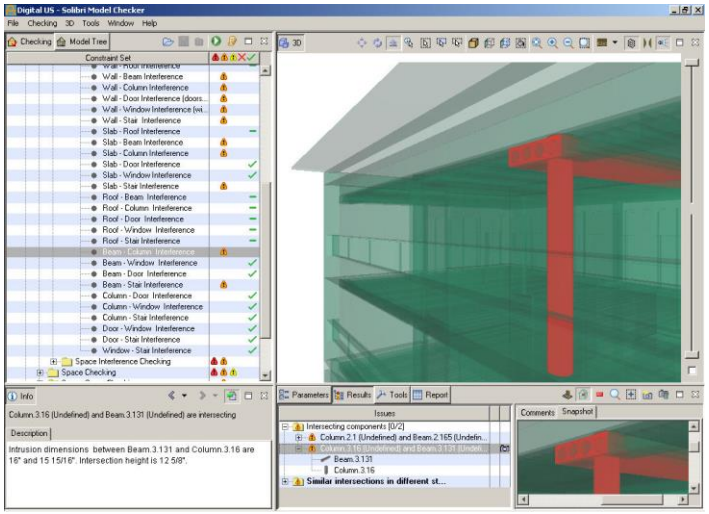
BIM-based Quantity Take-off → Tendering

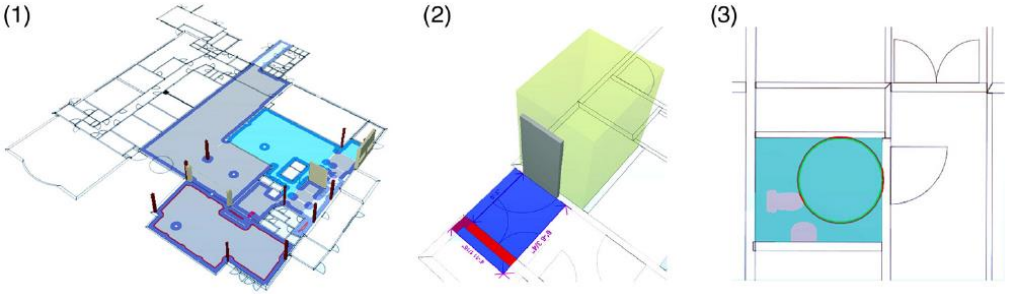


RIB iTwo

BIM-Supported standards and guidlines

- **Today:**
  Manual Checking of Building design with standards and guidlines
- **Future:**
  - Digital database and construction of standards
  - Automated checks in BIM-Model

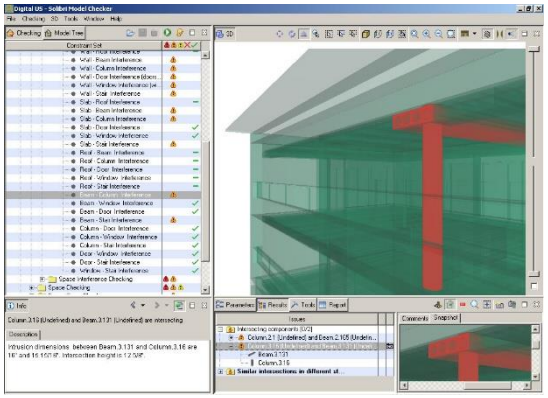


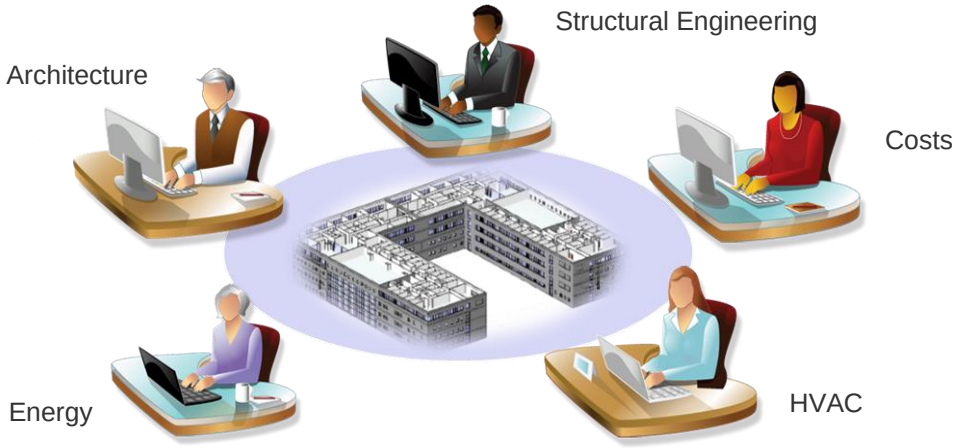


BIM-based Coordination of the Planning Process

Advantages

- no repetitive data input
- better coordination among the stakeholder
- clash detection
- less errors, reduced costs

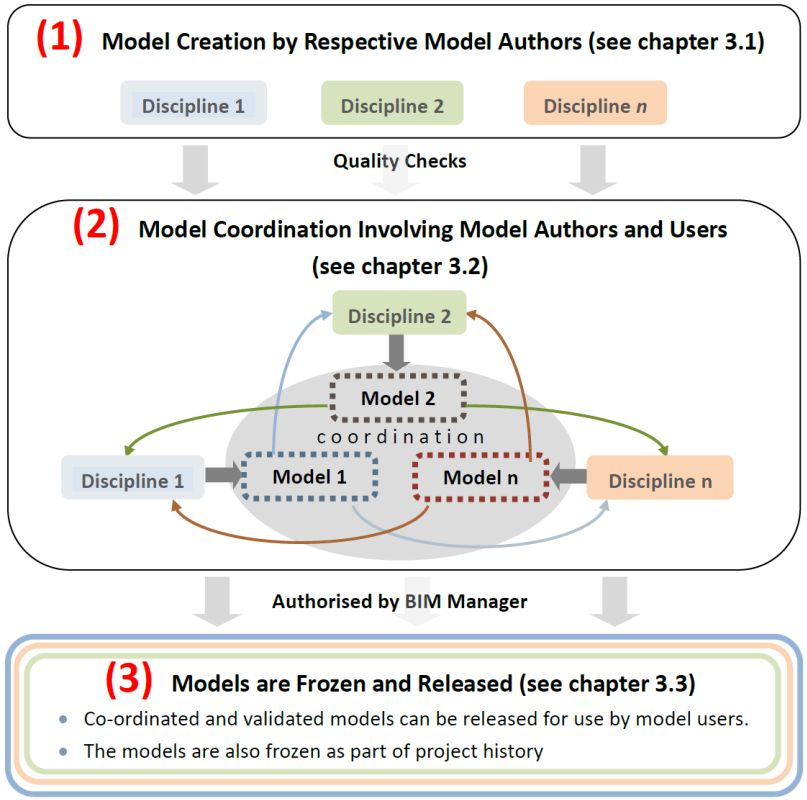




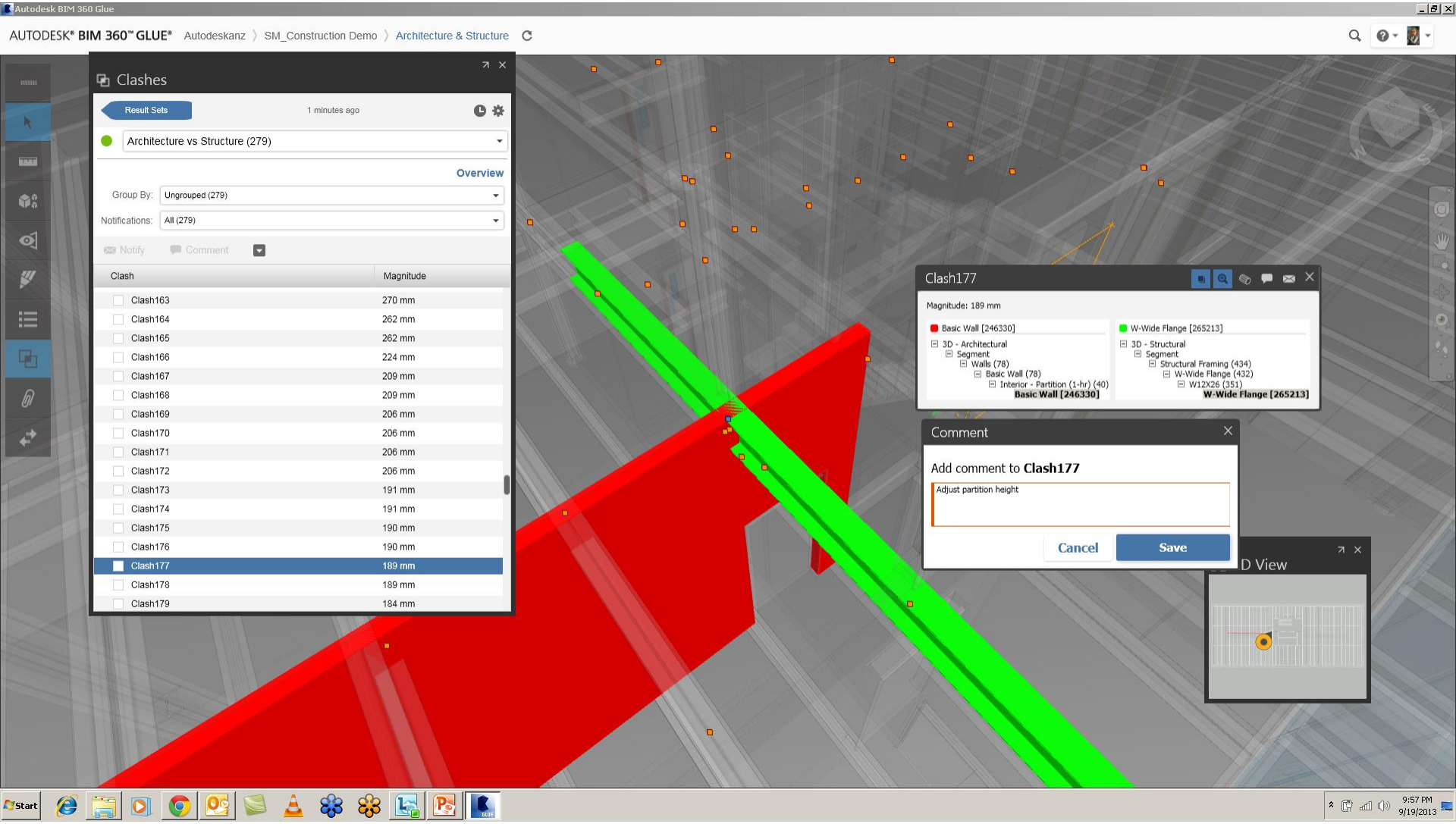
BIM-based Coordination of the Planning Process

Federated models approach

- Each engineering discipline maintains control over their data
  → *responsibilities*
  → *IPR ownership*
- Discipline modes are merged into one model in regular intervals
- → *Clash Detection*
  → *Clash Documentation*
  → *Clash Resolution*
- Modification of a discipline model is only performed by the responsible engineer/architect

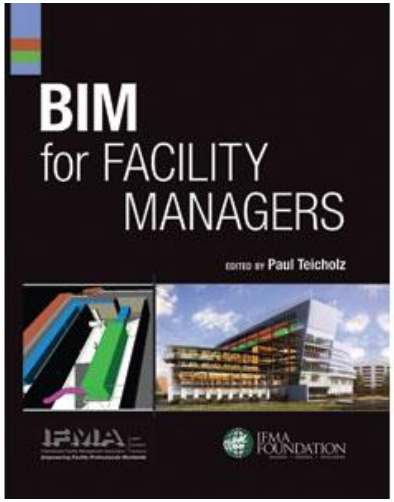


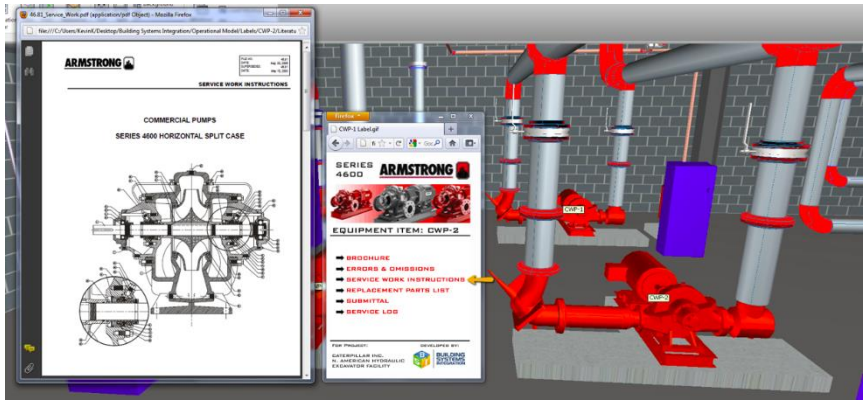
Singapore BIM Guide



Advantages for the owners

- Handover of the model
- Continuous use of the model throughout the operation phase
- Facility Management Systems
- Archiving the building model (neutral format!)





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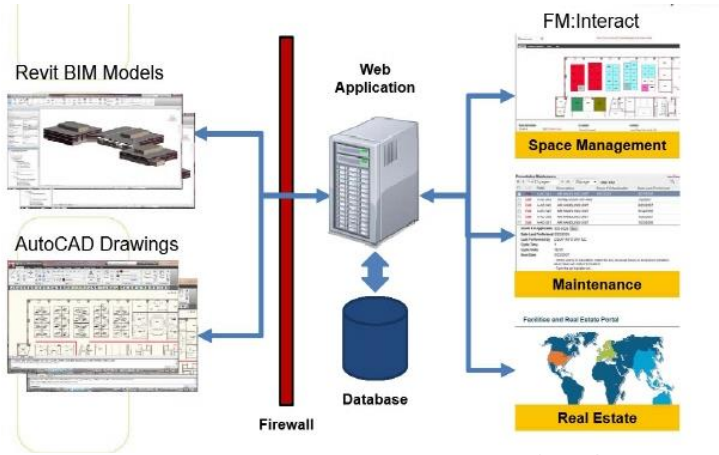

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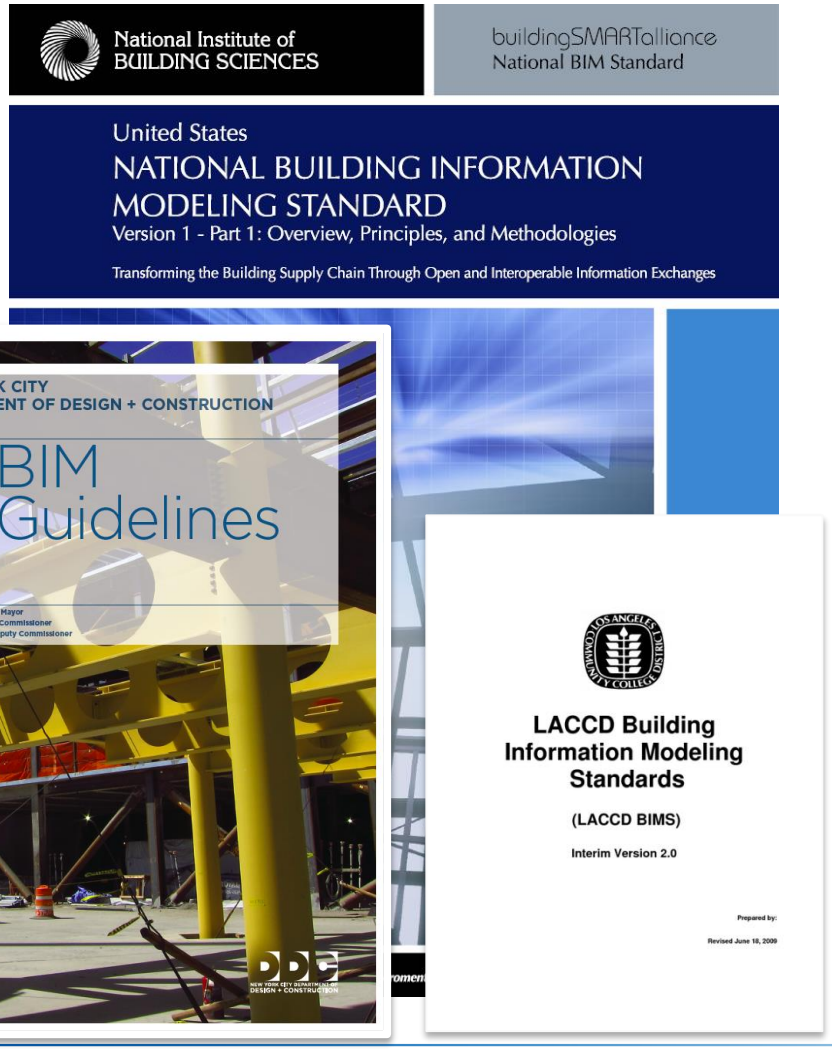
State of implementation

USA

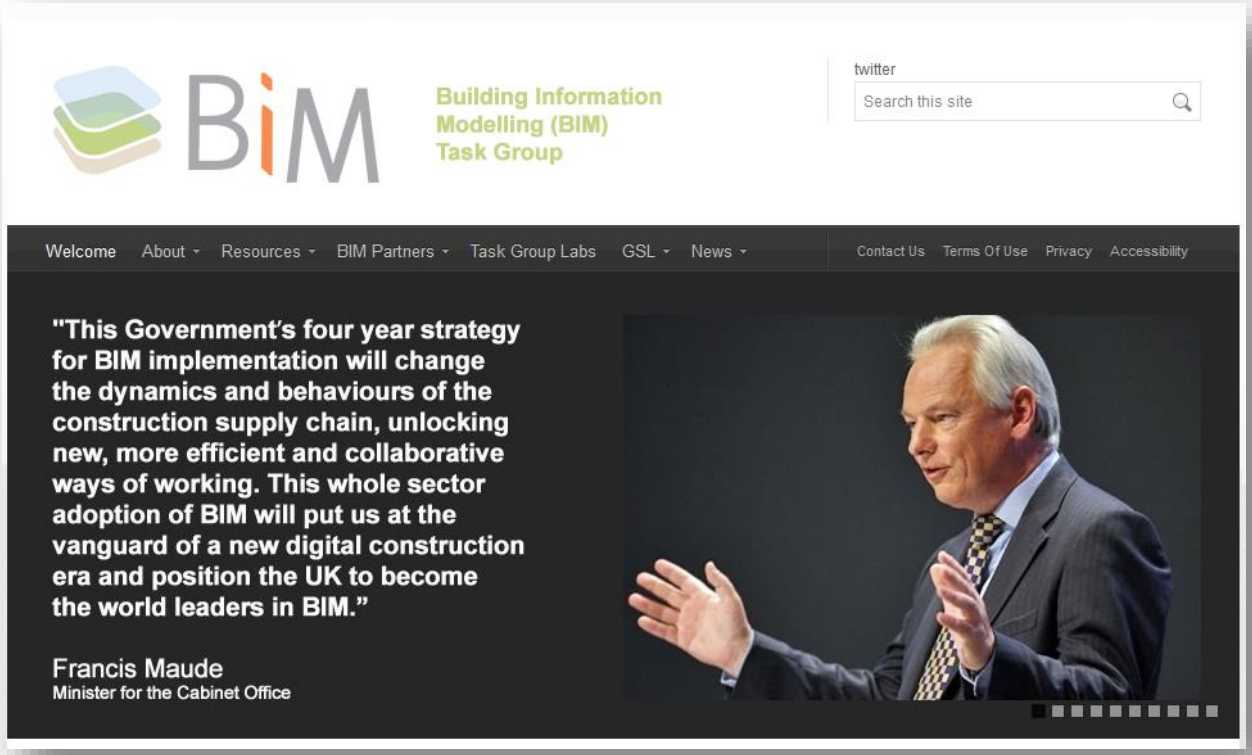
- wide adoption in building industry
- nationwide guidelines
  - NIST: National BIM Standard (NBIMS)
  - General Service Administration (GSA) National 3D/4D BIM program
  - US Army Corps of Engineers
- large number of local guidelines



State of implementation

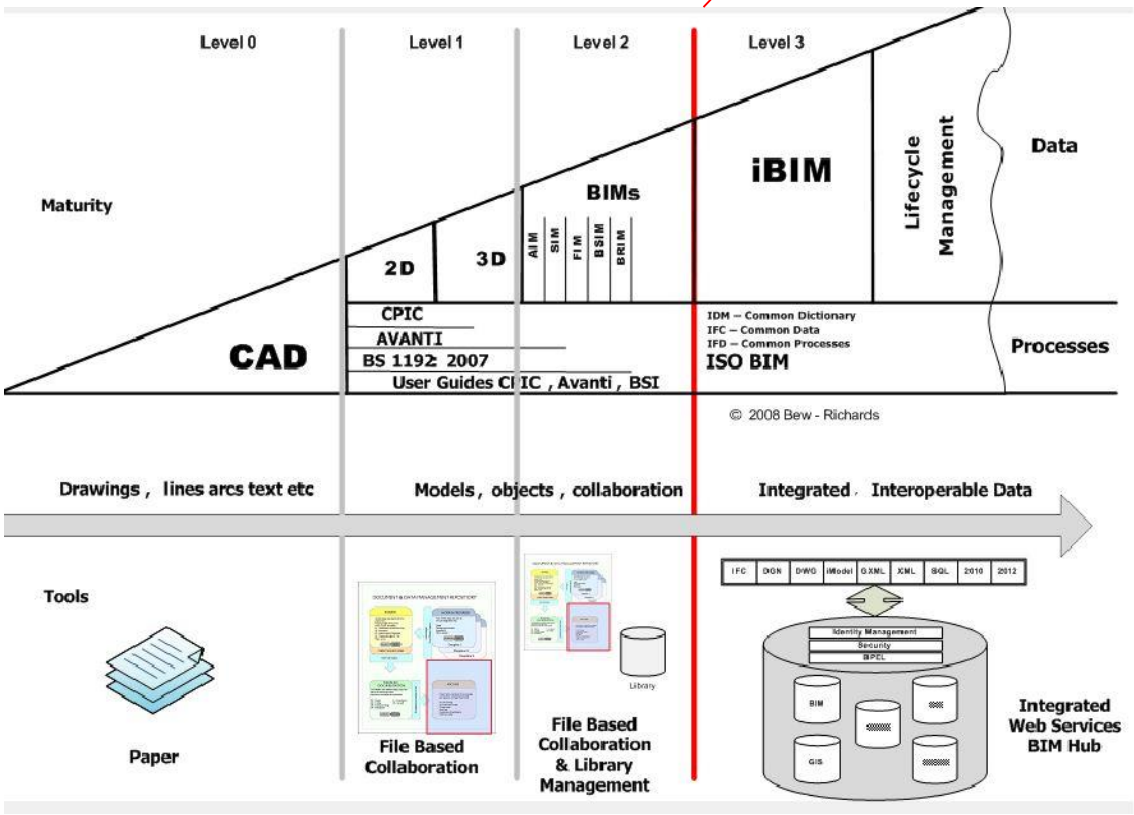
United Kingdom

- UK BIM Strategy since 2011



State of implementation

United Kingdom



BIM LEVEL 2

Home About BIM Level 2 Standards Guidance Events Tools FAQs

Glossary

Welcome to the new BIM Level 2 website

We have developed this resource as a point of reference for clients, designers, contractors, trade suppliers, manufacturers, maintainers, operators and users to understand how to use Building Information Modelling (BIM) and data to improve productivity and reduce waste.

Work has been undertaken over the past four years in a joint Government – Industry Working Group called the BIM Task Group to provide Standards, Guides, Case Studies and shared experiences to help all stakeholders with their BIM adoption Journey.

BIM in Germany

BIM in Germany

History: Reform Commission

Der BIM Beirat

Der BIM Beirat wurde am 12. Oktober 2010 unter Vorsitz des Bundesministeriu Berlin gegründet

In Abstimmung mit den Verbänden und Kammern der deutschen Bauwirtschaft, d und dem BMVBS - Bundesministerium für Verkehr, Bau und Stadtentwicklung entw

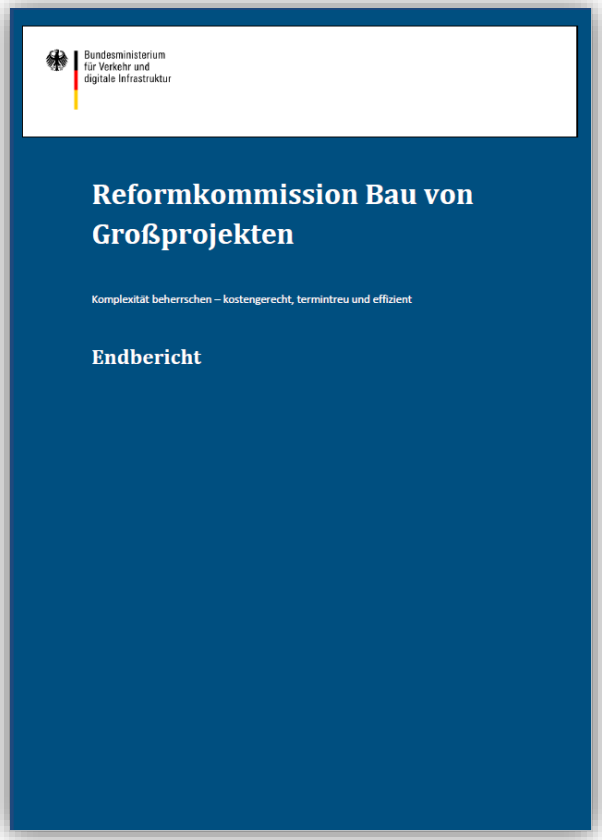
Reformkommission für Großprojekte erarbeitet Problemlösungen

Ramsauer: Experten für Großprojekte beginnen Arbeit

Erscheinungsdatum 17.04.2013
Laufende Nr. 064/2013

Heute ist die von Bundesminister einberufene Reformkommission fü zur ersten Sitzung in Berlin zusam Bundesminister **Ramsauer** hatte c besetzte Gremium vor Ostern ins um gemeinsam mit Spitzenkräften Wirtschaft, Wissenschaft und Verv Teil erheblichen Kosten- und Terminüberschreitungen beim Bau privater Bauprojekte auf den Grun

Auftaktsitzung zur Reformkommission "Großprojekte" (Quelle: BMVBS)



Bundesministerium für Verkehr und digitale Infrastruktur

Reformkommission Bau von Großprojekten

Komplexität beherrschen – kostengerecht, termintreu und effizient

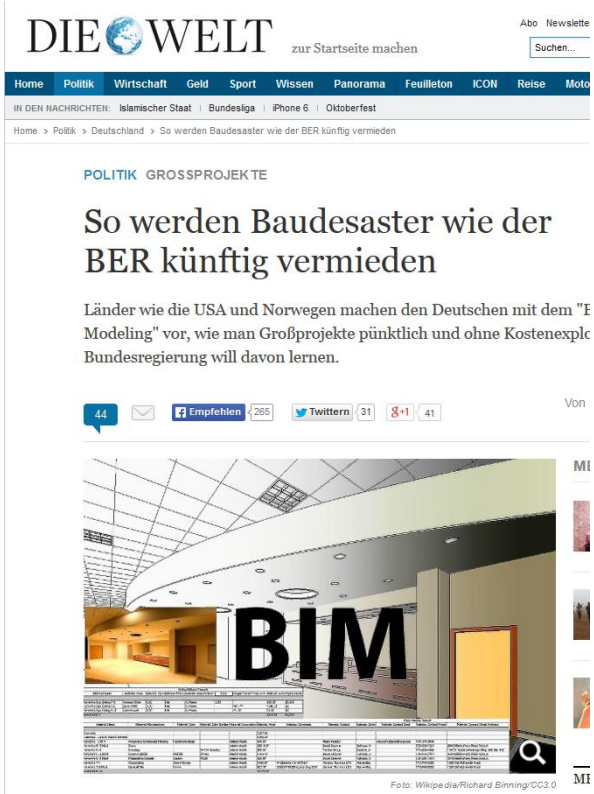
Endbericht

BIM in Germany

Politics

Minister of Transport, Alexander Dobrindt, 14.5.2014:

„The **digitalisation of the construction industry** provides chances to realize large construction projects within their time and budget limits. A better data basis for all stakeholders ensures transparency and networking. By doing so, schedules, costs and risks can be determined earlier and more precise.
Modern construction means: Built first virtually, and then in reality.
To foster the digitalisation in construction I will install pilot projects.”



Federal Ministry of Transport and Digital Infrastructure

BIM in Germany

Step-by-Step Plan

- Announced by the Minster of Transport in December 2015
- **Mandatory usage** of BIM methods in public infrastructure projects starting **2020**
- **Strong impulse** for German construction industry

German BIM Roadmap

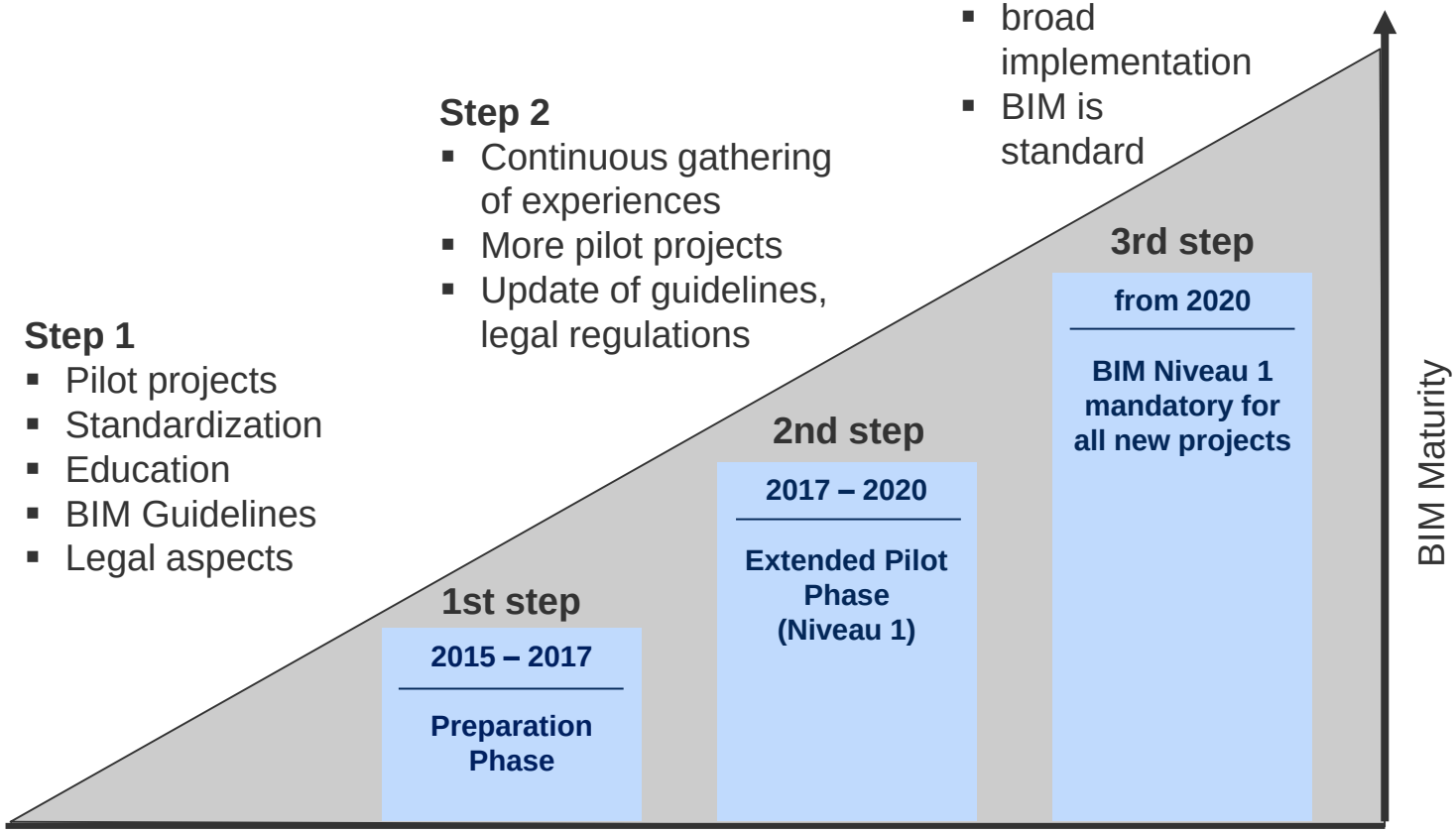
Bundesministerium für Verkehr und digitale Infrastruktur

Stepwise Introduction of BIM

Step 1
- Pilot projects
- Standardization
- Education
- BIM Guidelines
- Legal aspects

Step 2
- Continuous gathering of experiences
- More pilot projects
- Update of guidelines, legal regulations

Step 3
- broad implementation
- BIM is standard



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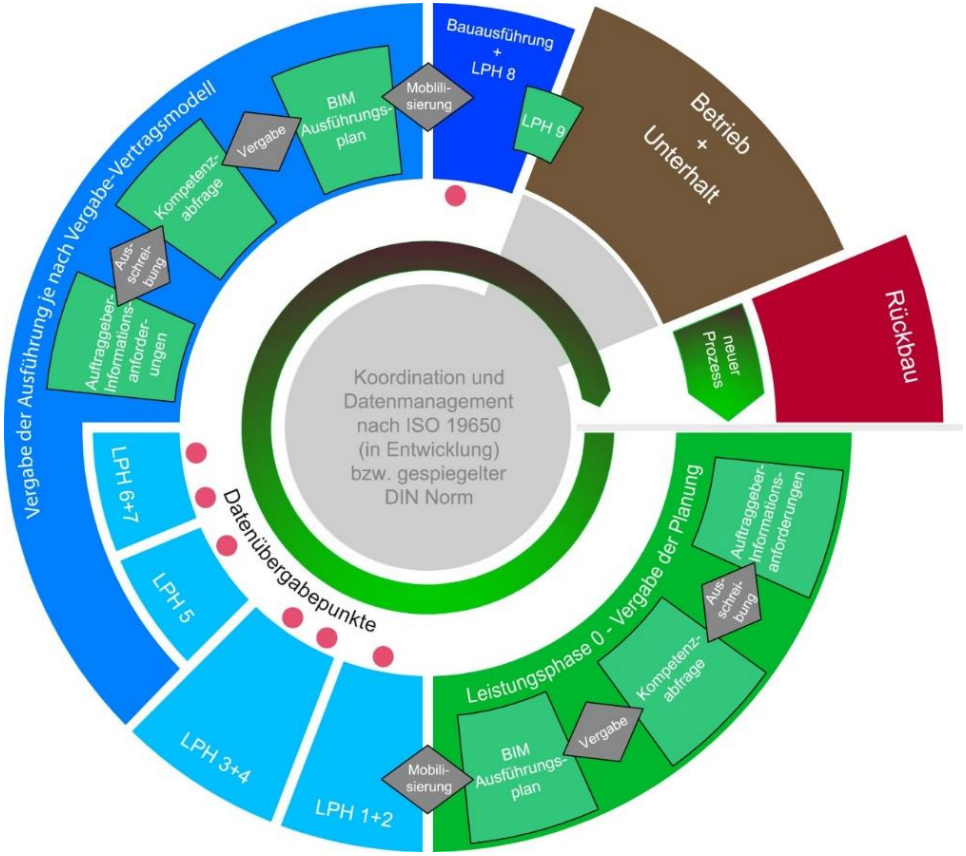
BIM Niveau 1

Bundesministerium für Verkehr und digitale Infrastruktur

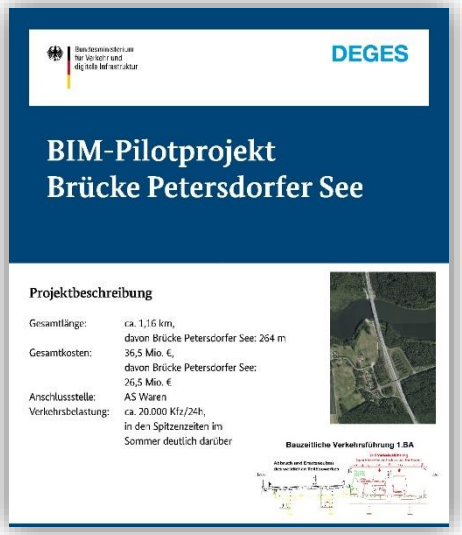
Most important characteristics

- **Integration of BIM methods into conventional procedures**
  → minor changes in laws and regulations
- **Employer‘s Information Requirements**
- **BIM Execution Plan**
- **Common Data Environment**: according to ISO 19650
- **Data Drops** for handover to client
- Usage of **open, vendor-neutral data formats** (IFC, OKSTRA, GEAB, etc.)



BIM Pilot Projects

Bundesministerium für Verkehr und digitale Infrastruktur



Bundesministerium für Verkehr und digitale Infrastruktur

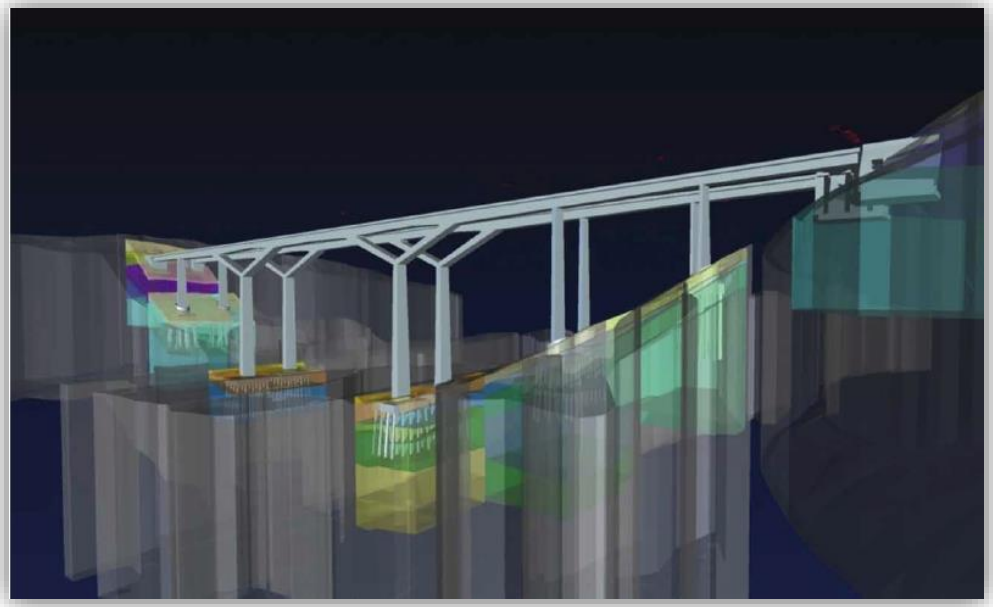
Scientific Analysis of the Pilot Projects

Tasks

- Detailed Analysis of BIM pilot projects
- Recommendations for actions

Consortium

- Technical University Munich
- Ruhr-University Bochum
- Obermeyer Planen + Beraten
- AEC3 Deutschland
- Kapellmann & Partner



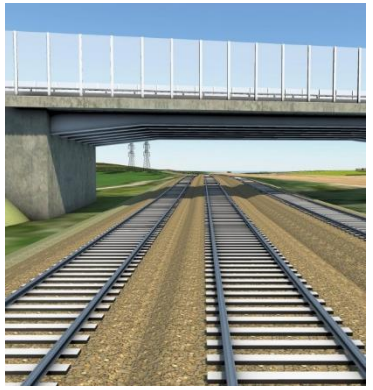
Filstalbrücke, © SSF Ingenieure AG

DEGES

BIM Pilot Projects

Auenbach Bridge – Southern Link Chemnitz

- New bridge in a 4-strip federal roadway, crossing a river and a railway
- Early planning phase (conceptual design)
- Investigation of different design options
  → BIM-based cost estimation
  → preferred option: 2 bridges and dam
- Fast and accurate cost estimation
- Communication with the public



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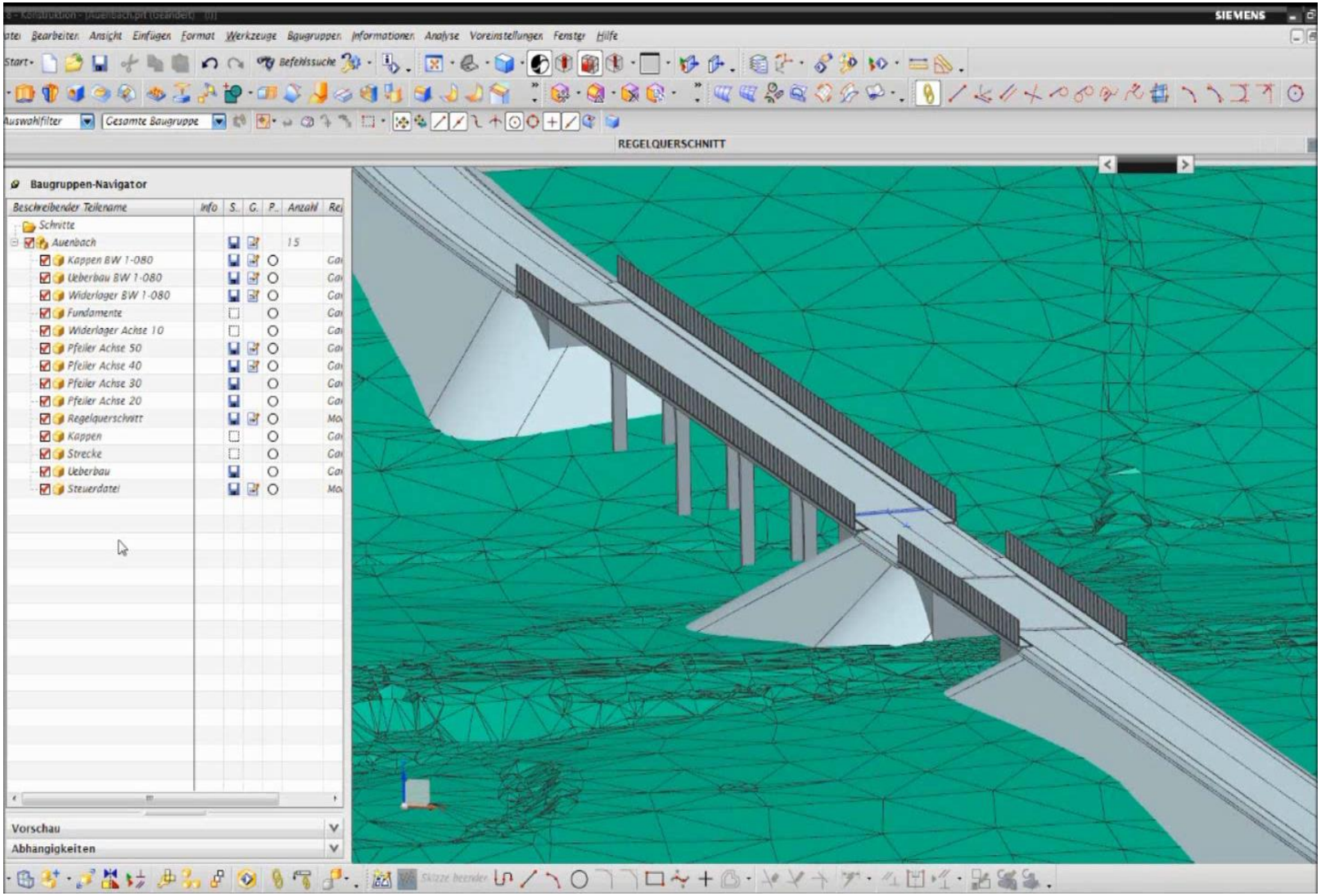

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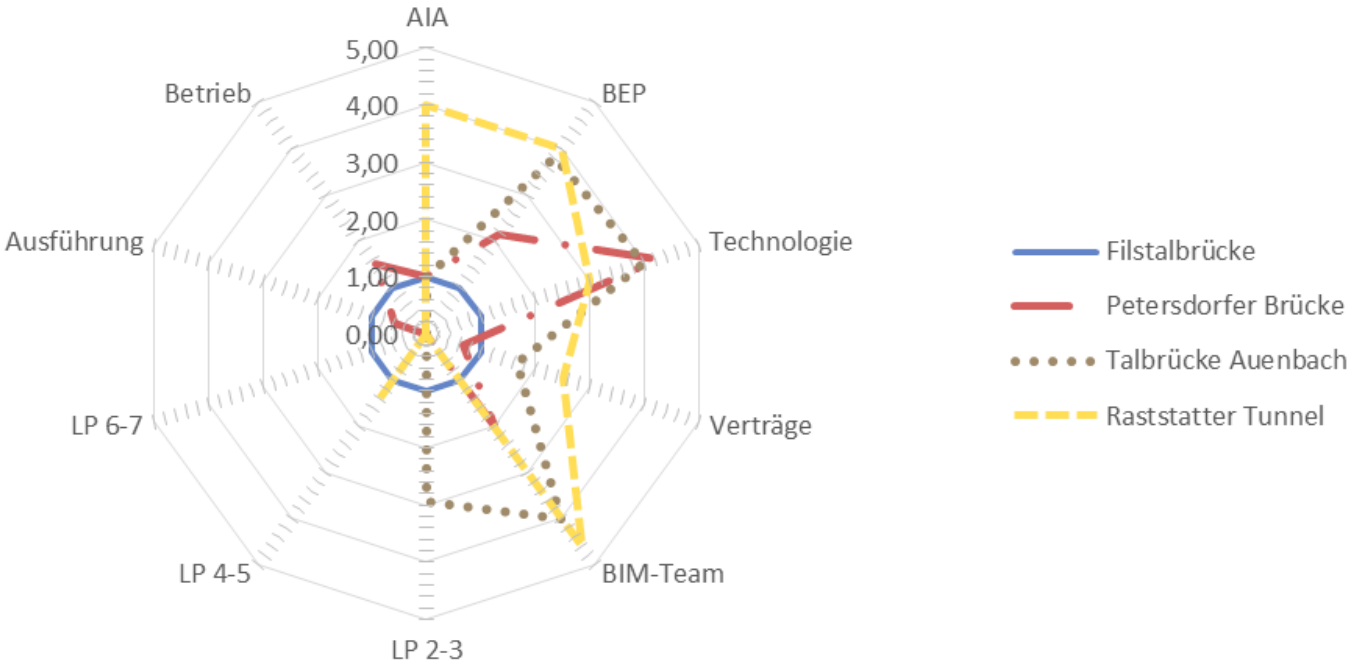
Scientific Analysis

Intermediate Results

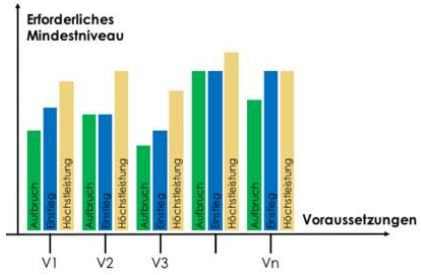


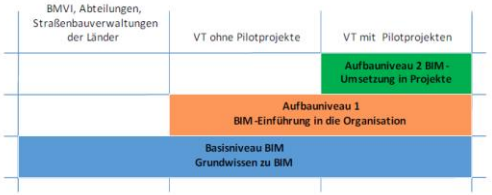
Bundesministerium für Verkehr und digitale Infrastruktur

Implementation of the BIM Roadmap

Ministry of Transport

- Detailed Definition of BIM 2020 scenario
- Guidance of 25 new pilot projects
- In-depth legal analysis
- Guidelines, templates, recommendations for public authorities
- Data base concept: BIM cloud
- Model checking concept





planen bauen 4.0

RUB TUM

KAPELLMANN UND PARTNER RECHTSANWÄLTE

MAX BÖGL

HOCHTIEF ViCon

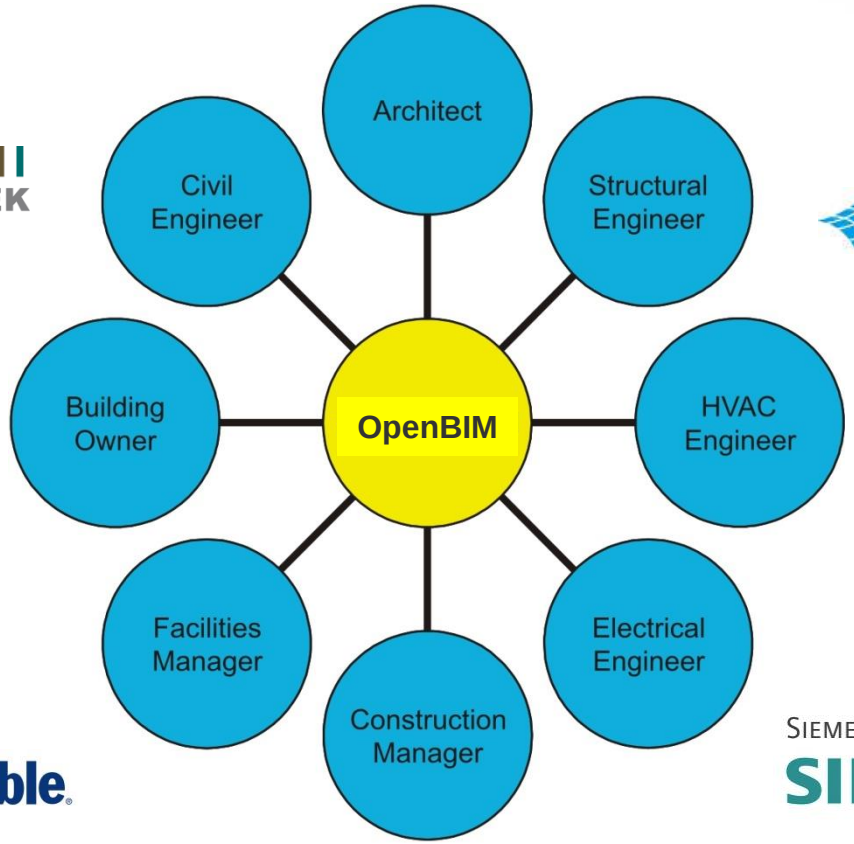
WTM ENGINEERS

AEC 3

interactive instruments

Industry Foundation Classes

Vendor-Neutral Data Exchange Standard



Research

Capturing existing bridges

SEEBridge

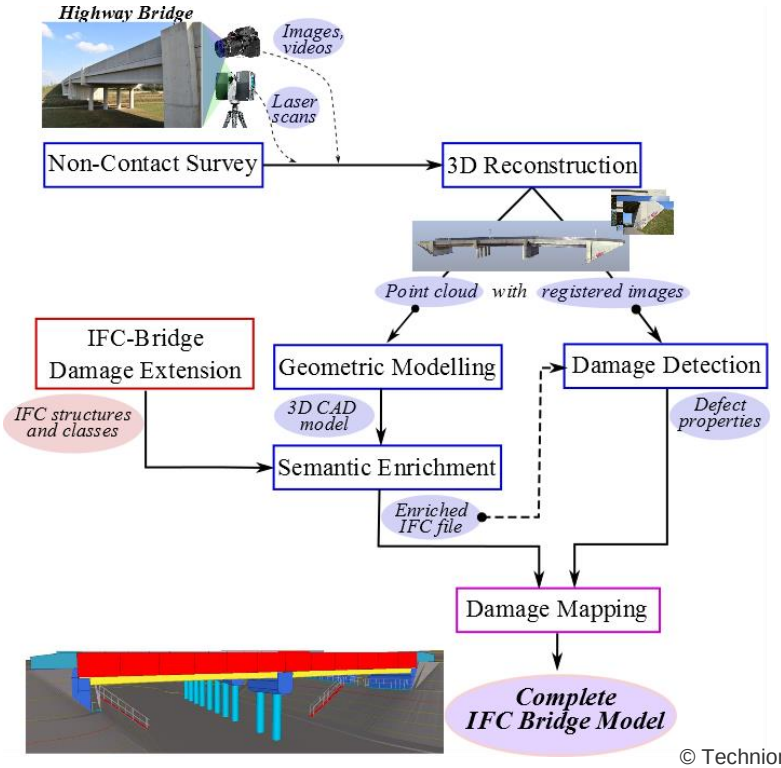
Infravation
An Infrastructure Innovation Programme

Transnational call for proposals on
´Advanced systems, materials and techniques
for next generation road infrastructure´

Automated Compilation of Semantically Rich BIM Models of Bridges

- Maintenance of existing bridges
  - Model are not available
- Approach
  - Laser scanning → Point cloud → 3D model
  - Semantic enrichment → IFC-Bridge model
  - Damage detection

- Partners
  - Cambridge University
  - GeorgiaTech
  - Technion Israel
  - **Trimble**
  - Georgia Department of Transportation
  - London Underground



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SEEBridge

Infravation
An Infrastructure Innovation Programme

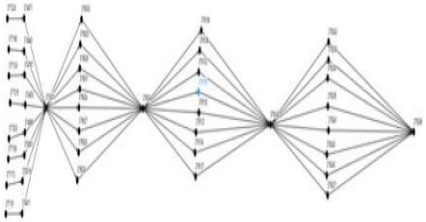
Research

BIM-based Progress Monitoring

Construction Progress Monitoring

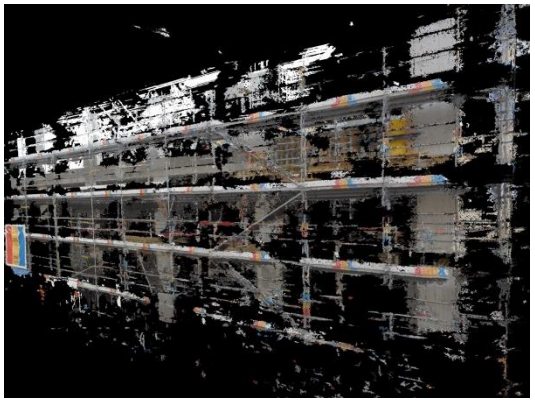
in Zusammenarbeit
mit Prof. Stilla

Building Information Model

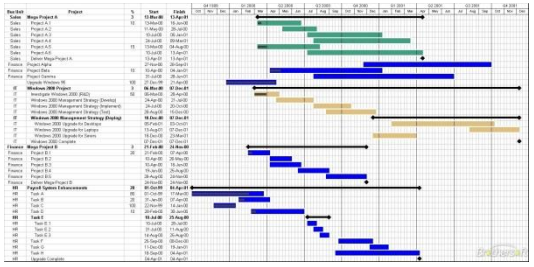


Precedence Relationship Graph

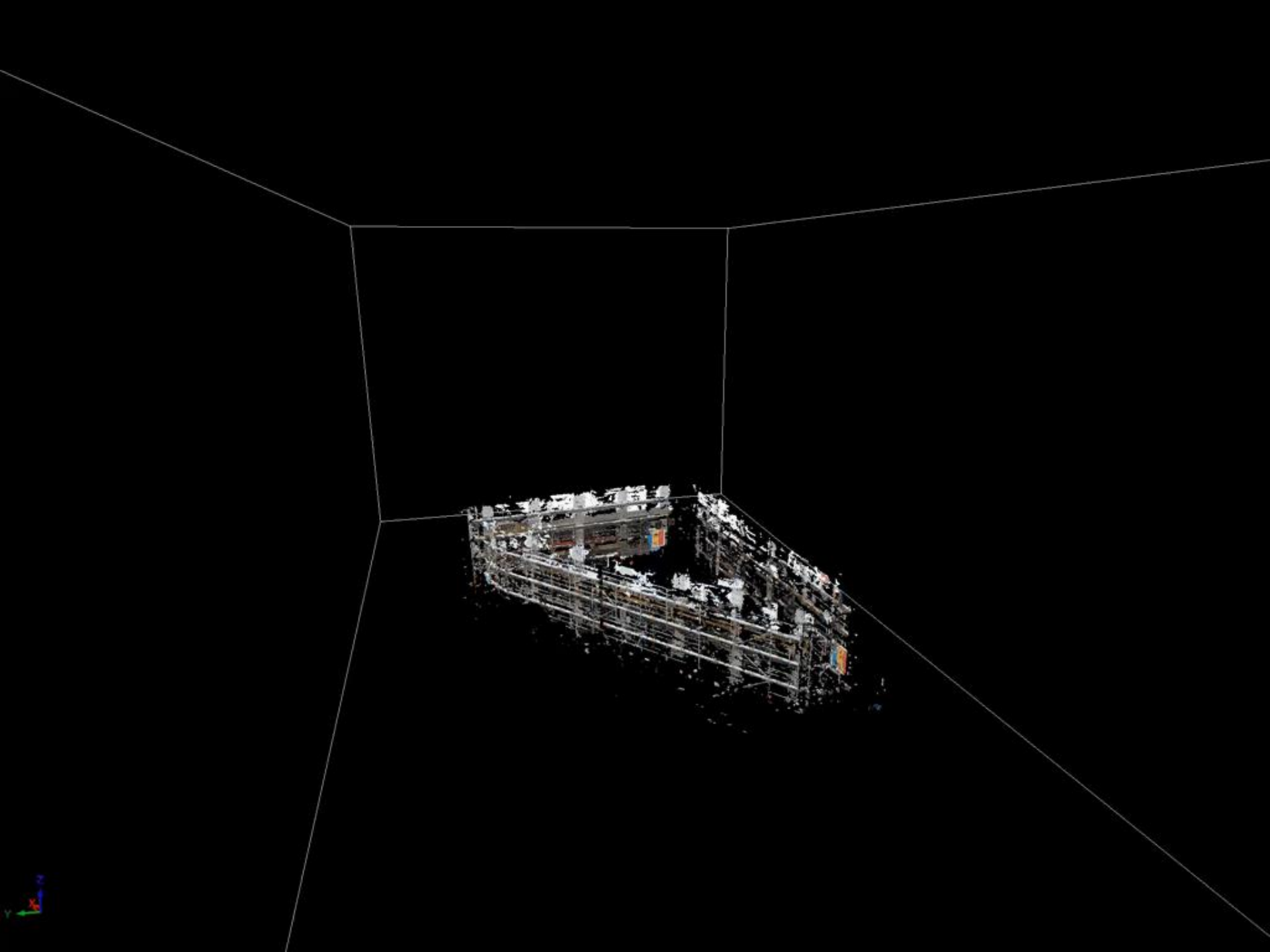
Matching



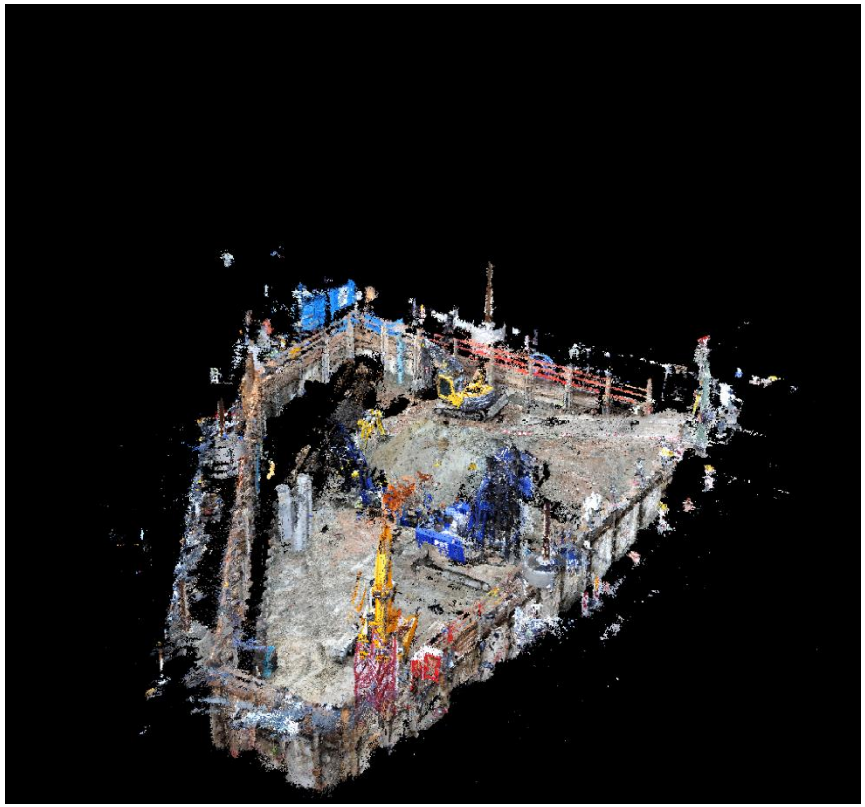
Captured Point Cloud



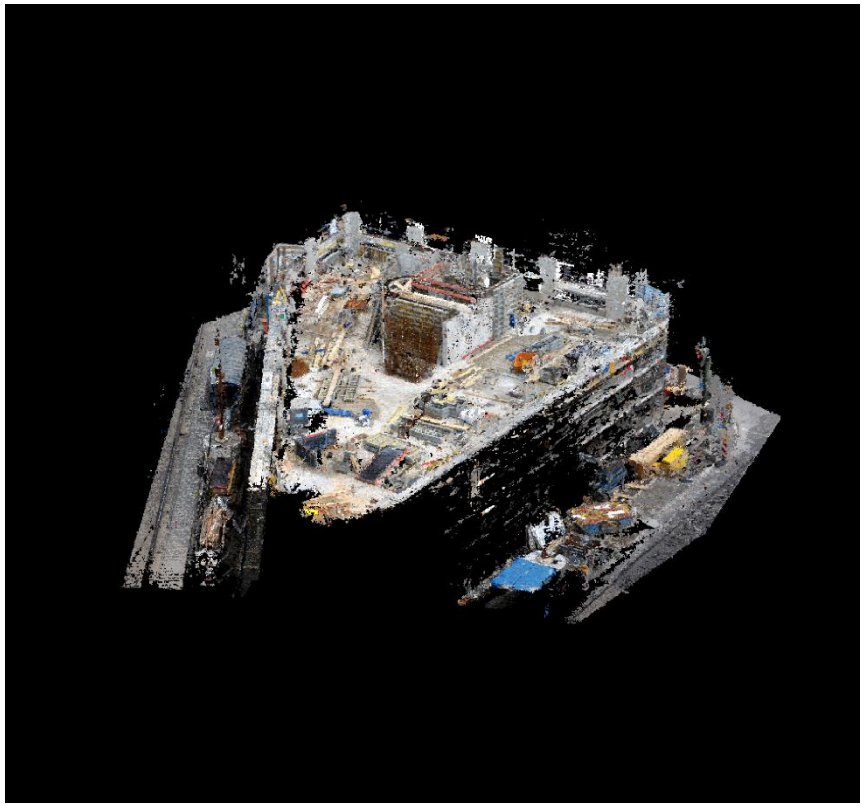
Delays in Schedule?



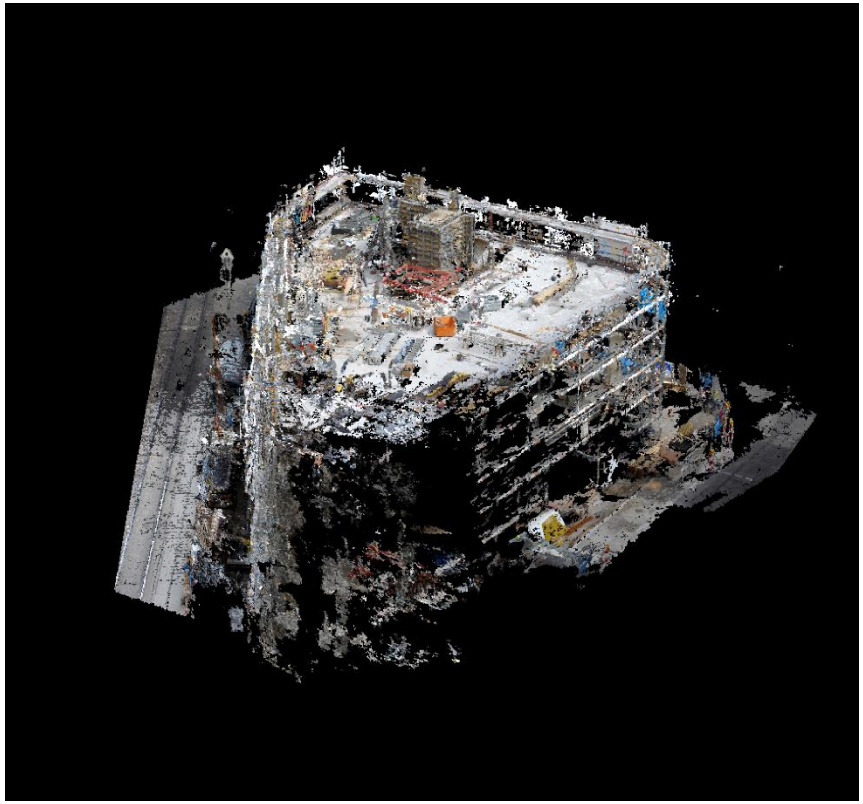
4. Dezember 2012

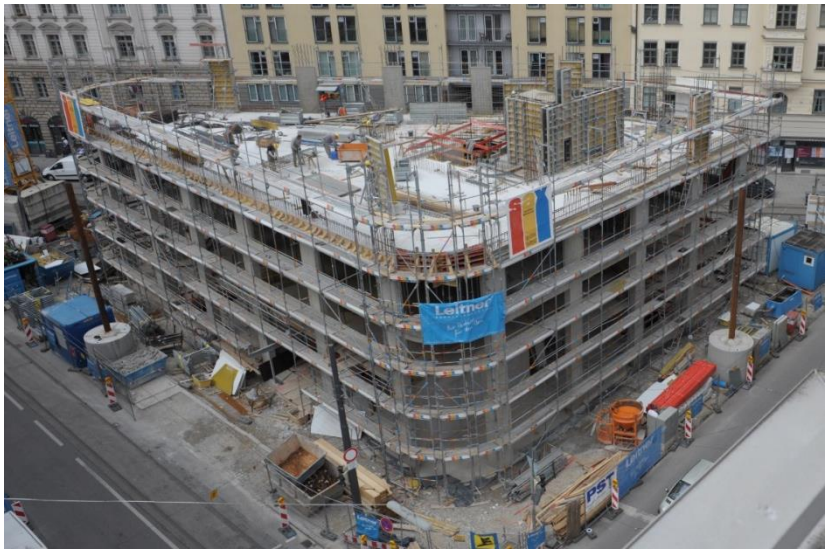


12. Juni 2013



27. Juni 2013





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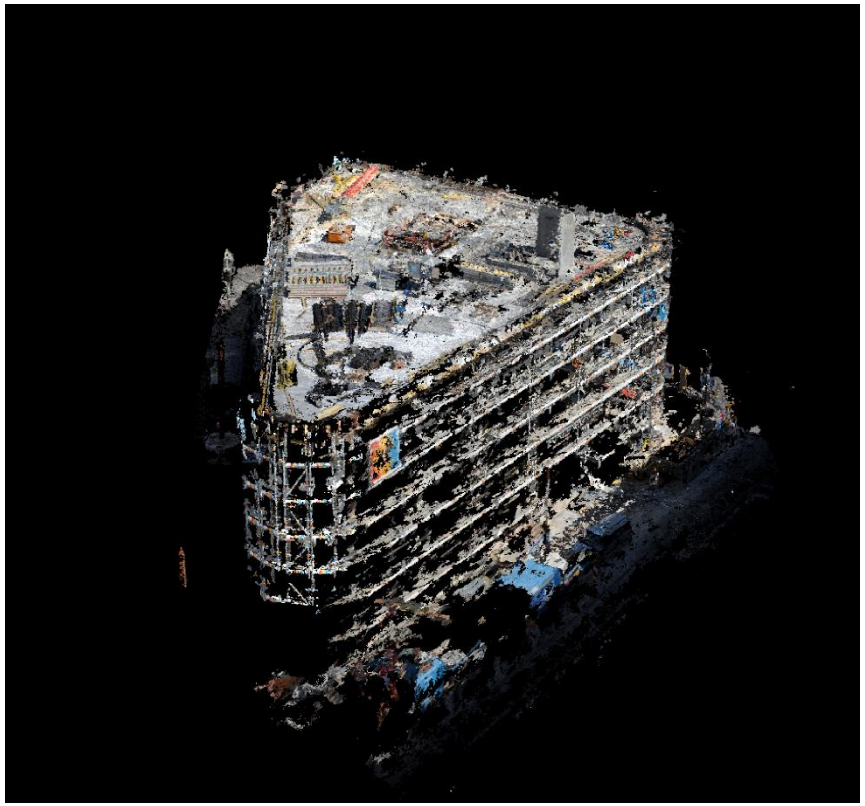
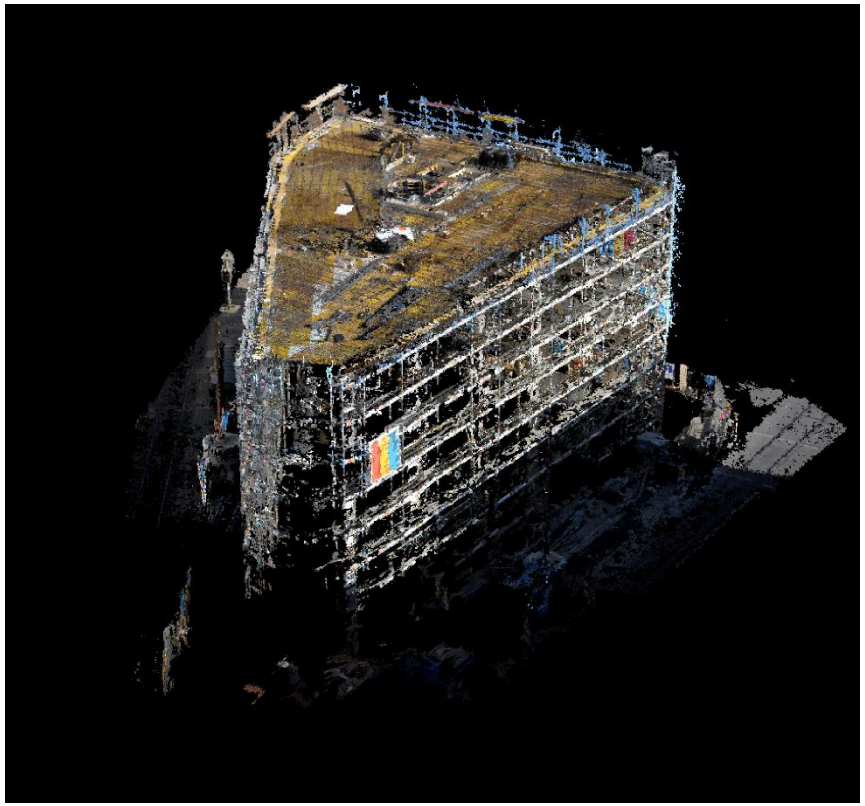
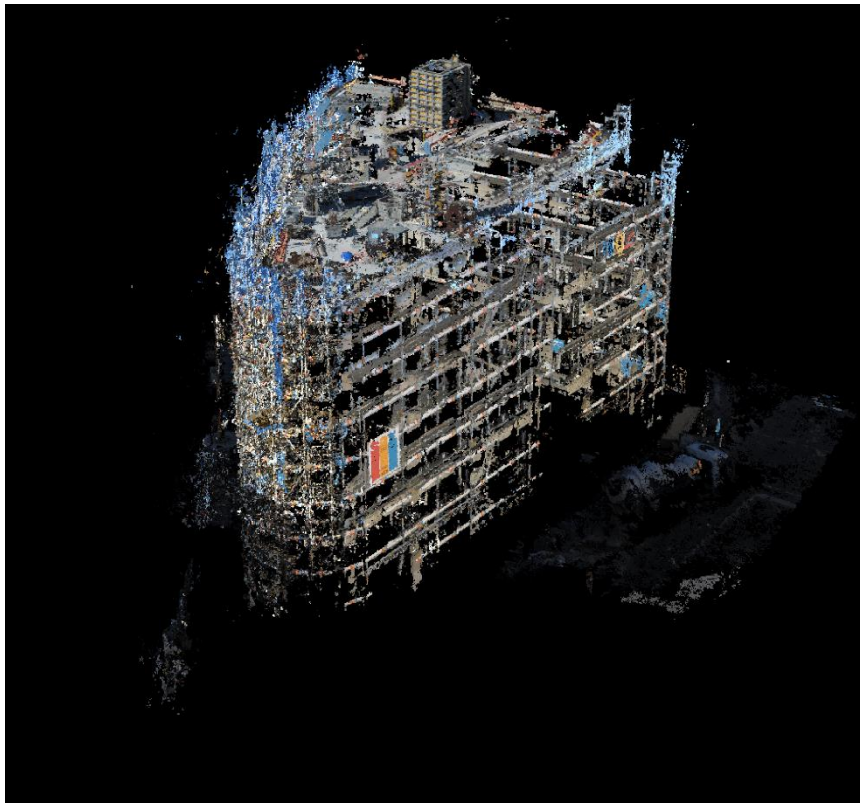


8. August 2013



4. September 2013



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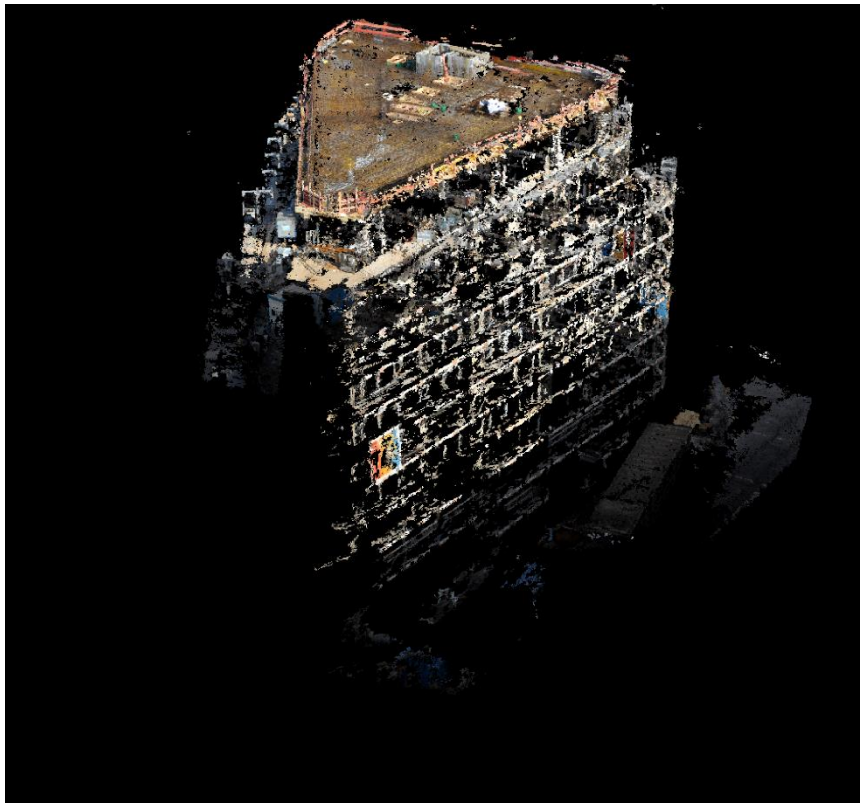

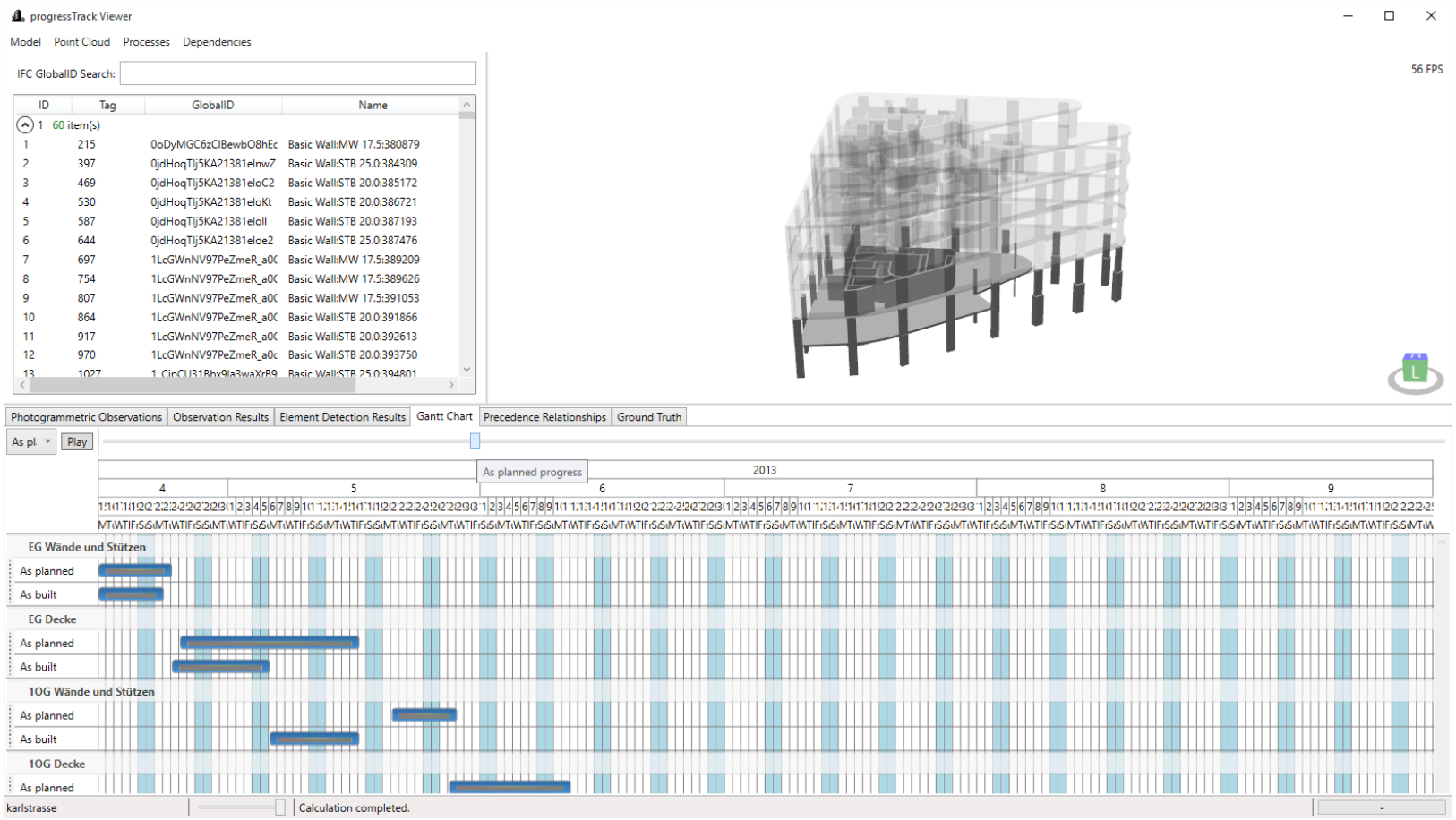

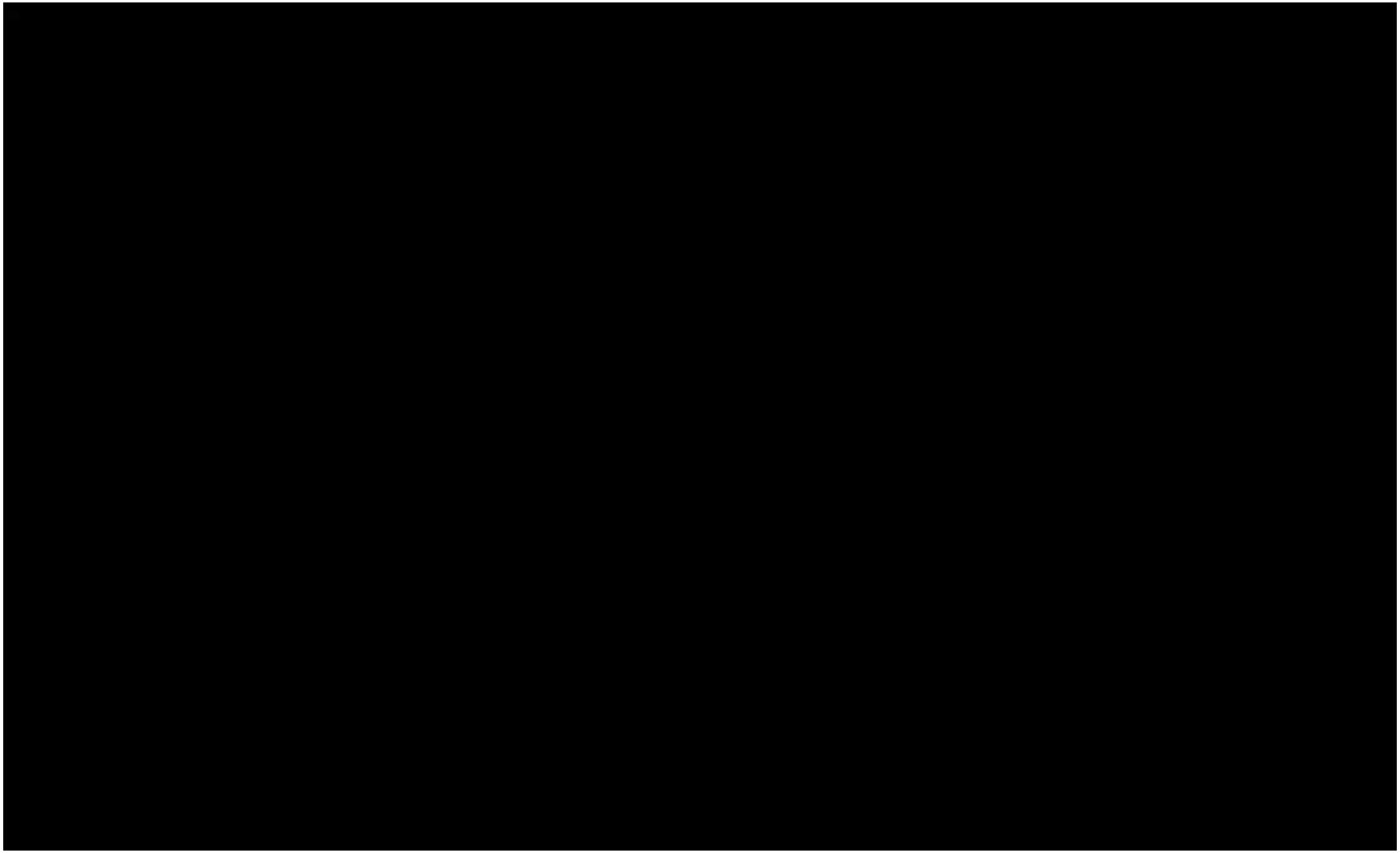

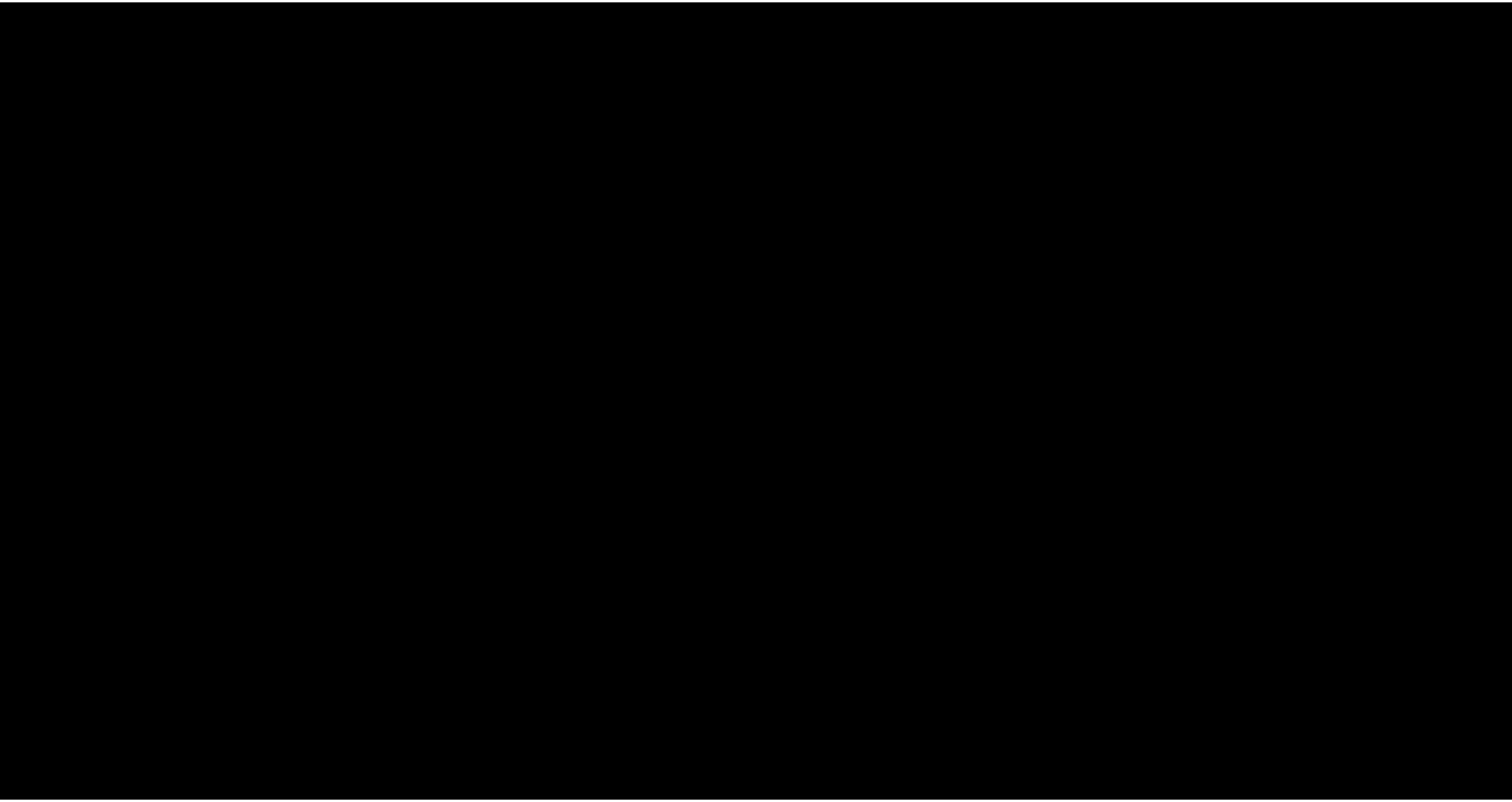

Summary

- BIM has big potential for improving the efficiency of the construction industry
- based on consistent use of semantically rich 3D models
- challenges lie in the contracts and processes
- modern surveying techniques provide a excellent basis for
  → capturing existing buildings
  → providing initial-state data
  → providing as-built data
  → automated progress monitoring

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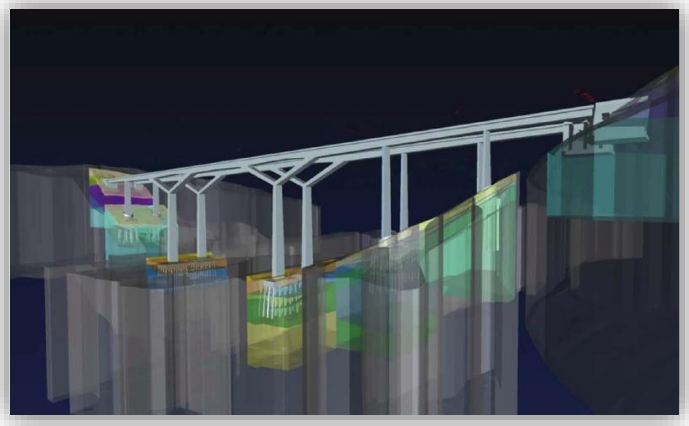

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