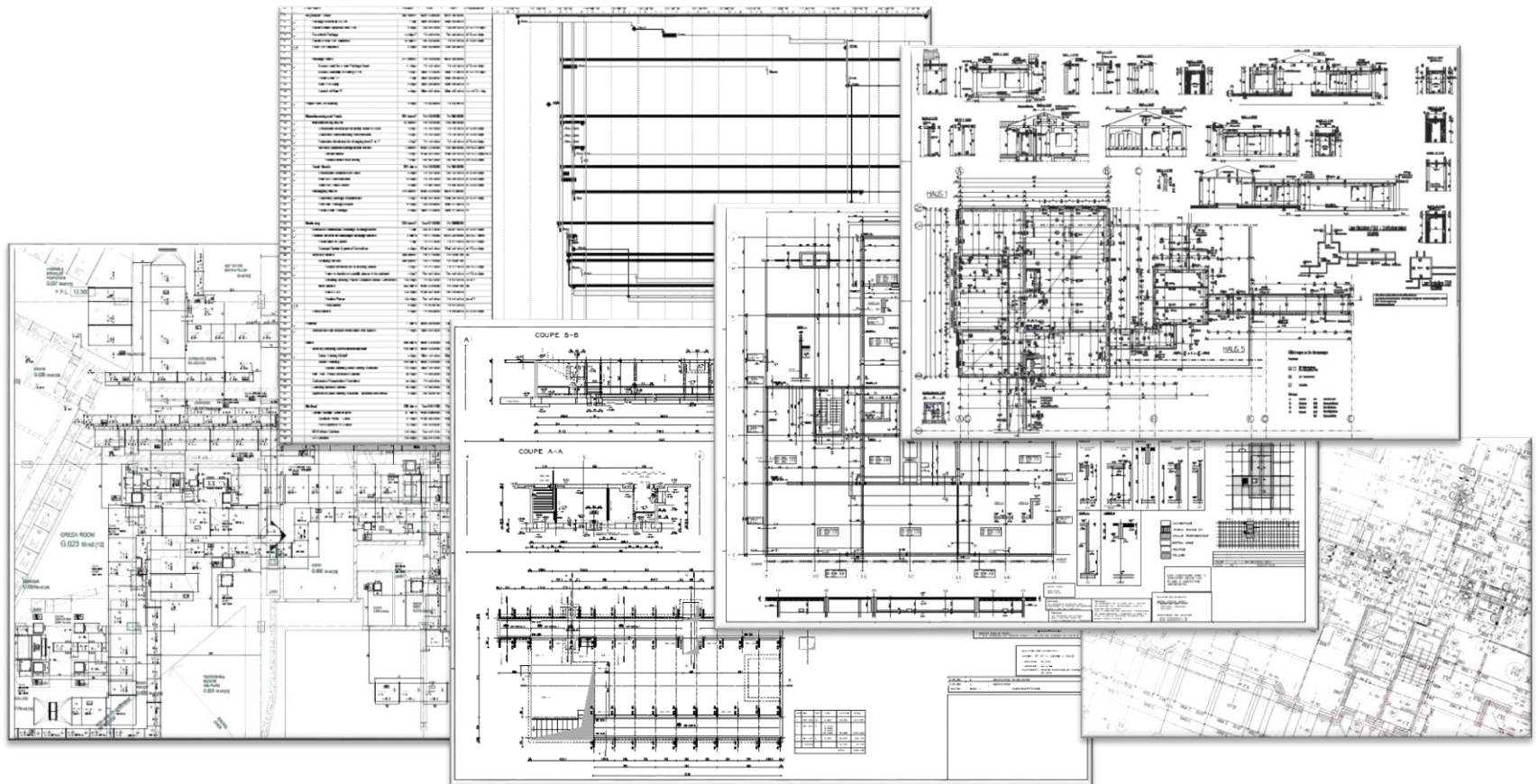


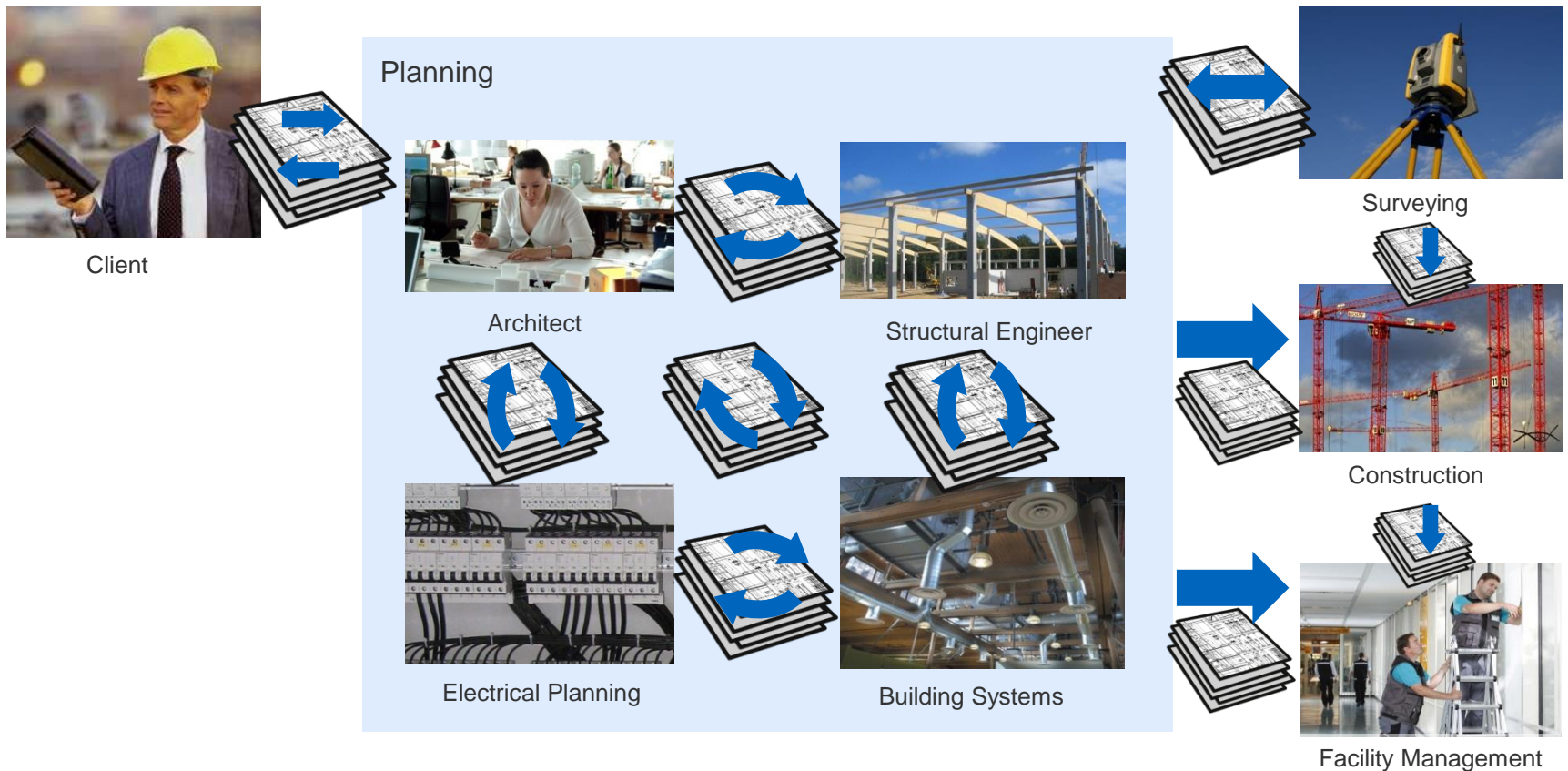
Building Information Modeling – Digitizing the construction industry

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

Planning and building today



Planning and building today



Problems

MailOnline

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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 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.

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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

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

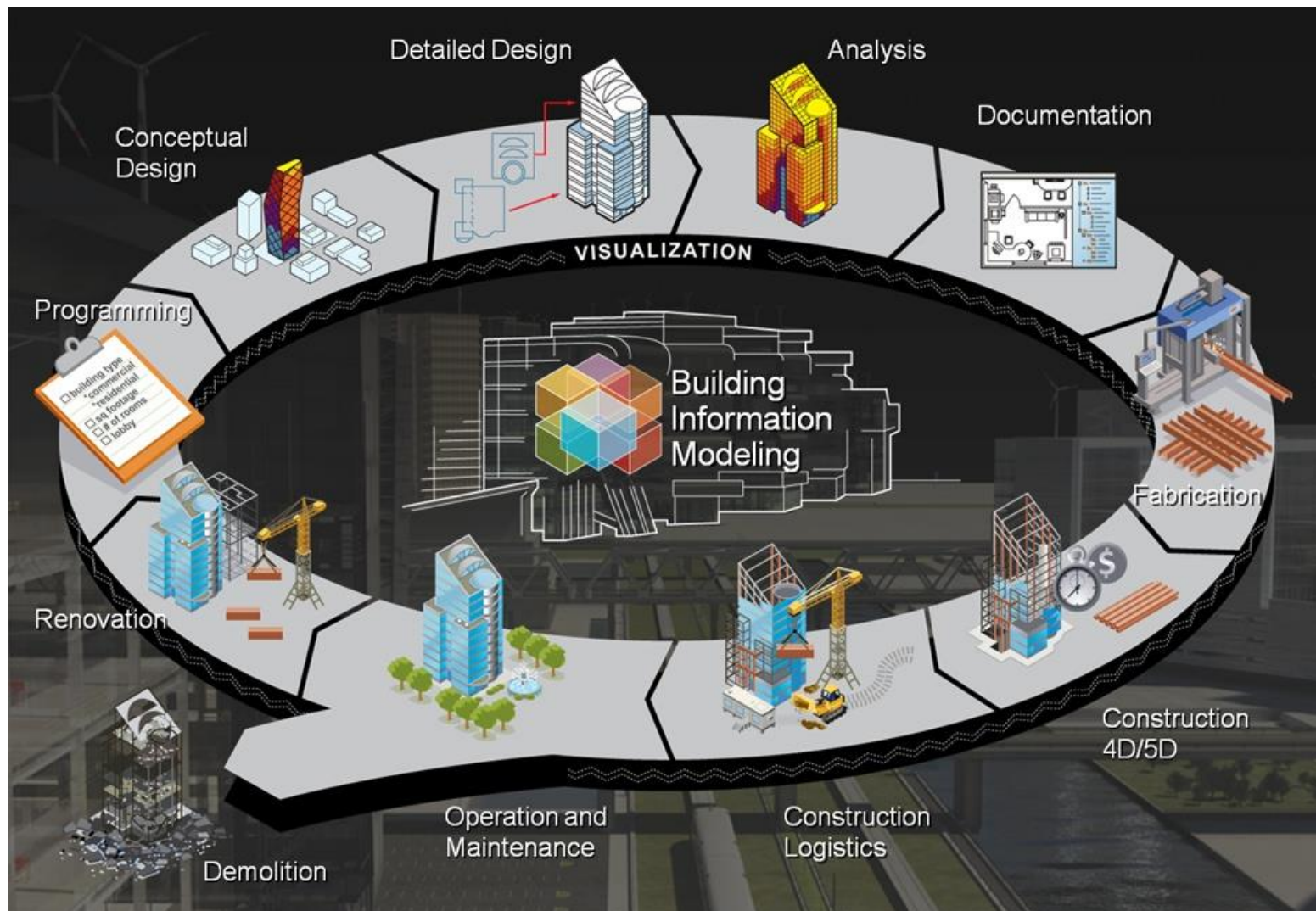
by Joshua Hammer
from **Bloomberg Businessweek**

Reprints

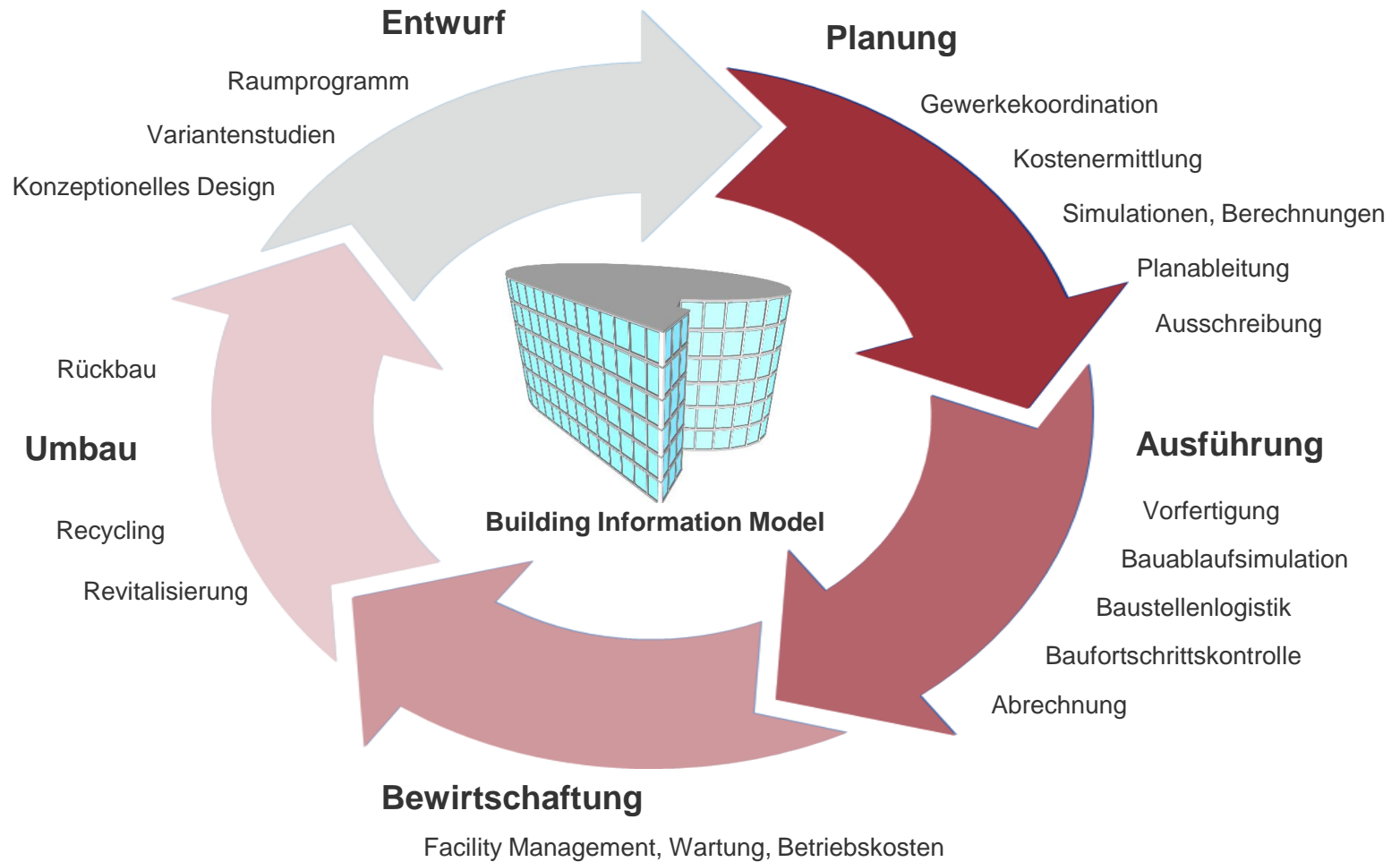
Automotive industry

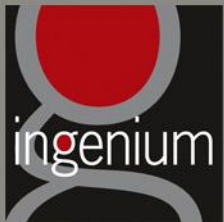
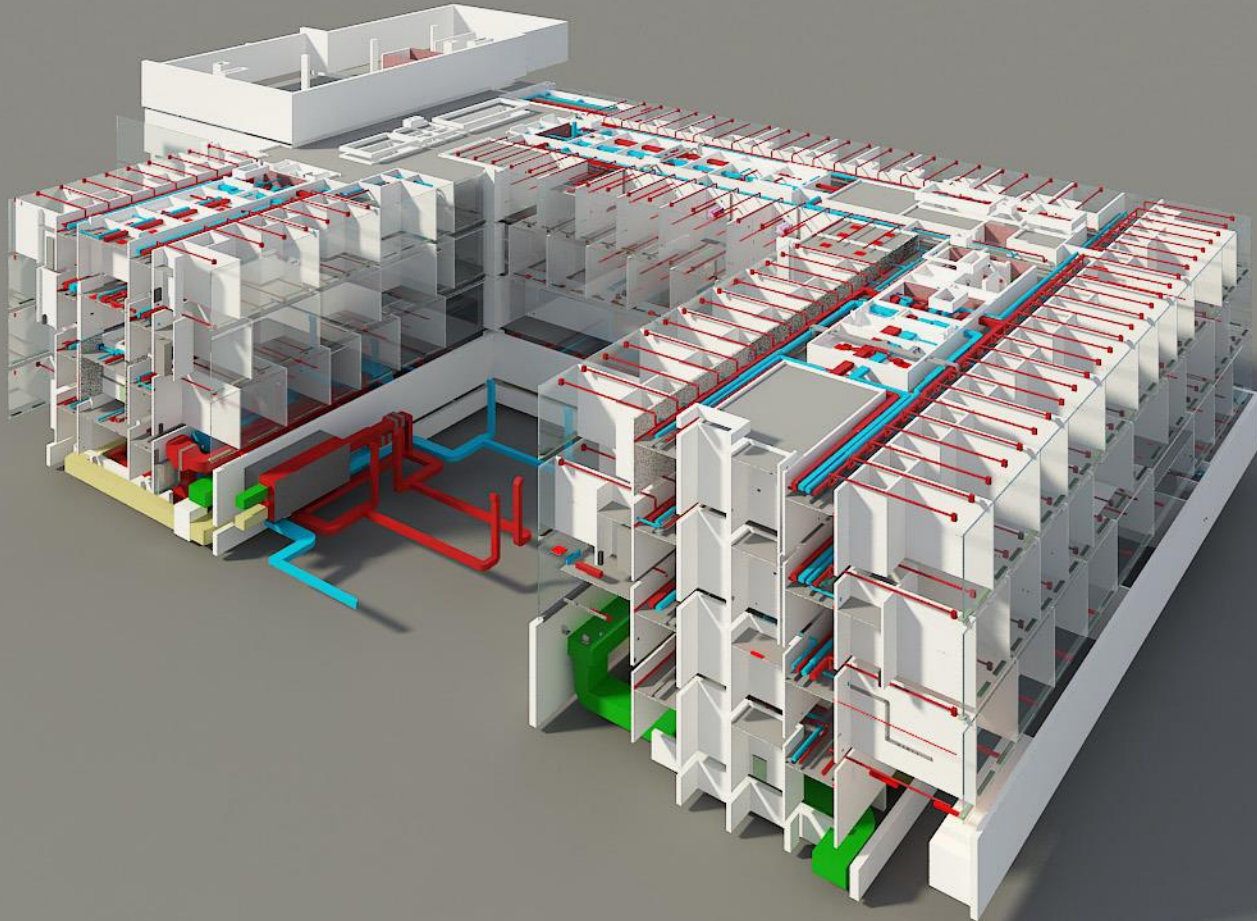


BMW



BIM im Hochbau



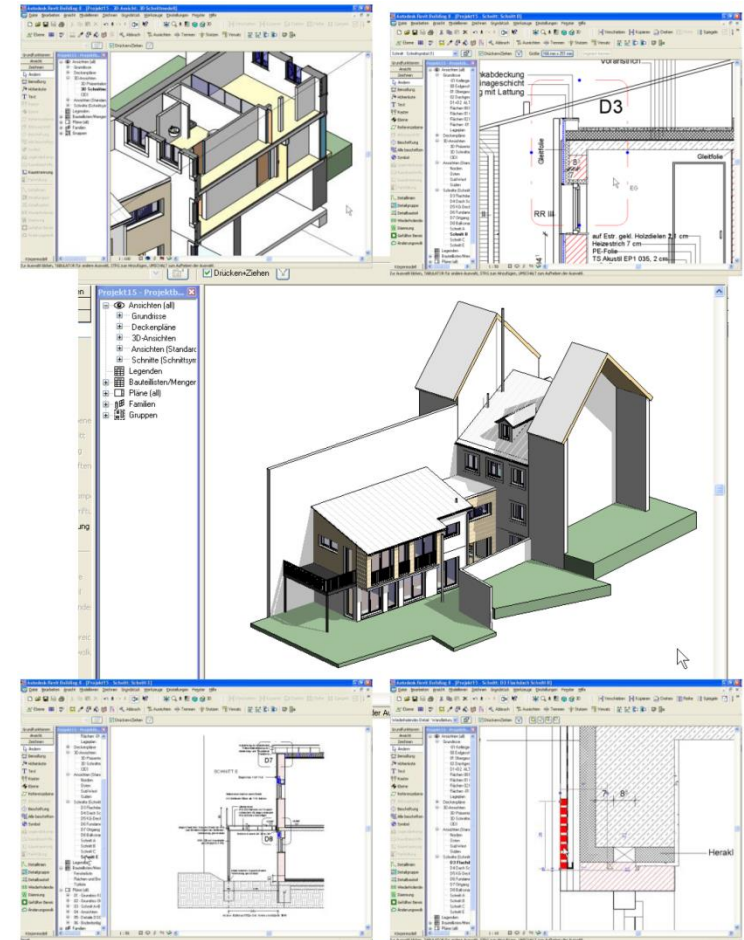




Building Information Model

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

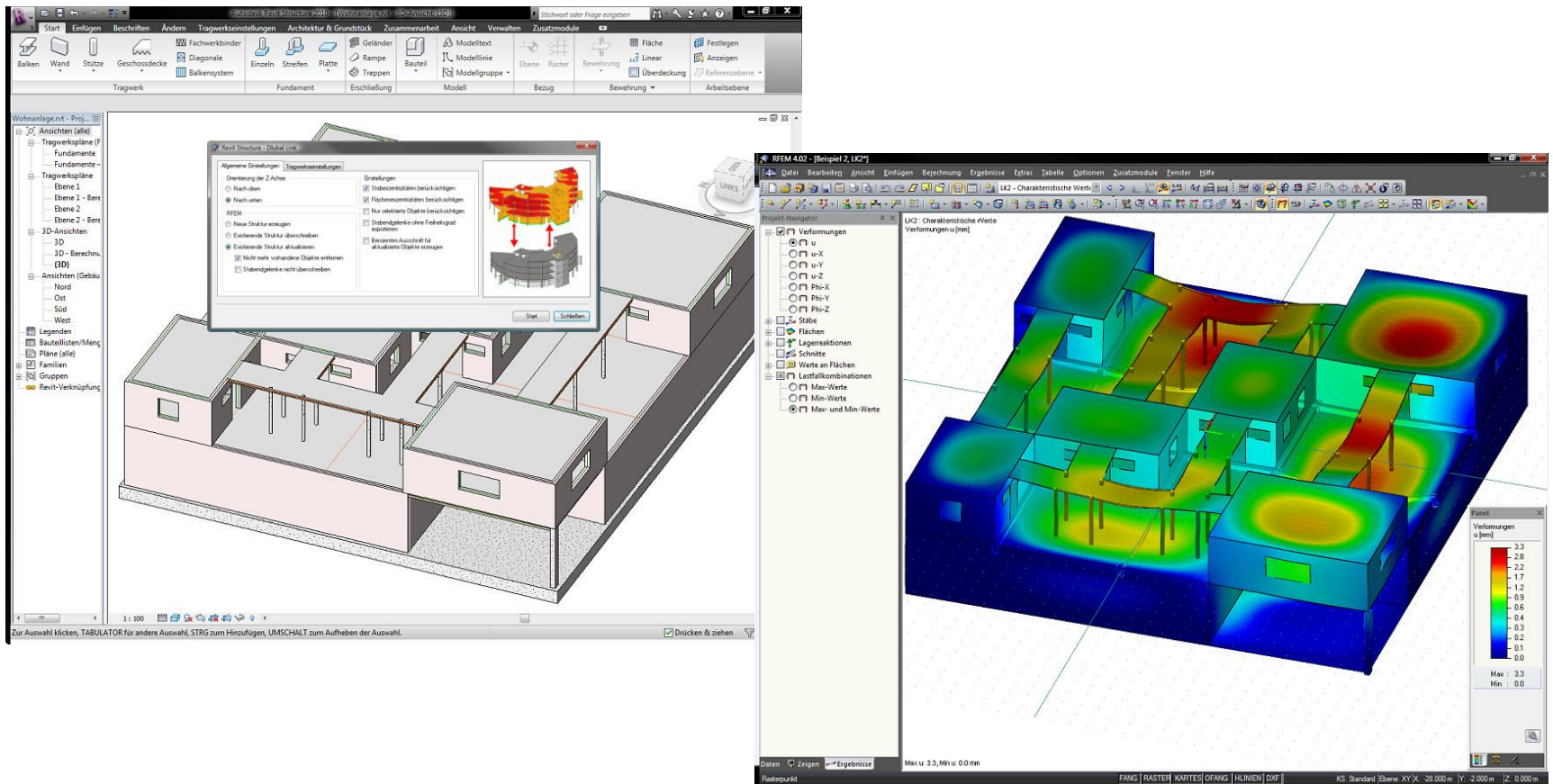


Autodesk Revit

BIM-based visualisation

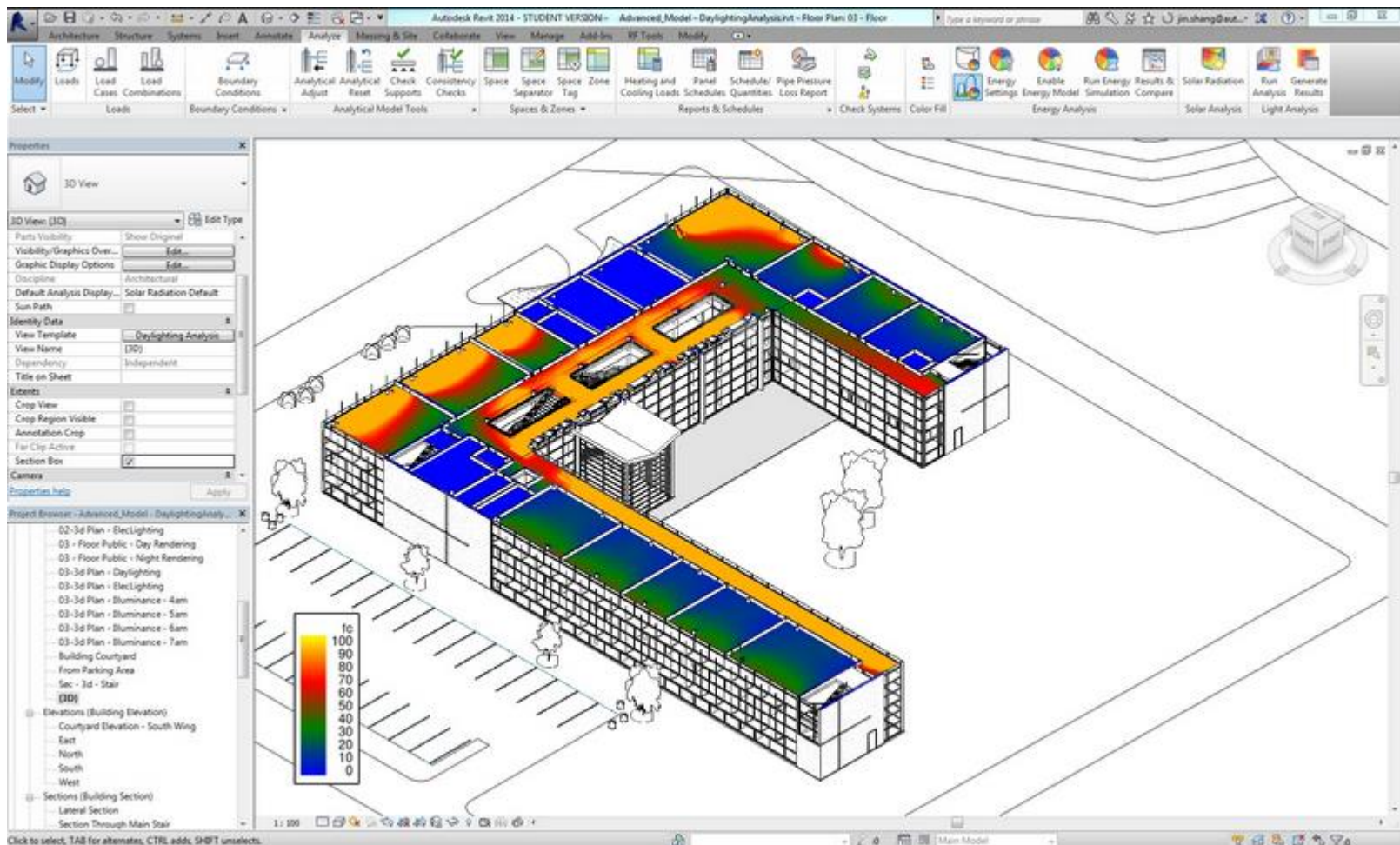


BIM-based structural analysis



Dlubal RFEM

BIM-based energy analysis



BIM-based Quantity Take-off → Tendering

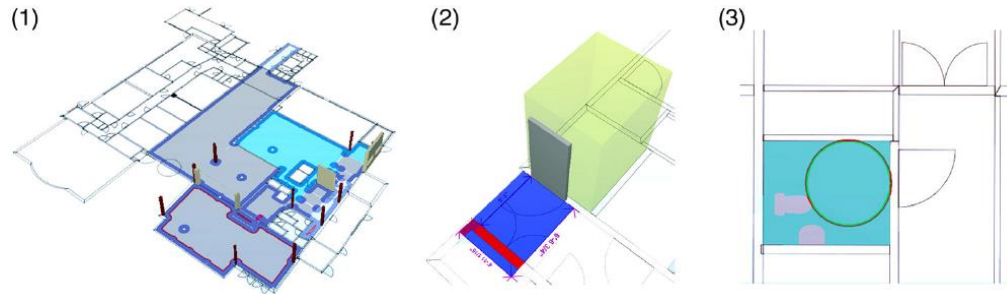
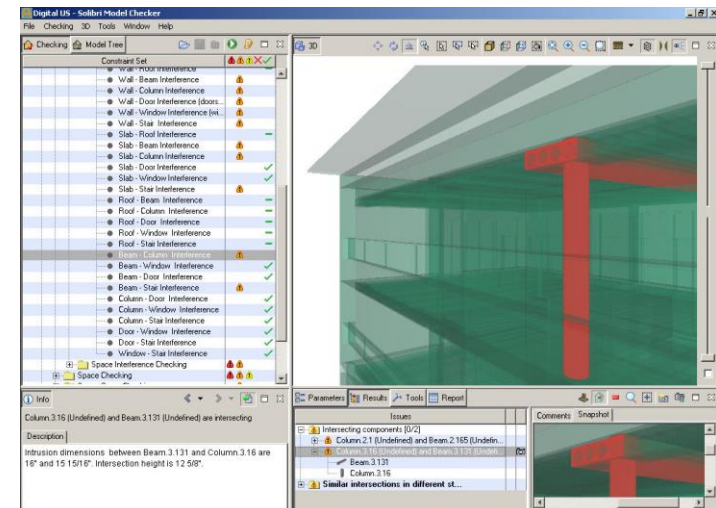
The screenshot displays the RIB iTWO 2.0 software interface, which is used for BIM-based Quantity Take-off and Tendering. The interface is divided into several main sections:

- Top Menu Bar:** Includes 'Start', 'Ansicht', 'Neu', 'Aktionen', 'Erweitert', and 'Daten'.
- Toolbars:** Contains icons for 'Modul-Eigenschaften', 'Geöffnete Dokumente', 'Projektfenster', 'Projektkataloge', 'Stammprojekt', 'Unterelement', 'Freitext', 'Gruppenstufe', 'Position', 'Filter', 'Bearbeiten', and 'Struktur'.
- Main Table:** A detailed table showing the breakdown of construction work. The columns include 'Struktur', 'OZ', 'Kurz-Info', 'Kurztext', 'Menge', 'ME', 'Einheitspreis', 'Stunden', and 'Gesamtbeitrag'. The table lists various construction items such as 'Mauerarbeiten' (Masonry) and 'Betonarbeiten' (Concrete work) with their respective quantities and costs.
- Right Panel (LV-Eigenschaften):** Contains fields for 'Menge / Preis' (Quantity / Price) and 'Positionsart / Grund-/Wahlposition' (Position type / Basic/Optional position). It includes checkboxes for 'EP-Aufgl.' (Breakdown) and 'Keine Leitmenge' (No lead quantity).
- Bottom Left (3D-Visualisierung):** A 3D model of a building structure, showing the spatial context of the take-off.
- Bottom Right (Mengensplit):** A table showing the split of quantities into 'Ote' (Order) and 'Vorgang' (Process) categories, with columns for 'Bez. Ote', 'Vorgang', 'LV-Menge', and 'VA-Menge'.
- Bottom Bar:** Includes a 'Navigation' bar with a breadcrumb trail: 'Muster' > 'M_BIM V1 (Angebot)' > 'Projektvarianten' > 'B' > 'LV 1'.

RIB iTWO

BIM-Supported standards and guidelines

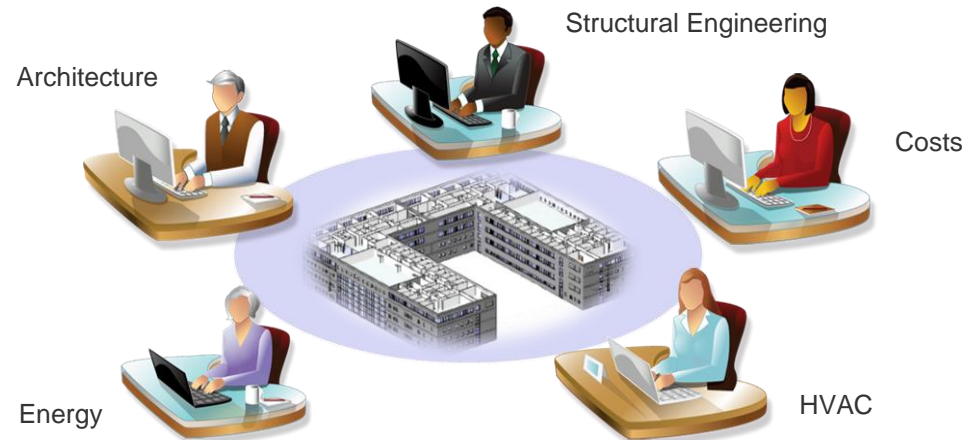
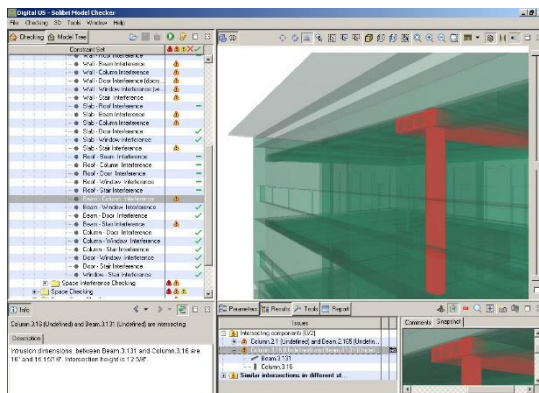
- **Today:**
Manual Checking of Building design with standards and guidelines
- **Future:**
 - Digital database and construction of standards
 - Automated checks in BIM-Model



BIM-based Coordination of the Planning Process

Advantages

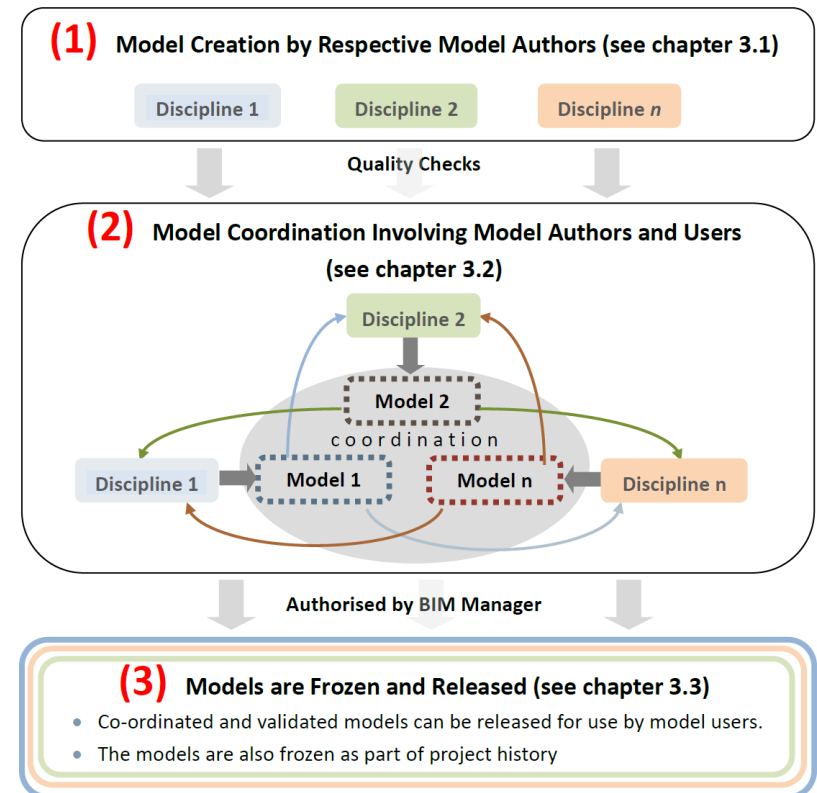
- no repetitive data input
- better coordination among the stakeholder
- clash detection
- less errors, reduced costs



BIM-based Coordination of the Planning Process

Federated models approach

- Each engineering discipline maintains control over their data
 - *responsibilities*
 - *IPR ownership*
- Discipline models 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

Autodesk BIM 360 Glue

AUTODESK® BIM 360™ GLUE® Autodeskkanz > SM_Construction Demo > Architecture & Structure

Clashes

Result Sets 1 minutes ago

Architecture vs Structure (279)

Group By: Ungrouped (279)

Notifications: All (279)

Notify Comment

Clash	Magnitude
<input type="checkbox"/> Clash163	270 mm
<input type="checkbox"/> Clash164	262 mm
<input type="checkbox"/> Clash165	262 mm
<input type="checkbox"/> Clash166	224 mm
<input type="checkbox"/> Clash167	209 mm
<input type="checkbox"/> Clash168	209 mm
<input type="checkbox"/> Clash169	206 mm
<input type="checkbox"/> Clash170	206 mm
<input type="checkbox"/> Clash171	206 mm
<input type="checkbox"/> Clash172	206 mm
<input type="checkbox"/> Clash173	191 mm
<input type="checkbox"/> Clash174	191 mm
<input type="checkbox"/> Clash175	190 mm
<input type="checkbox"/> Clash176	190 mm
<input checked="" type="checkbox"/> Clash177	189 mm
<input type="checkbox"/> Clash178	189 mm
<input type="checkbox"/> Clash179	184 mm

Clash177

Magnitude: 189 mm

- Basic Wall [246330]
 - 3D - Architectural
 - Segment
 - Walls (78)
 - Basic Wall (78)
 - Interior - Partition (1-hr) (40)
 - Basic Wall [246330]
- W-Wide Flange [265213]
 - 3D - Structural
 - Segment
 - Structural Framing (434)
 - W-Wide Flange (432)
 - W12X26 (351)
 - W-Wide Flange [265213]

Comment

Add comment to Clash177

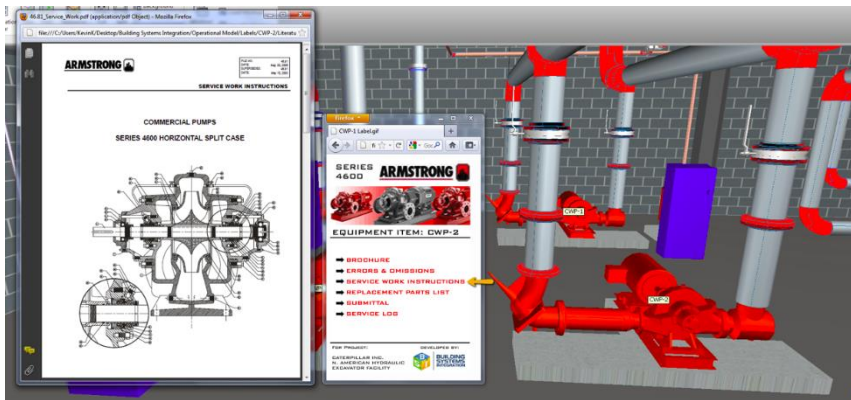
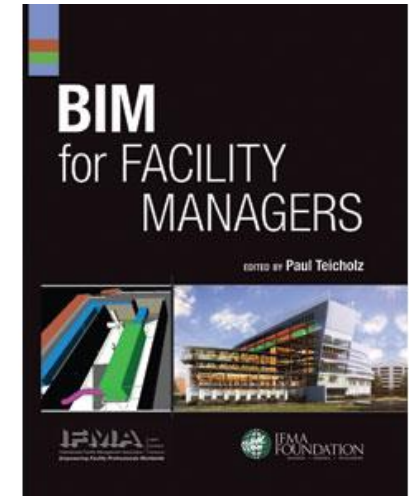
Adjust partition height

Cancel Save

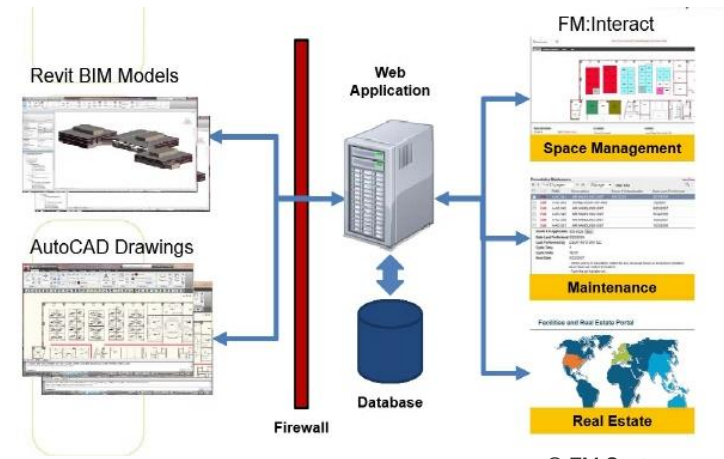
D View

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!)



© Behance.net

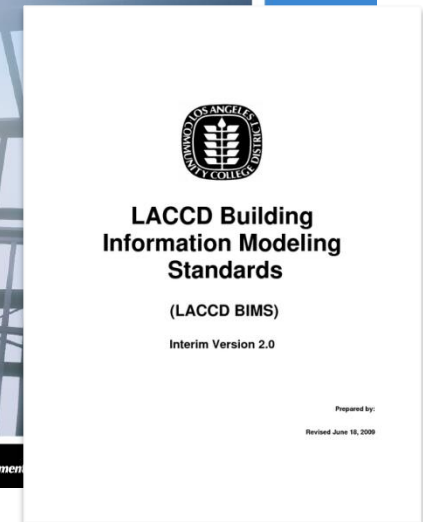
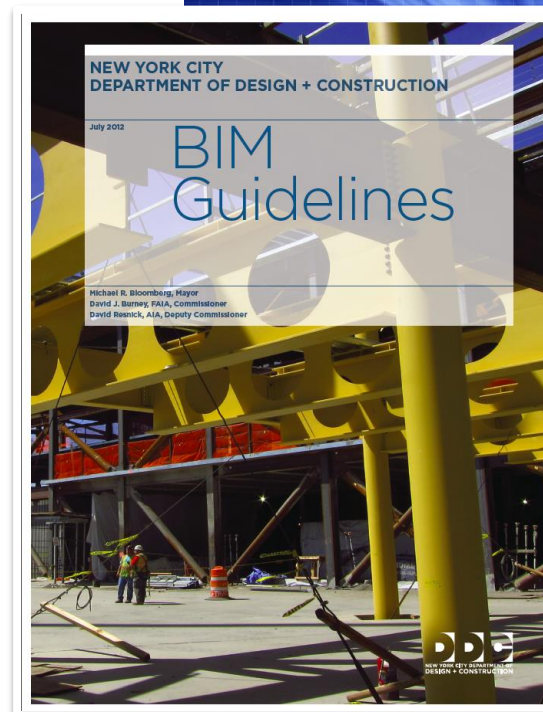


© FM Systems

State of implementation

USA

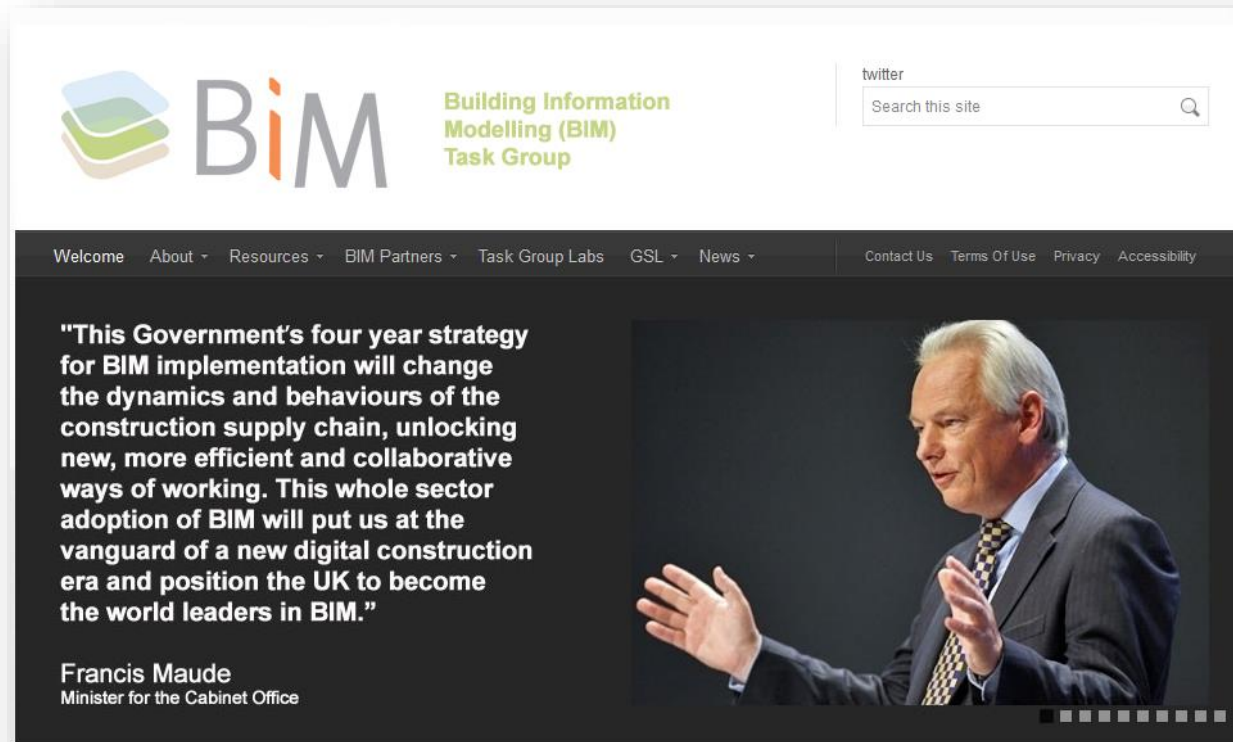
- wide adoption in building industry
- nationwide guidelines
 - NIST: National BIM Standard (NBIMS)
 - General Service Administration (GSA) National 3D/4D BIM program
 - US Army Corps of Engineers
- large number of local guidelines



State of implementation

United Kingdom

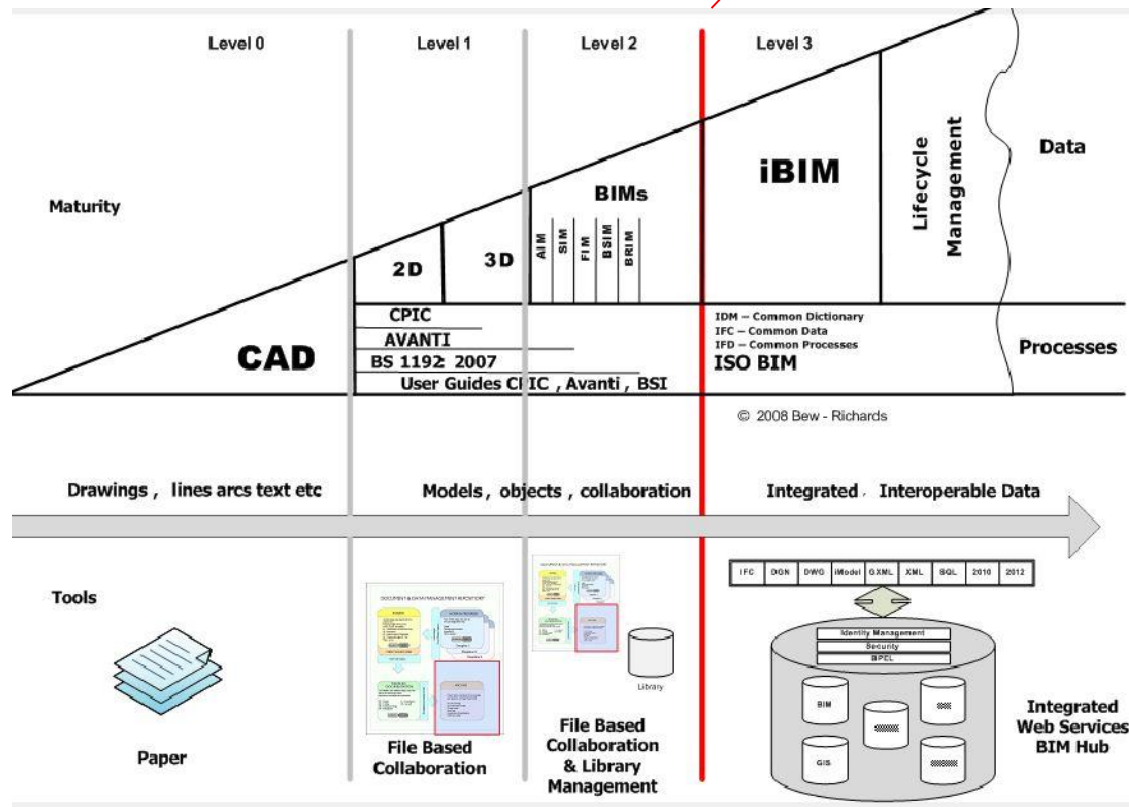
- UK BIM Strategy since 2011



State of implementation

United Kingdom

1.4.2016



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 Bundesministeriums für Verkehr, Bau und Stadtentwicklung in Berlin gegründet

In Abstimmung mit den Verbänden und Kammern der deutschen Bauwirtschaft, dem Bundesverband der Architekten (BDA) und dem BMVBS - Bundesministerium für Verkehr, Bau und Stadtentwicklung

Orga
Deu
Im E
wes
Guta
Verg
scha
erklä
Mitg

Reformkommission für Großprojekte erarbeitet Problemlösungen

Ramsauer: Experten für Großprojekte beginnen Arbeit



Auftaktsitzung zur Reformkommission
"Großprojekte" (Quelle: BMVBS)



Erscheinungsdatum 17.04.2013
Laufende Nr. 064/2013

Heute ist die von Bundesminister **Ramsauer** einberufene Reformkommission für Großprojekte zur ersten Sitzung in Berlin zusammengekommen. Bundesminister **Ramsauer** hatte das Gremium vor Ostern ins Leben gerufen, um gemeinsam mit Spitzenkräften der Wirtschaft, Wissenschaft und Verwaltung erheblichen Kosten- und Terminüberschreitungen beim Bau privater Bauprojekte auf den Grund zu gehen.



Reformkommission Bau von Großprojekten

Komplexität beherrschen – kostengerecht, termintreu und effizient

Endbericht

BIM in Germany

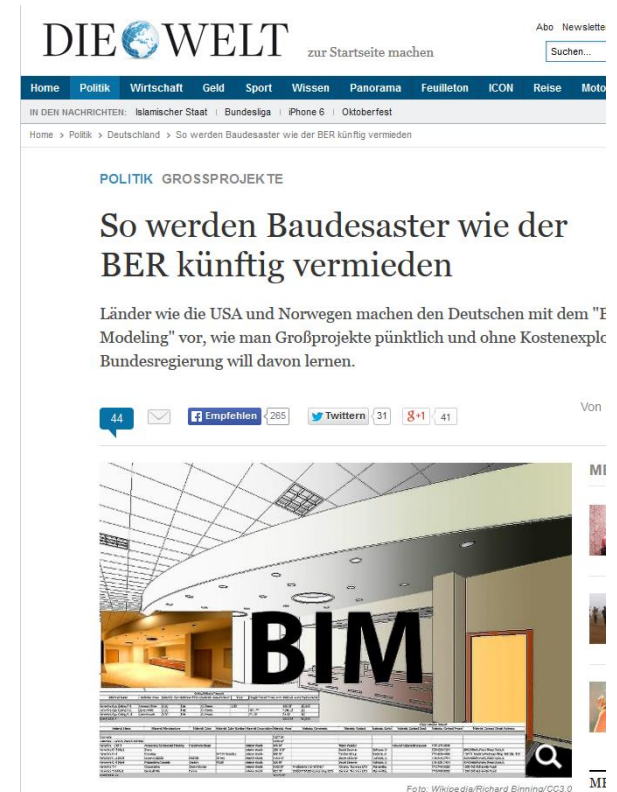
Politics

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.”



BIM in Germany

Step-by-Step Plan

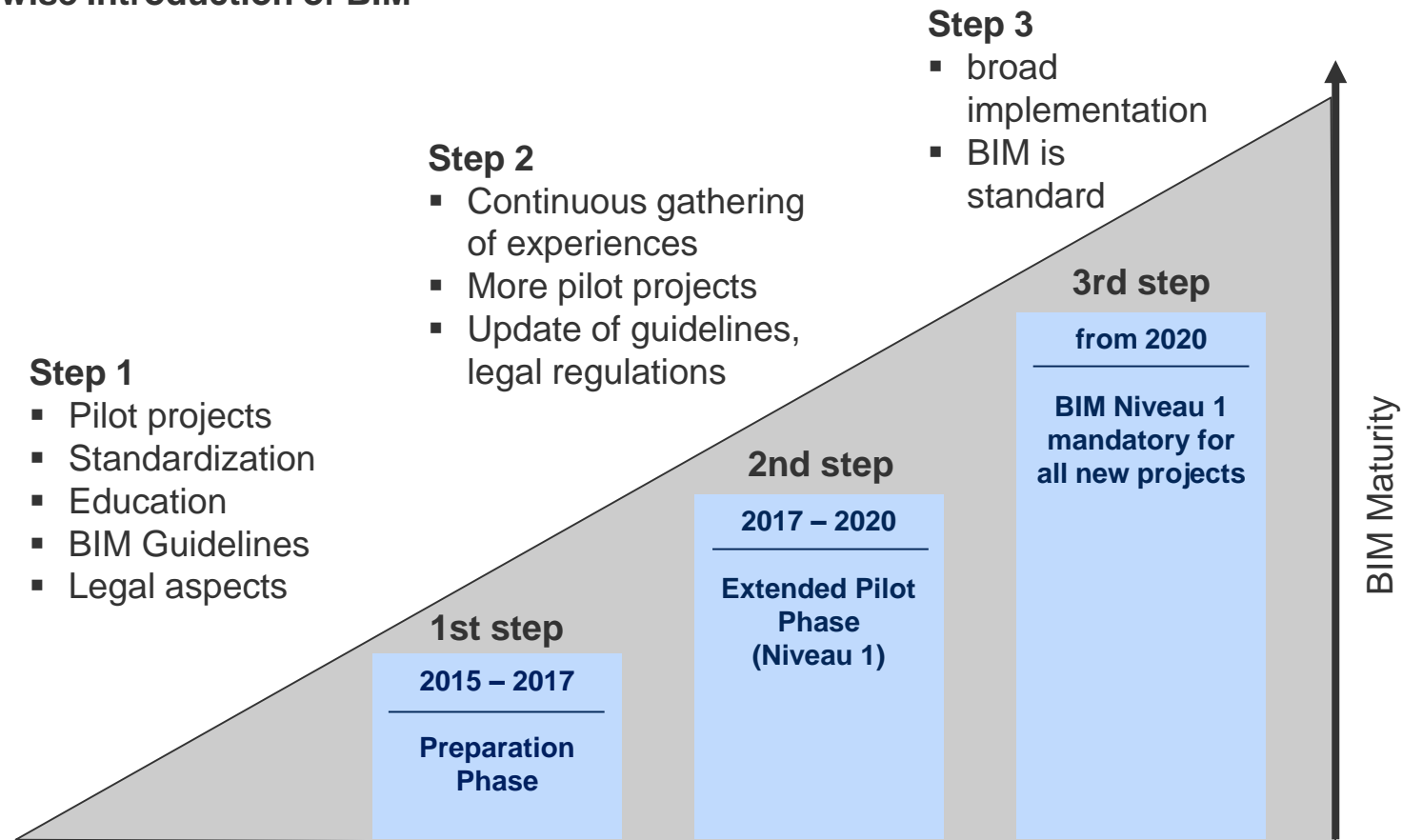
- Announced by the Minister of Transport in December 2015
- **Mandatory usage** of BIM methods in public infrastructure projects starting **2020**
- **Strong impulse** for German construction industry





German BIM Roadmap

Stepwise Introduction of BIM

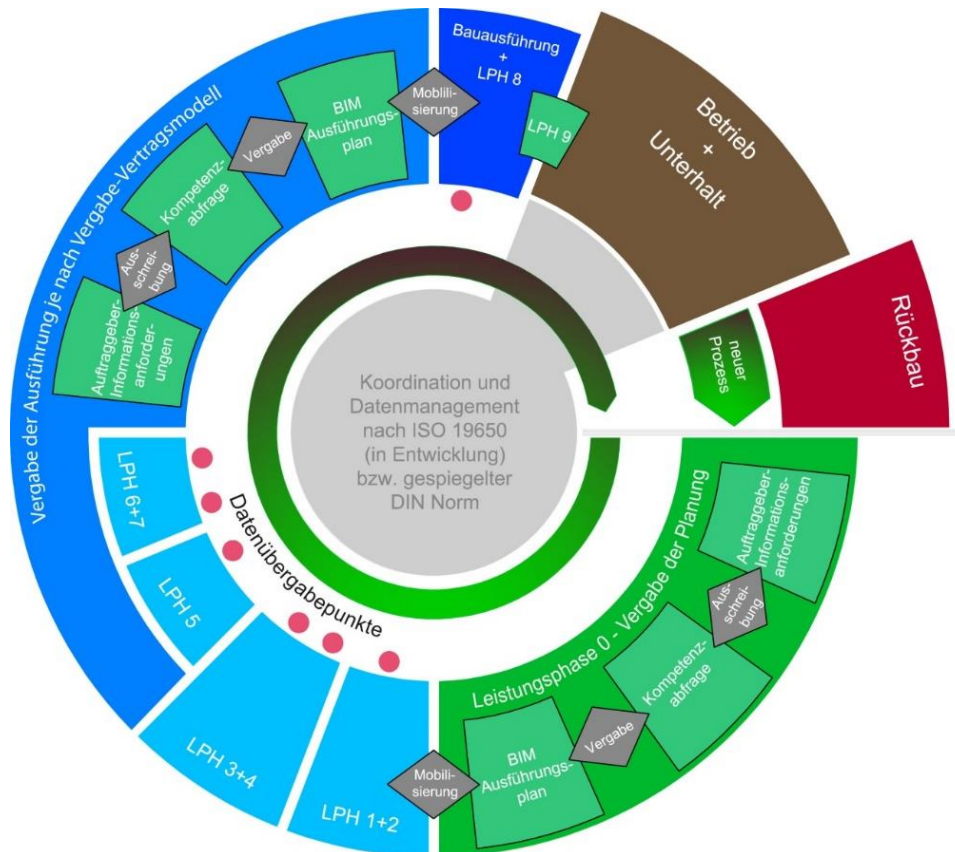


© PB 4.0

BIM Niveau 1

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




BIM-Pilotprojekt Brücke Petersdorfer See

Projektbeschreibung

Gesamtlänge: ca. 1,16 km,
davon Brücke Petersdorfer See: 264 m
Gesamtkosten: 36,5 Mio. €,
davon Brücke Petersdorfer See:
26,5 Mio. €
Anschlussstelle: AS Waren
Verkehrsbelastung: ca. 20.000 Kfz/24h,
in den Spitzenzeiten im
Sommer deutlich darüber



Bezugliche Verkehrsführung 1.BA





BIM-Pilotprojekt Südverbund Chemnitz

Projektbeschreibung

Stützweiten: zwischen 21 m und 35 m
Gesamtlänge Brücke: 290,5 m
Nutzbreite Brücke: 71,50 m
Brückenfläche: 6245 m²
Querung: DB AG u. Privatsbahn
Querung: Auerbach
(Gewässer 2. Ordnung)
Gesamtlänge: ca. 11,3 km
Straßenabschnitt: ca. 20.000–25.000 Kfz/24 h
Verkehrsbelastung: (Prognose 2020)







BIM-Pilotprojekt Eisenbahnüberführung Filstal

Projektbeschreibung

Gesamtlänge: 485 m
Höhe: 85 m
Spannweite (max.): 150 m
Breite Überbau: 8,4 m
Anzahl Brücken: 2
Bauweise/ methode: semiintegral/
Vorschubrüstung






BIM-Pilotprojekt Rastatter Tunnel

Projektbeschreibung

Gesamtlänge PFA 1: 8,3 km
Durchmesser: innen 9,6 m, außen 10,6 m
Abbruchmasse: rund 710.000 m³
Gesamtkosten Tunnel: ca. 450 Mio. €
Bauzeit Tunnel: ca. 5 Jahre





Bundesministerium
für Verkehr und
digitale Infrastruktur

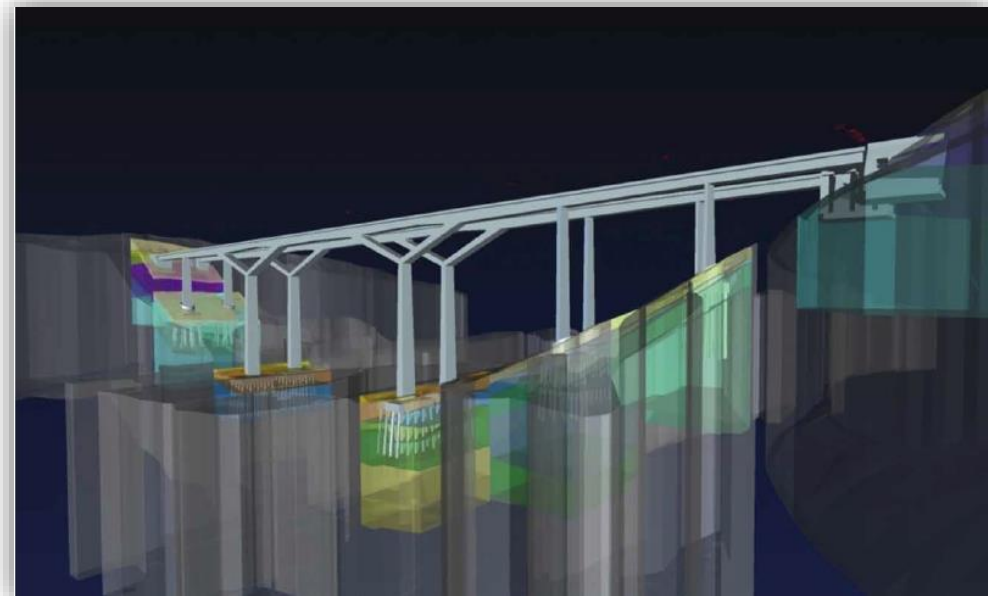
Scientific Analysis of the Pilot Projects

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

BIM Pilot Projects

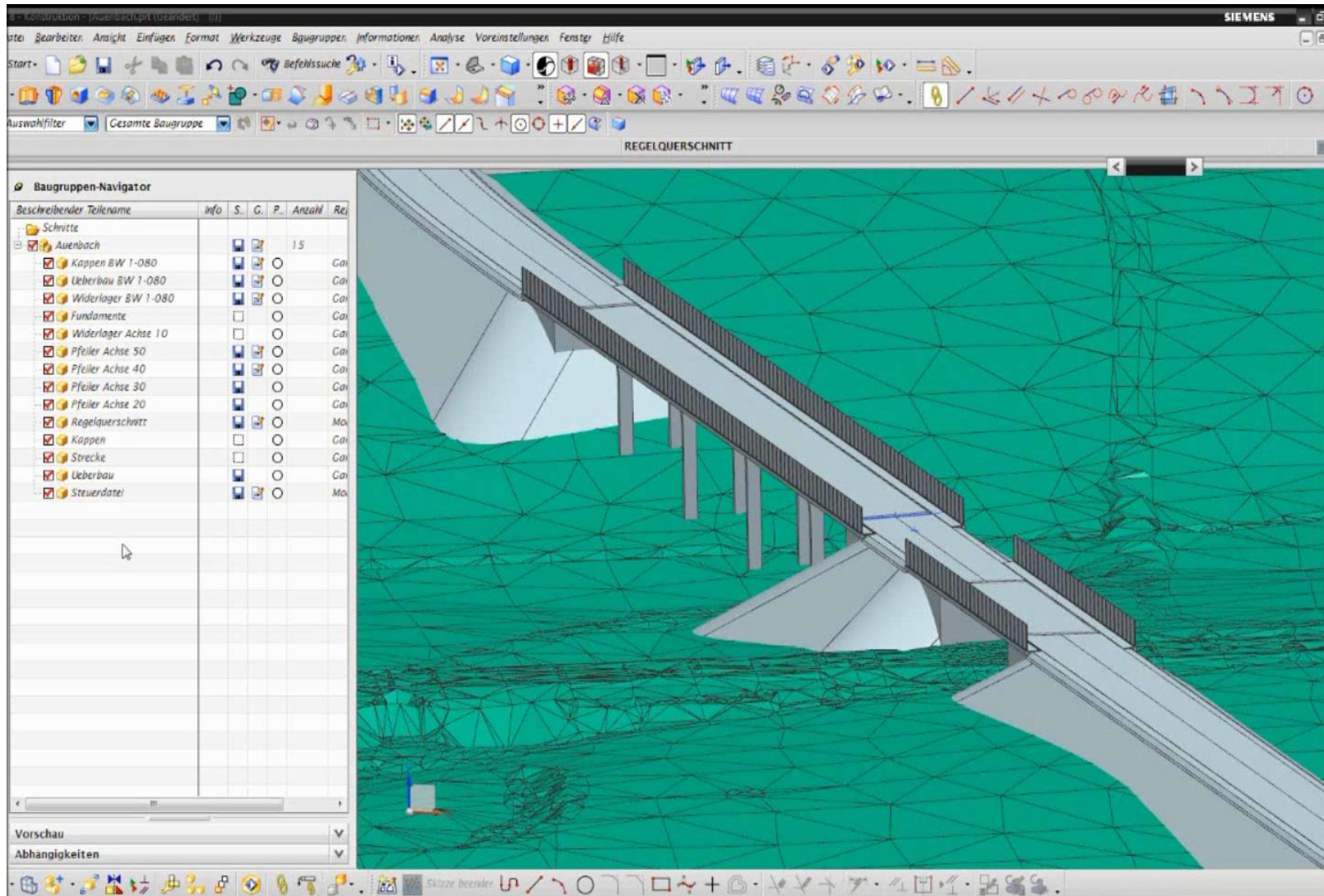
Auenbach Bridge – Southern Link Chemnitz

- 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



© Obermeyer Planen + Beraten

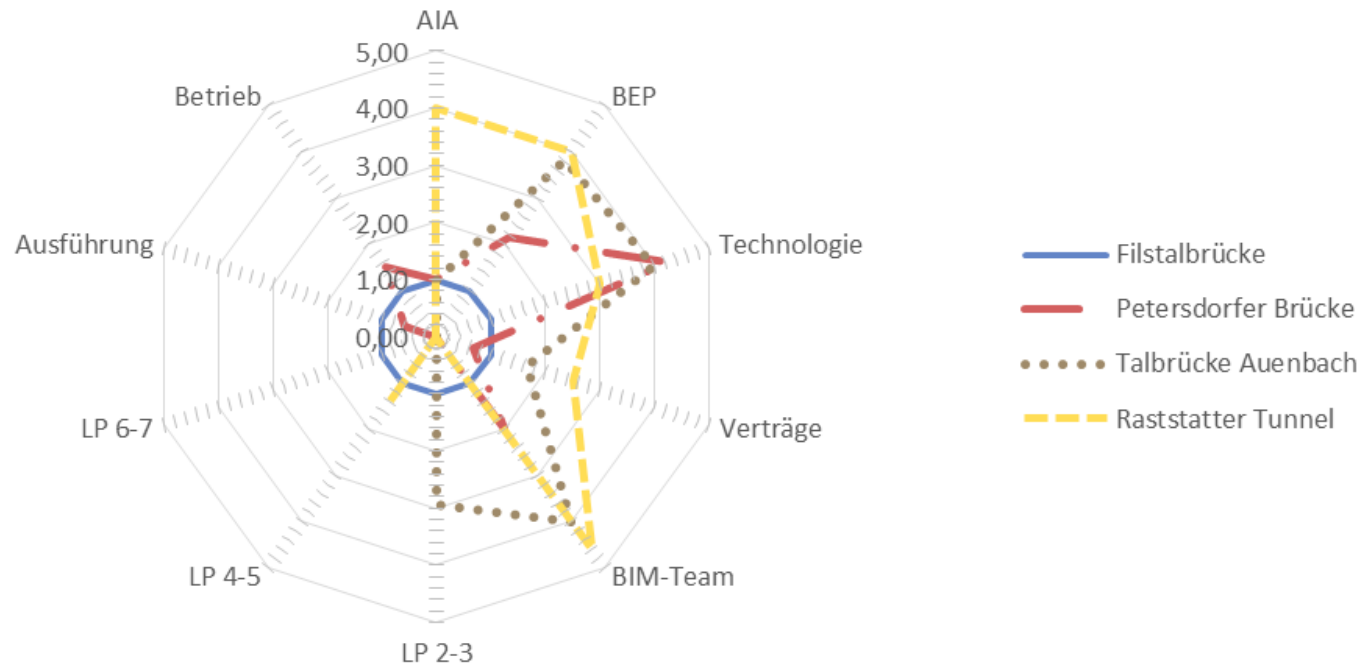




© Obermeyer Planen + Beraten

Scientific Analysis

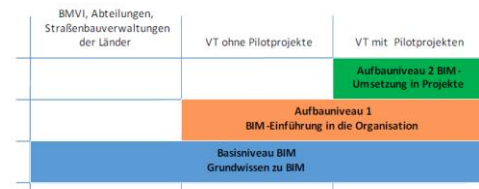
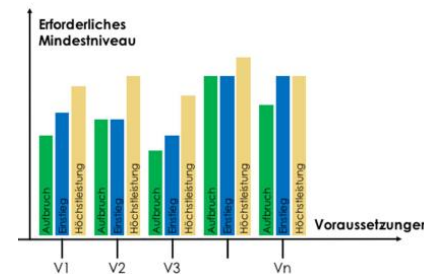
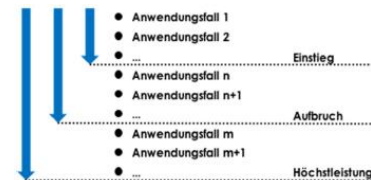
Intermediate Results



Implementation of the BIM Roadmap

Ministry of Transport

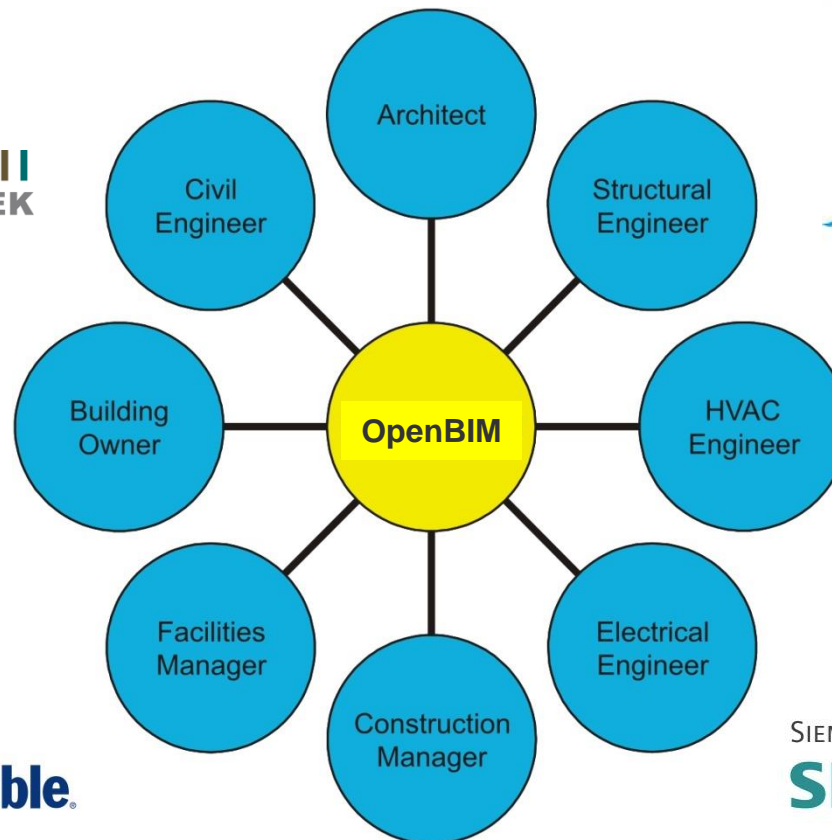
- Detailed Definition of BIM 2020 scenario
- Guidance of 25 new pilot projects
- In-depth legal analysis
- Guidelines, templates, recommendations for public authorities
- Data base concept: BIM cloud
- Model checking concept





Industry Foundation Classes

Vendor-Neutral Data Exchange Standard





Research

Capturing existing bridges

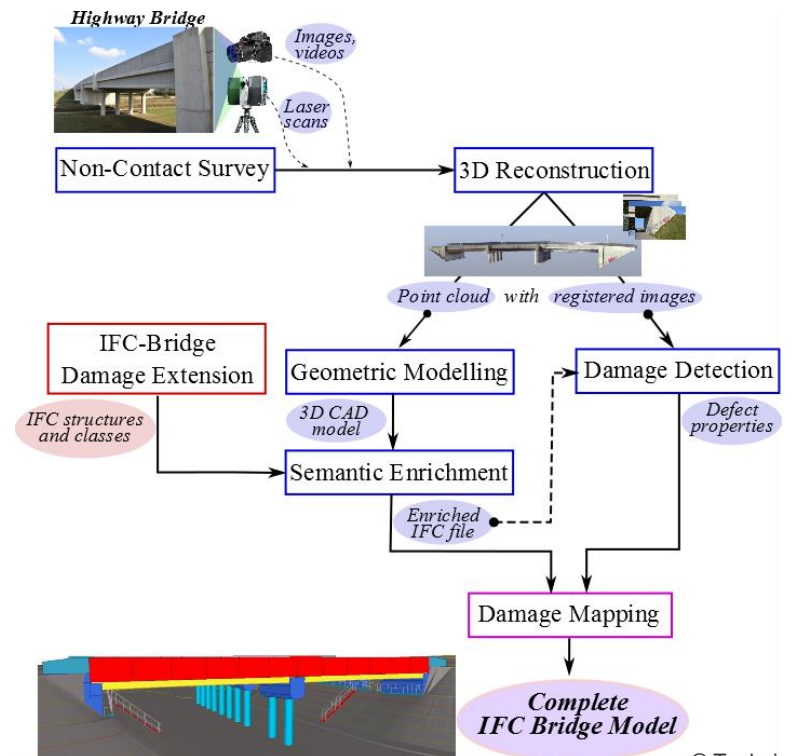
SEEBridge

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

Infravation
An Infrastructure Innovation Programme

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



© Technion



SEEBridge

Infravation
An Infrastructure Innovation Programme





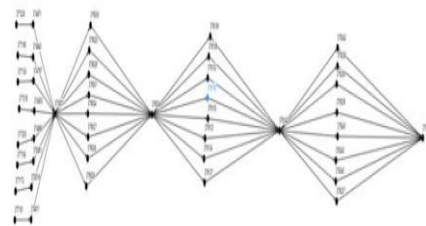
Research

BIM-based Progress Monitoring

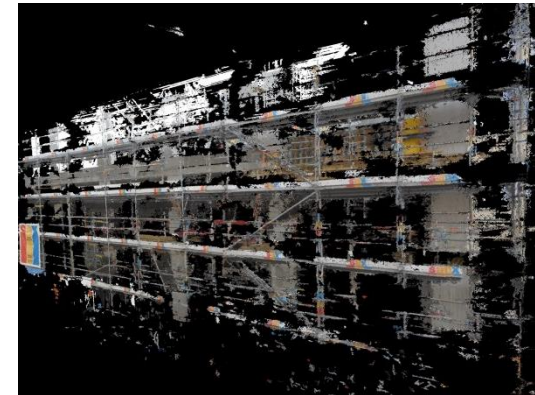
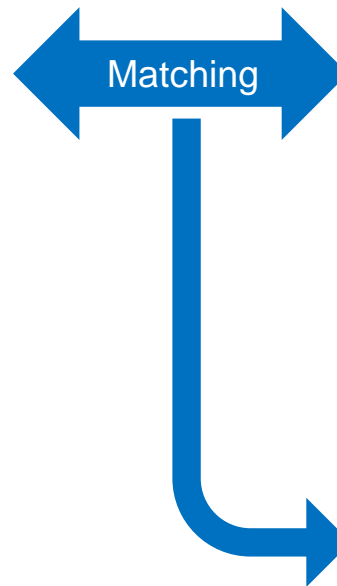
Construction Progress Monitoring



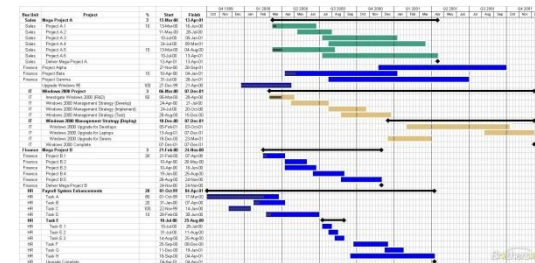
Building Information Model



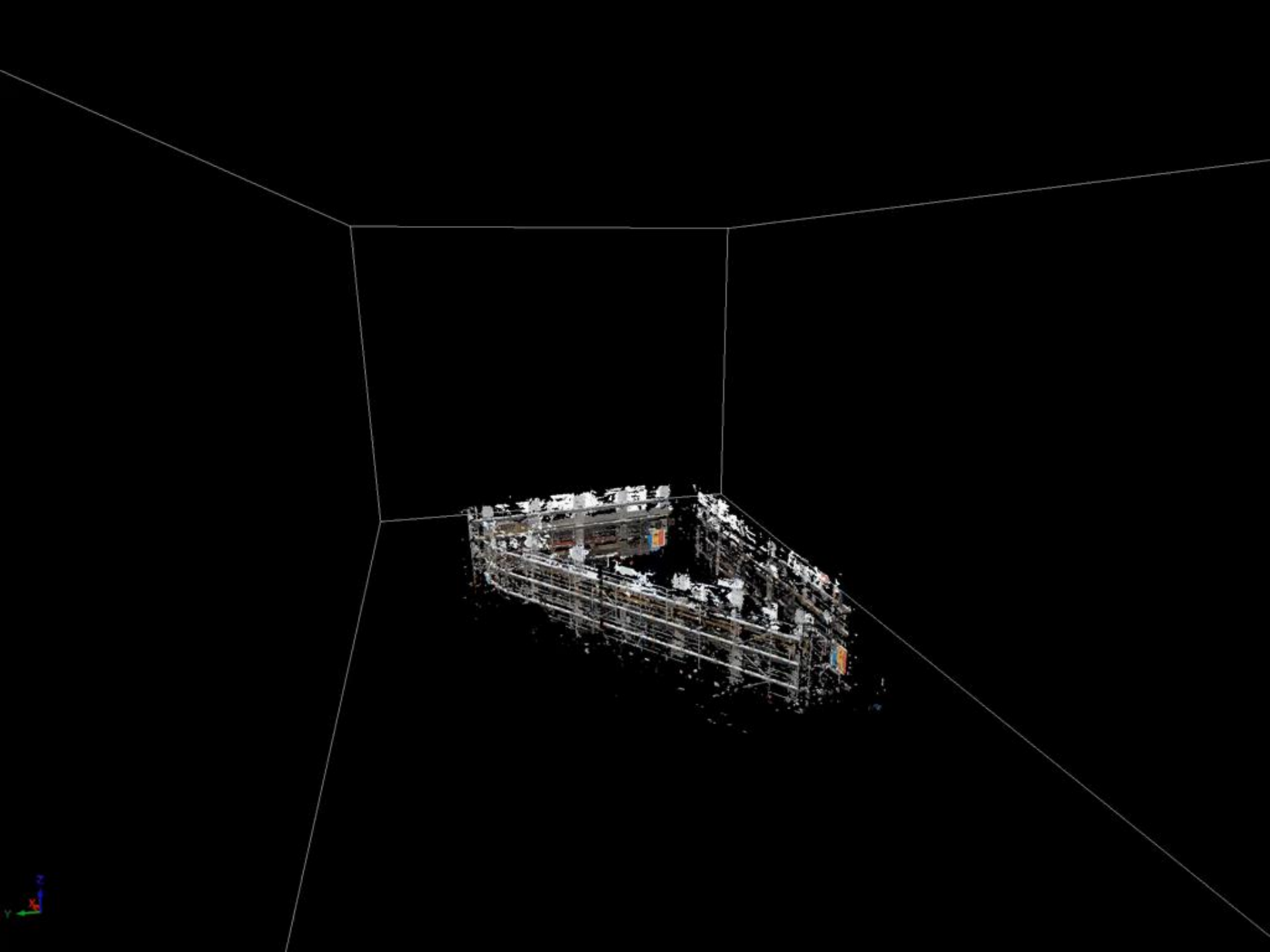
Precedence Relationship Graph



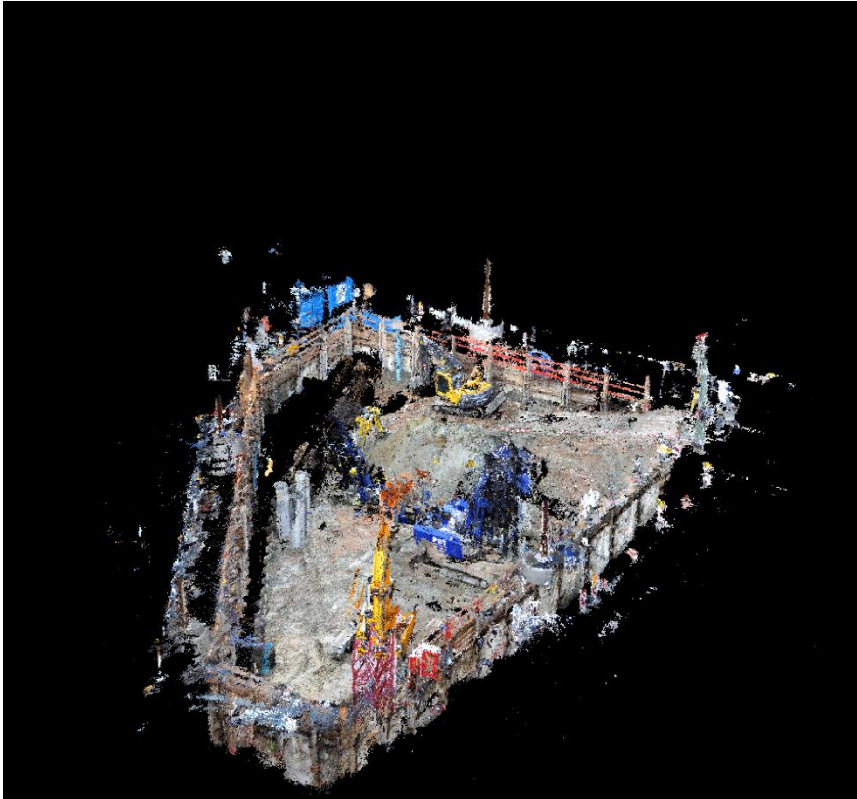
Captured Point Cloud



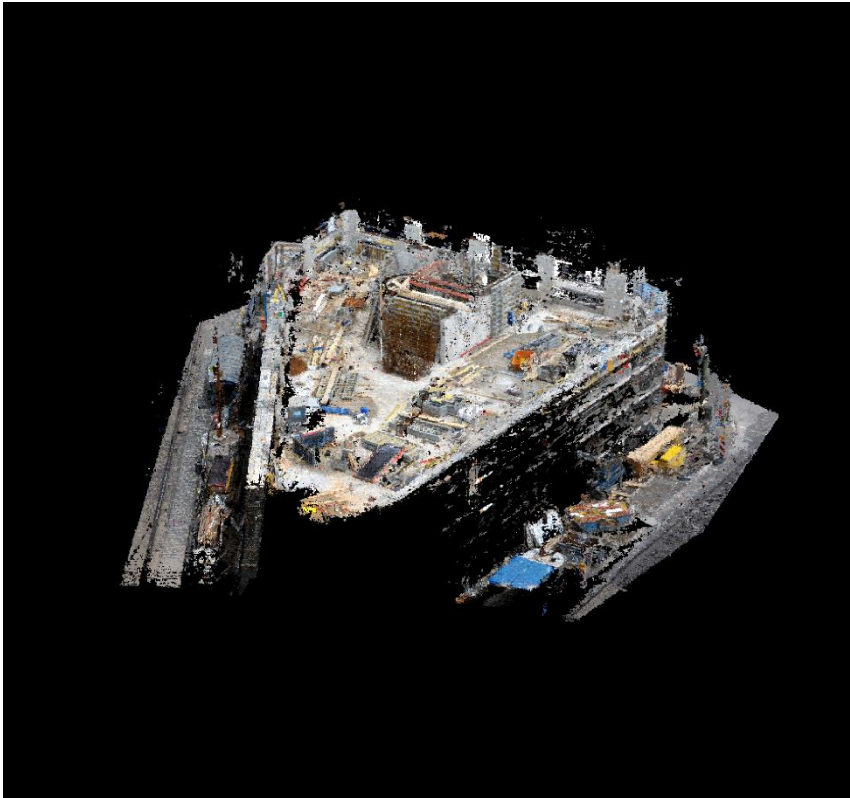
Delays in Schedule?



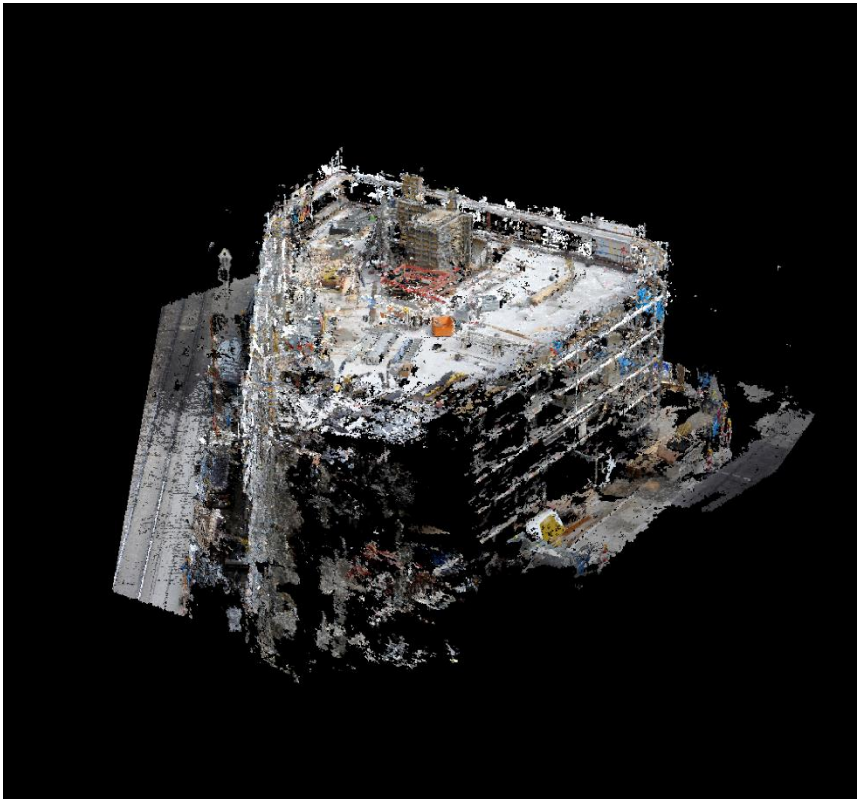
4. Dezember 2012



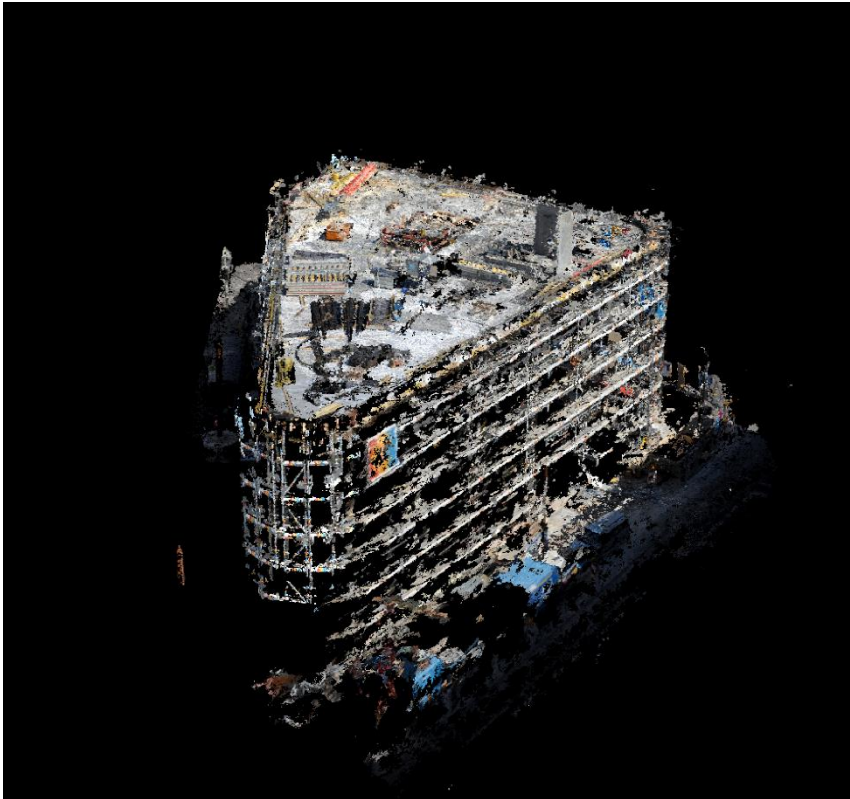
12. Juni 2013



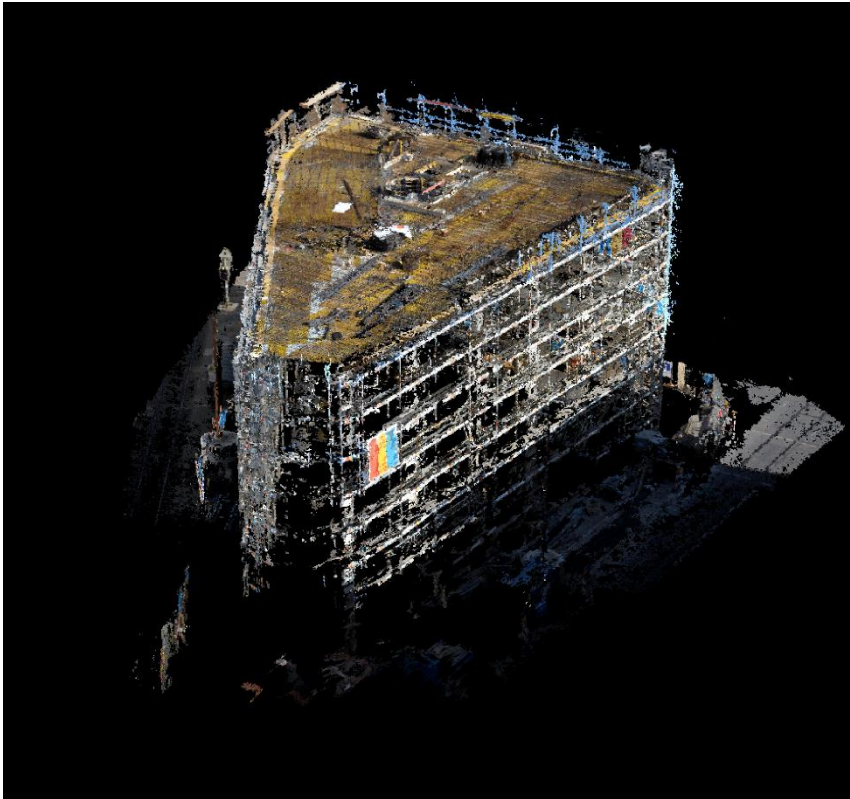
27. Juni 2013



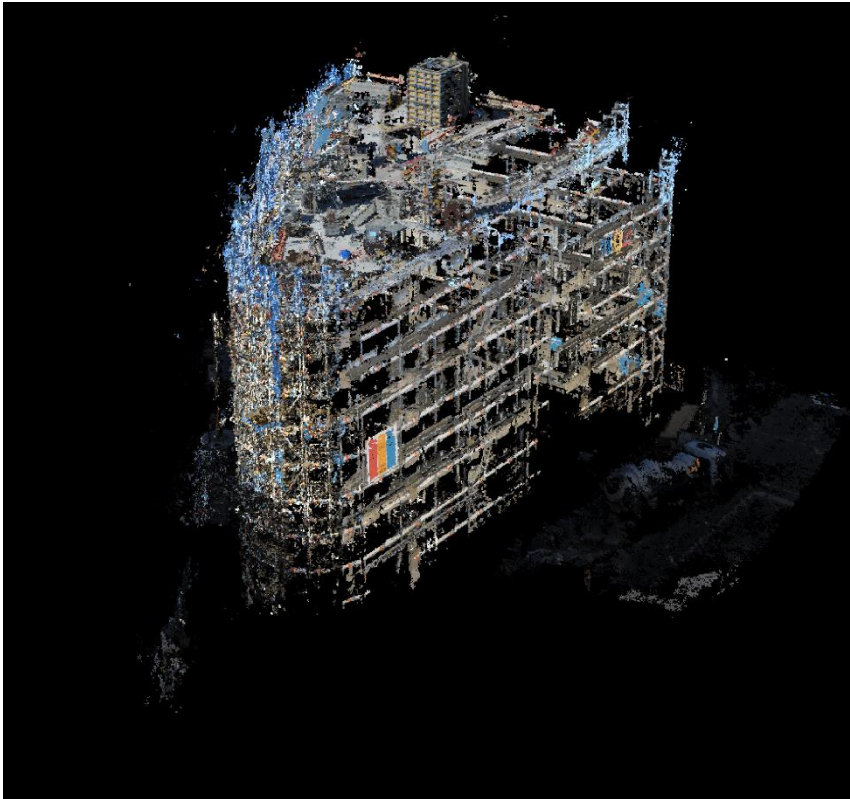
17. Juli 2013



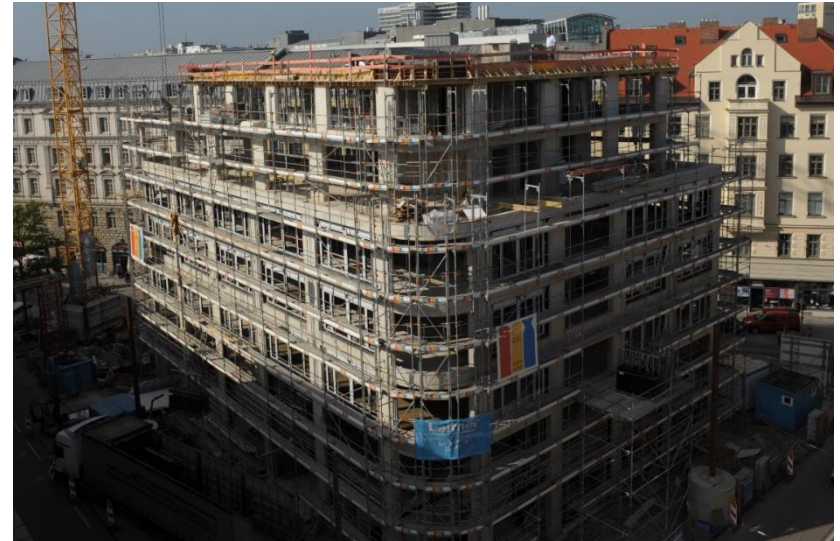
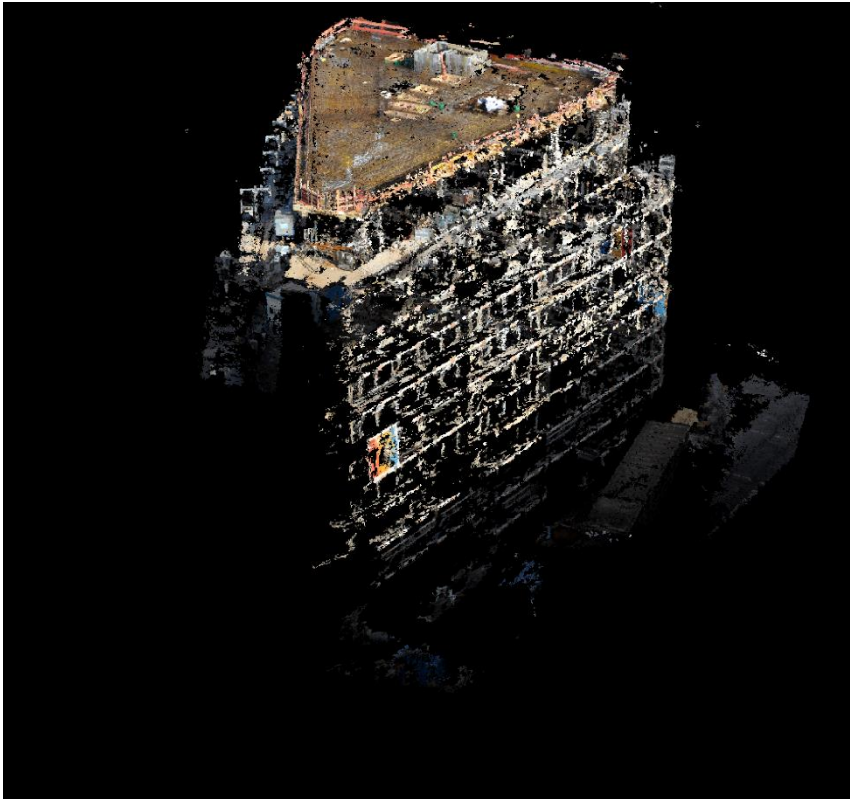
8. August 2013

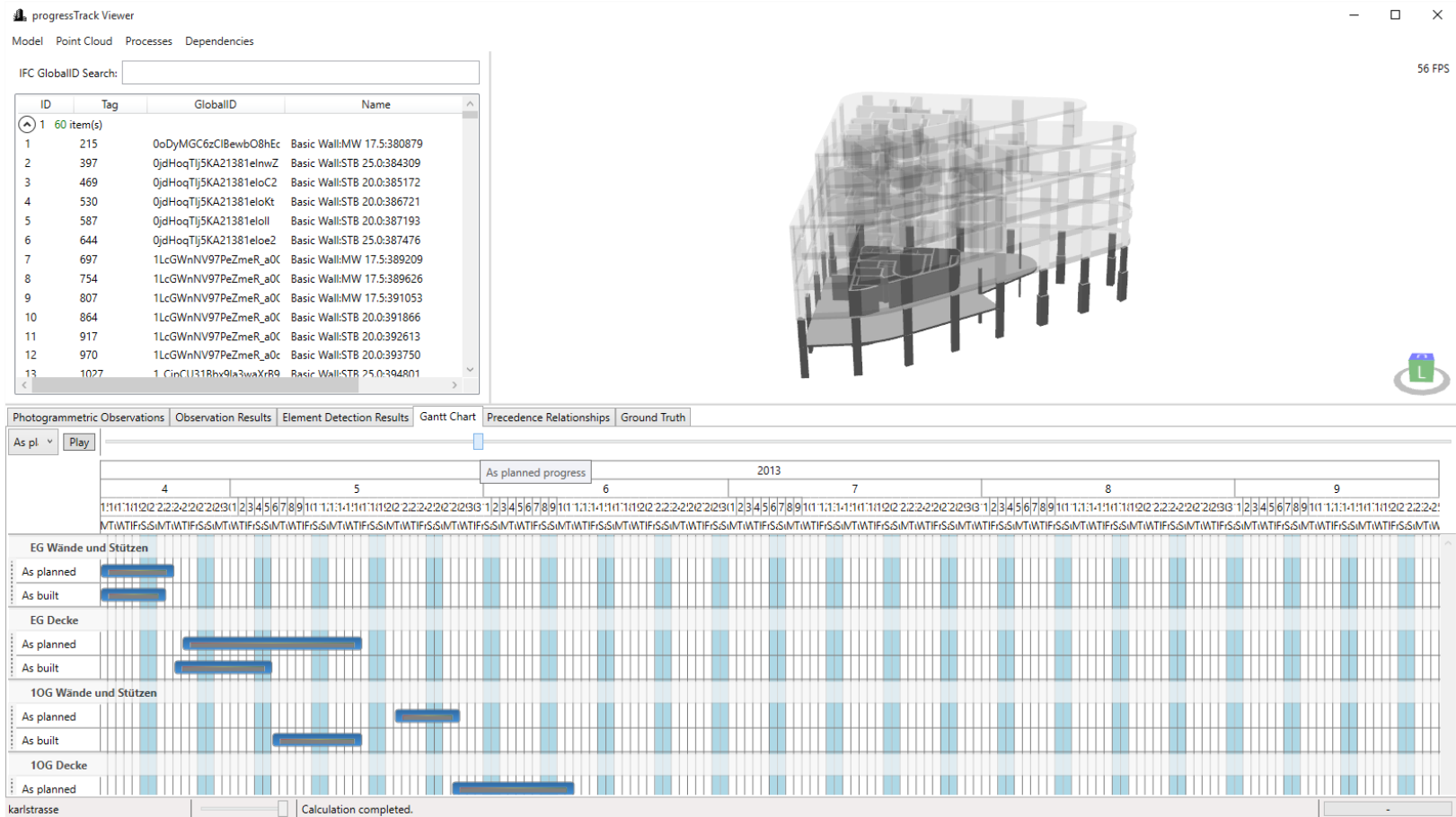


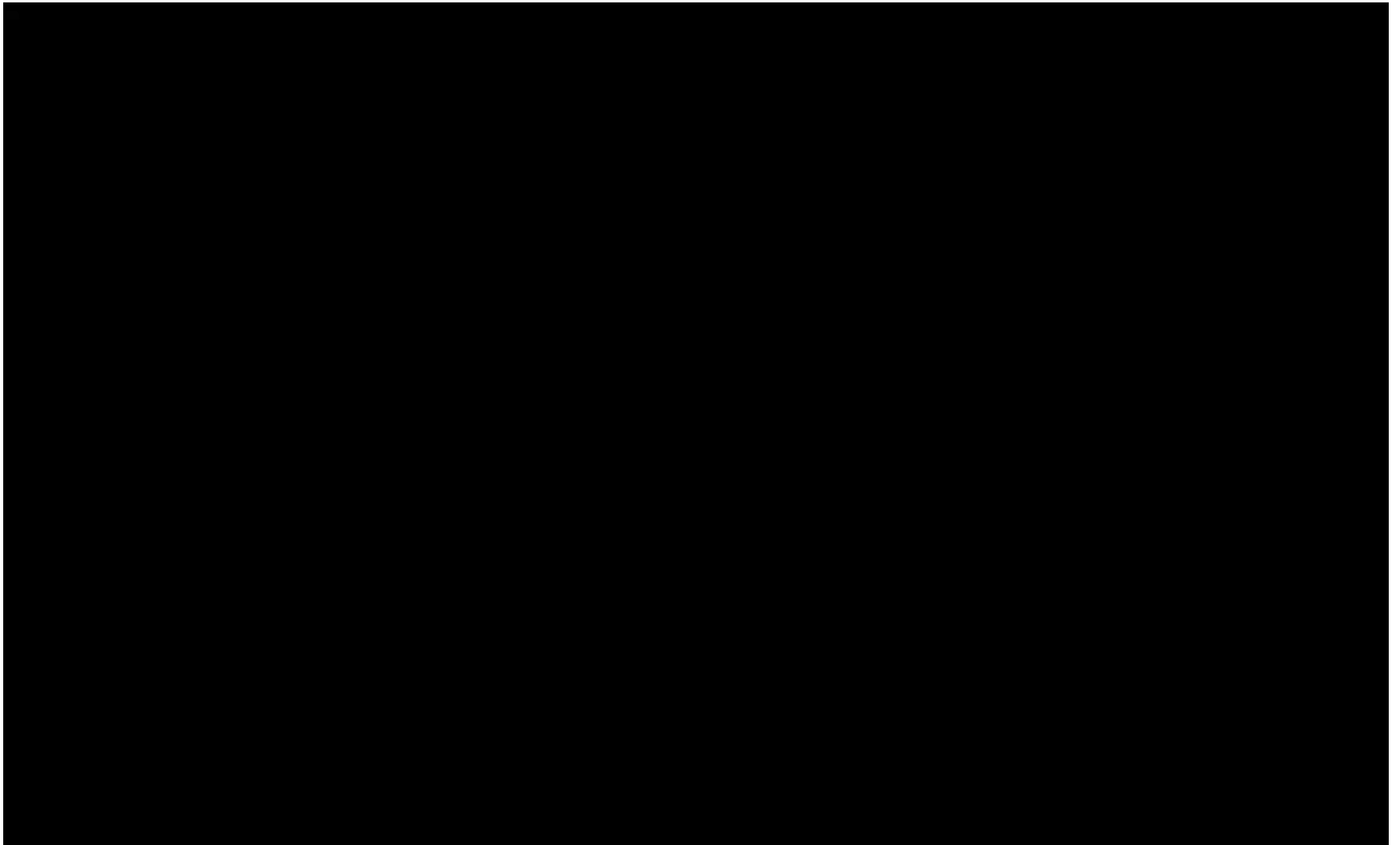
4. September 2013



24. September 2013







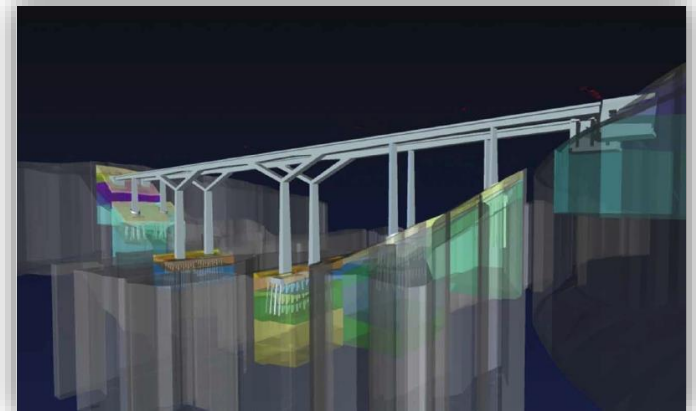


Summary

- 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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