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BIM in Tunnelling

Webinar – March 18, 2021

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Example for Application of BIM in a Specific Project

Dipl.-Ing. Wolfgang Fentzloff
Implenia Construction GmbH (D)

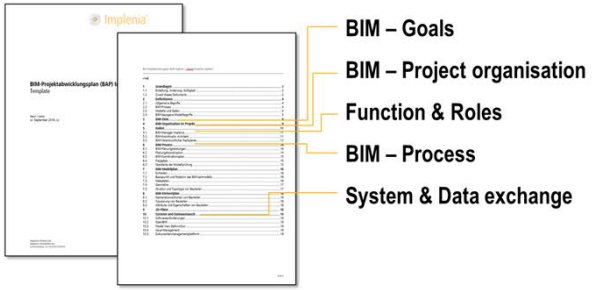
DAUB/EUTF-Webinar „BIM in Tunnelling“ – March 18, 2021

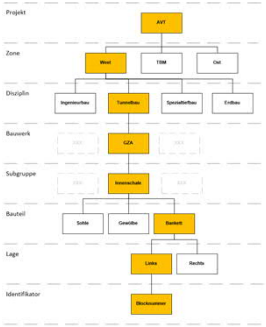
Practical Hints for BIM Application at a Project

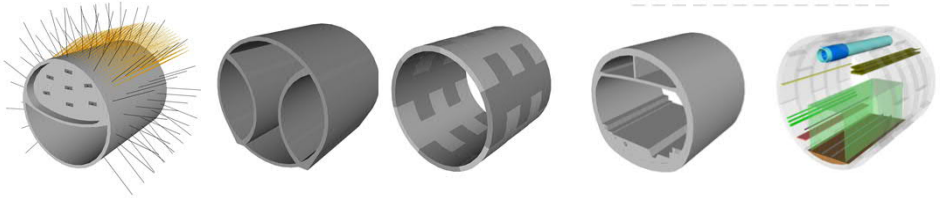
BIM Application at a Project

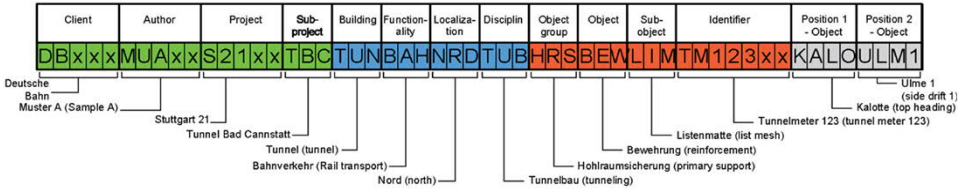
General principles

- Define goals and use cases which shall specifically guarantee the project success
- Have tools ready for implementing BIM (model structure (e.g. DAUB) products, families, object catalogue, processes)
- Train staff and implement it on the project as a multiplier
- Tender and/or execution phase





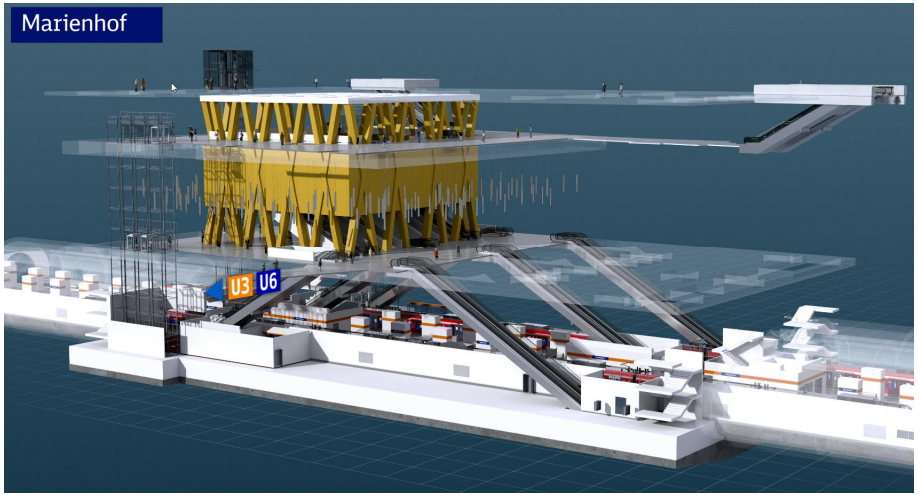




BIM Application at a Project

BIM applications defined by the client

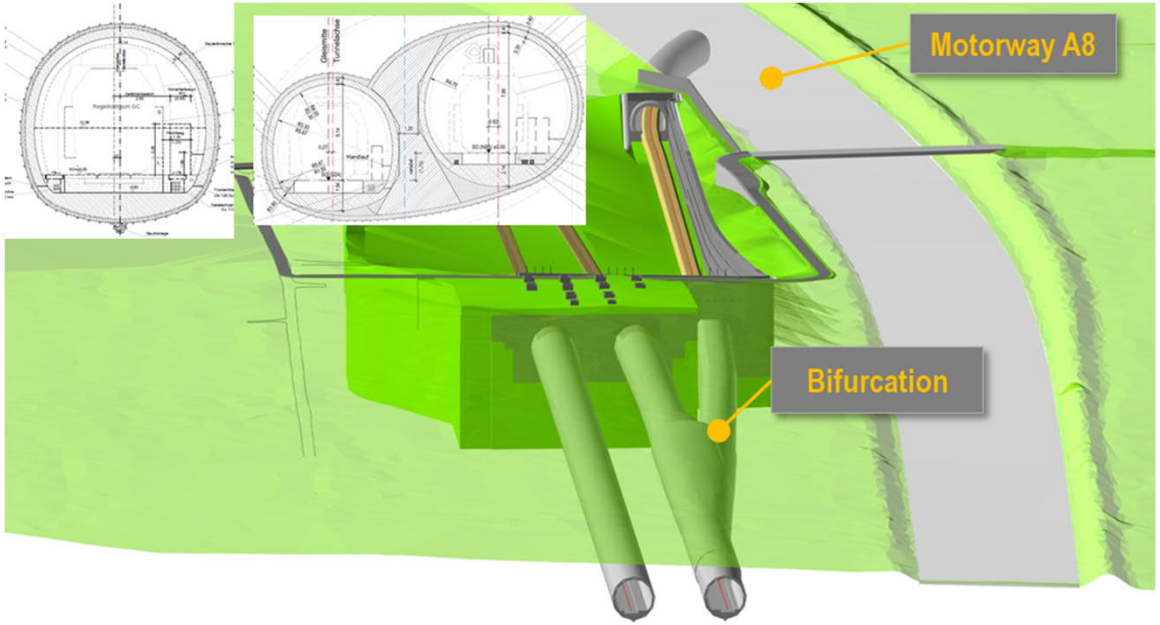
- Set up of employers information requirements (EIR)
- Enter into cooperation with project parties as early as possible
- Elaborate logic project structure to be matched by 3D-model according to use cases (incl. 4D & 5D if appropriate)
- 3D-model handed over by client
- General standards are a great help



Reference: Deutsche Bahn AG

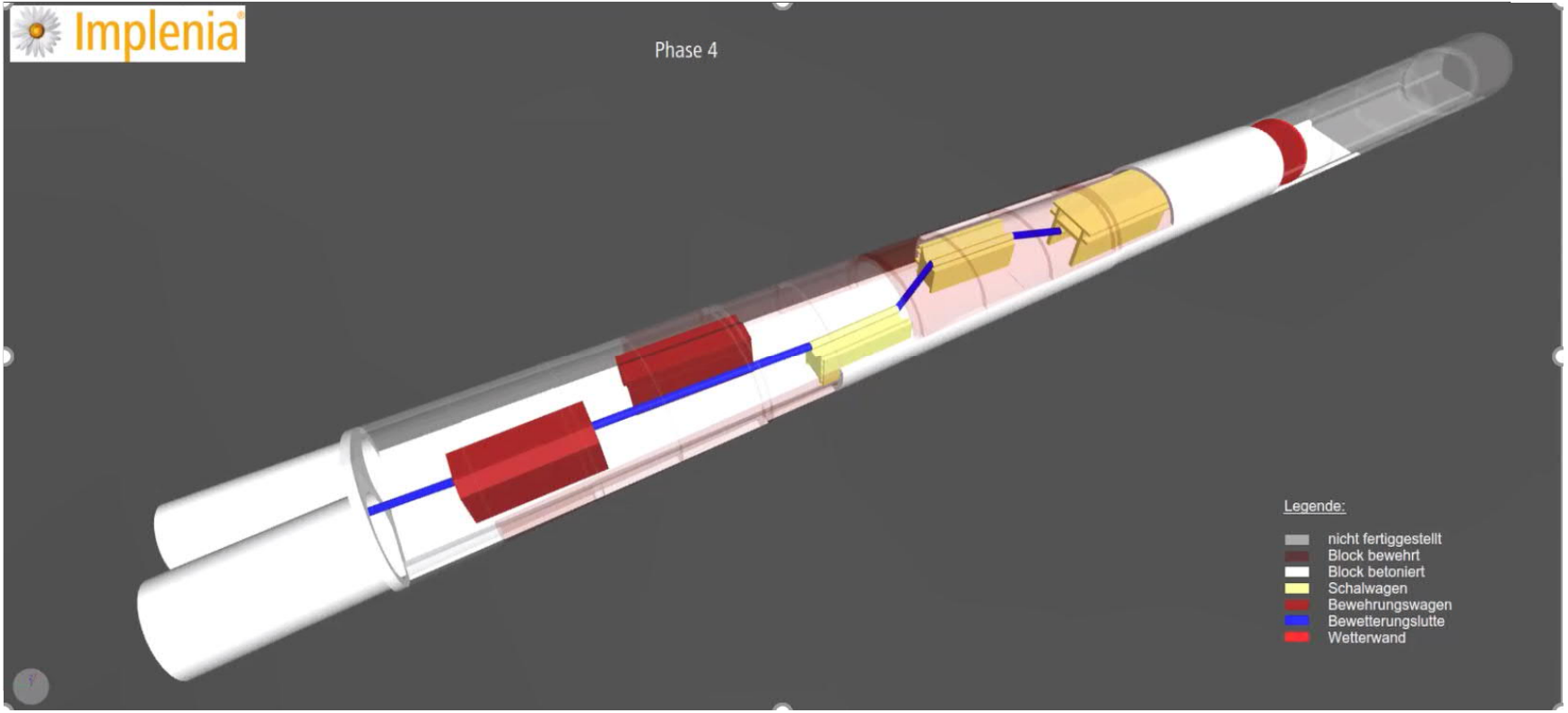
Transforming Planning into Reality

Planning to Reality - Bifurcation Albvorlandtunnel

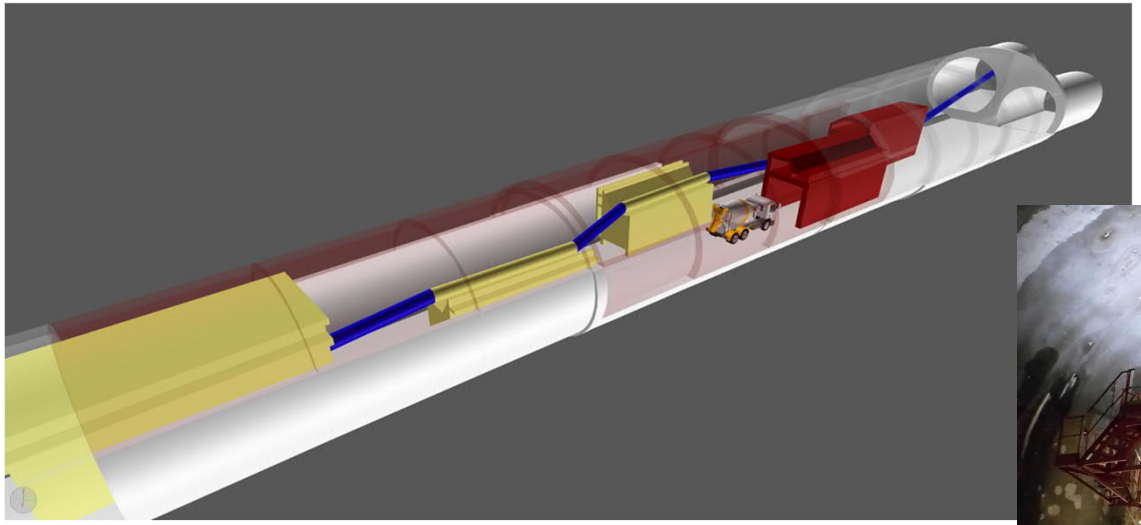


- Construction of underground bifurcation of two tunnel tubes, connected from different levels
- Multiple changing of cross sections
- Sealing works, reinforcement & inner lining
- Dead end tunnel
- Visualizing construction sequences incl. equipment, logistics and auxiliary structures

Planning to Reality - Bifurcation Albvorlandtunnel

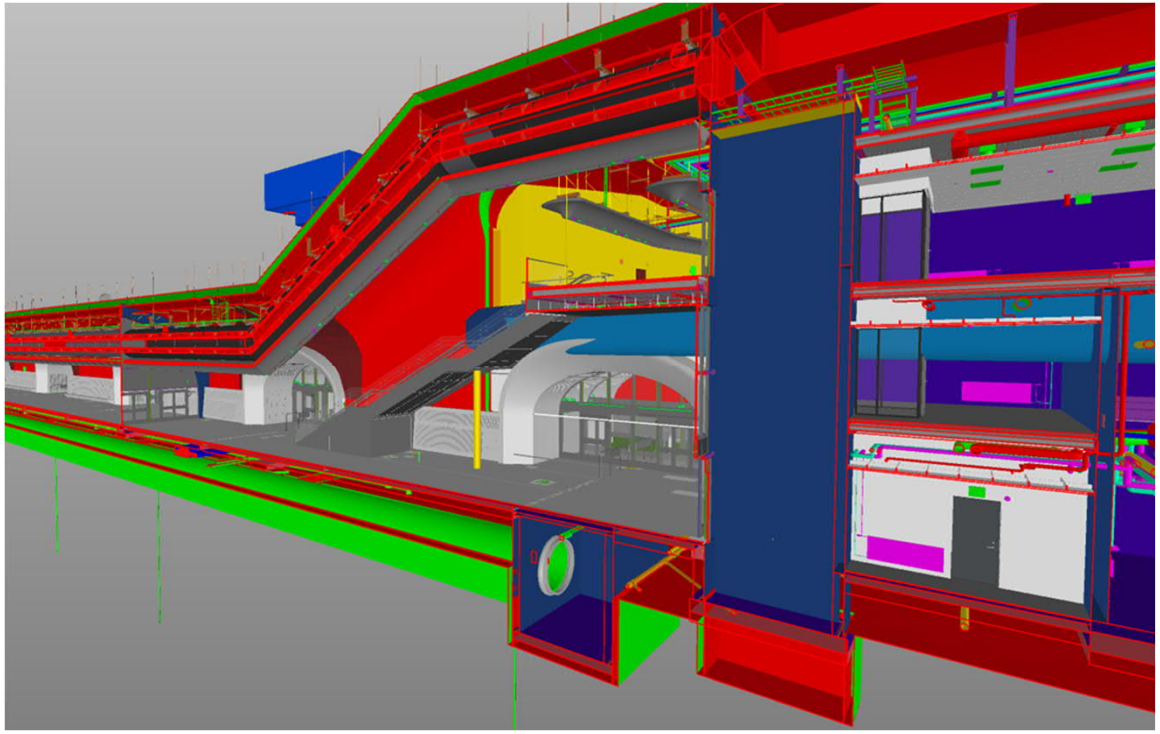


Planning to Reality - Bifurcation Albvorlandtunnel

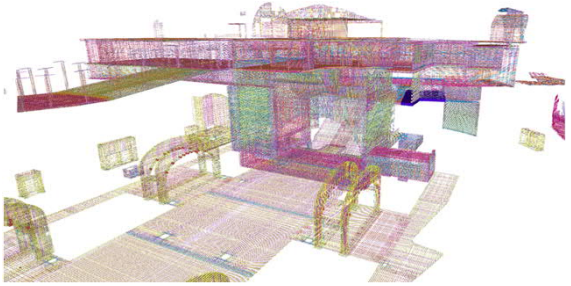


- Clash detection of logistics
- „Virtual execution prior to real execution “

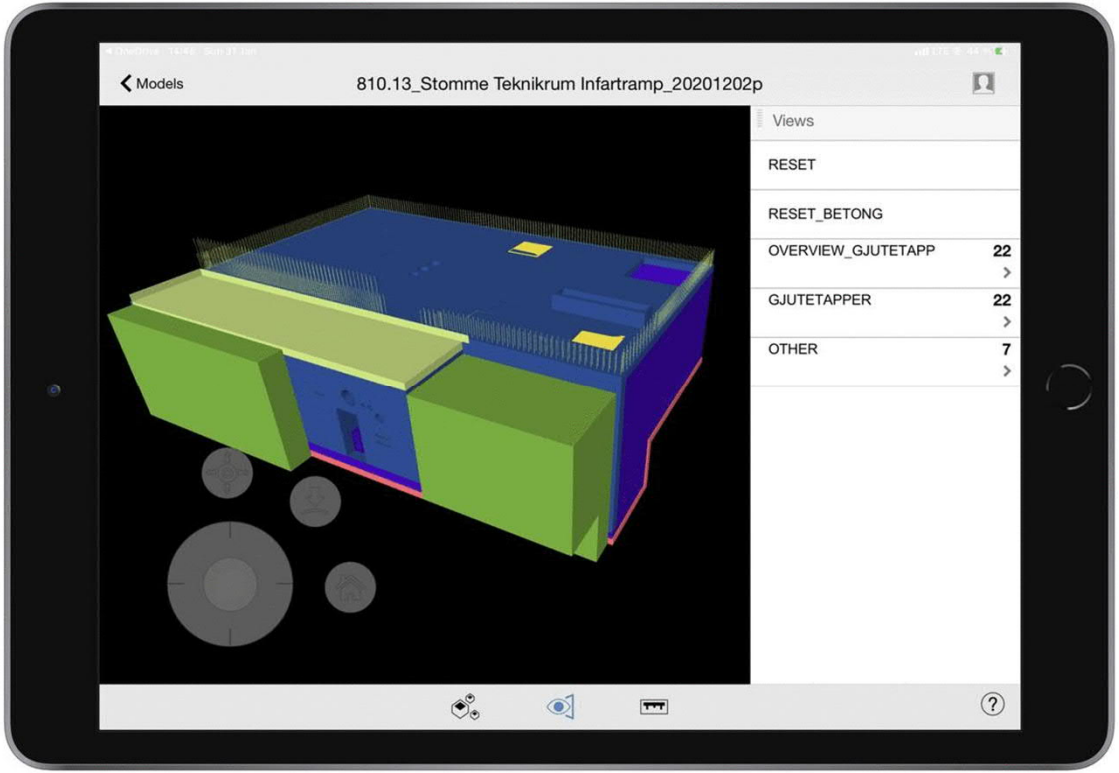
Planning to Reality - Reinforcement Handling on Site



- Project SN 91 Slussen (S)
- Model provided by client, no drawings
- Models very large and not structured in a logic way for construction purposes



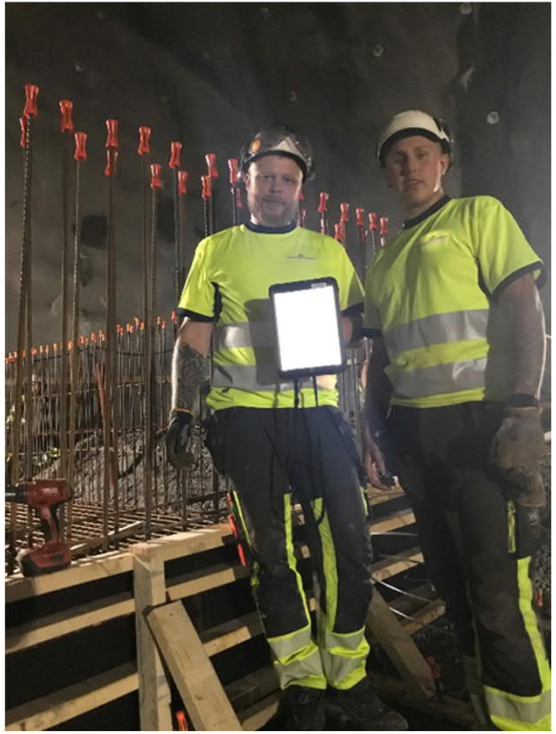
Planning to Reality - Reinforcement Handling on Site



- Automatic generation of viewpoints (pre-defined locations in the model) based on BIM parameters

1. Open the desired construction
2. Select the desired casting step
3. Navigate the rebar sets to be installed

Planning to Reality - Reinforcement Handling on Site

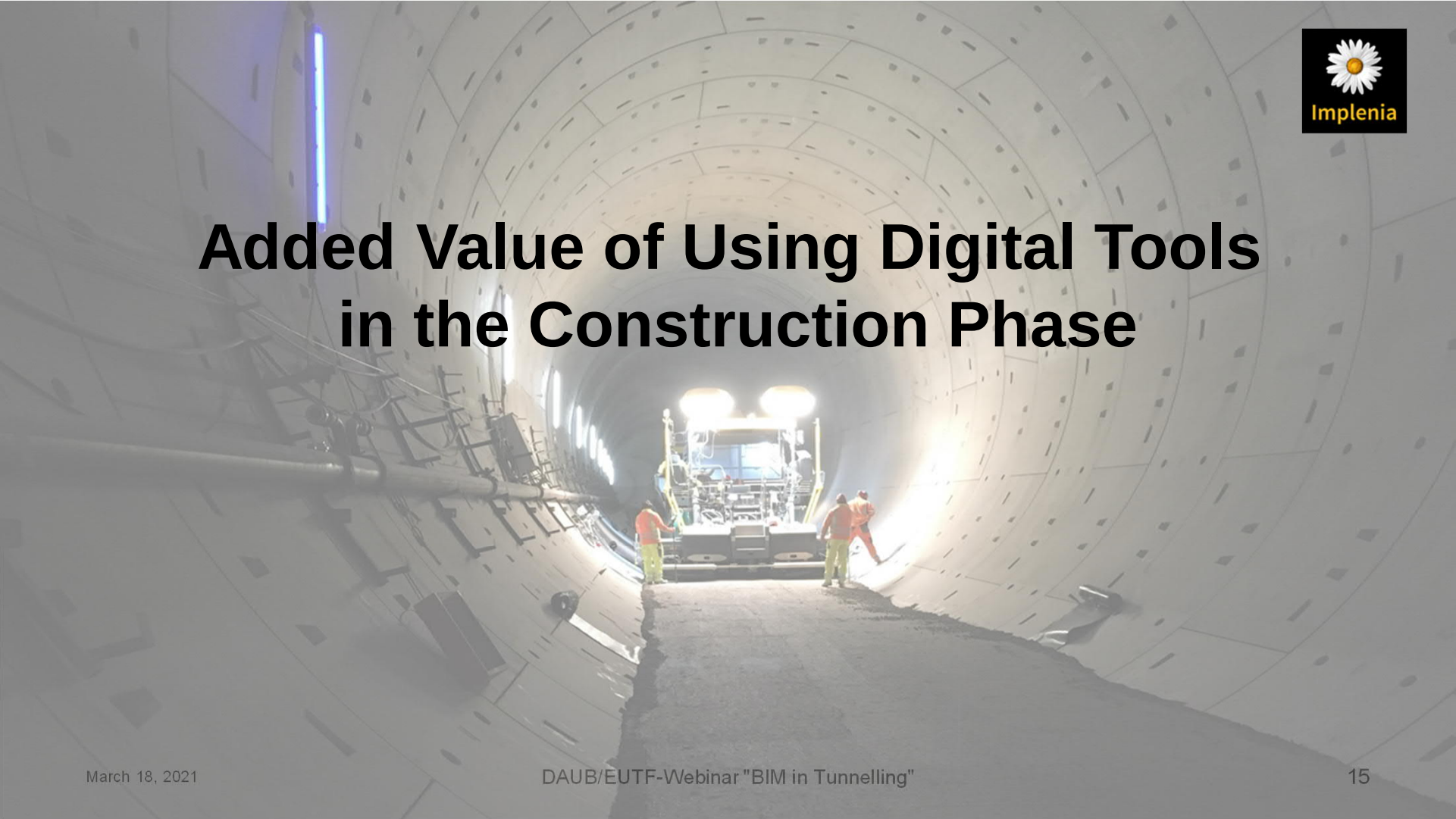


- Each group of steel fixers uses 1 iPad
- 15 iPads on site
- No iPads reported broken so far
- Possibility to read models offline (updates as soon as the iPad restores internet connection)

Challenges and Implementation

Challenges and Implementation

- Readiness of using BIM methods by all parties involved
- Skilled manpower
- Cooperation of project participants already in early project phases
  - Client / Owner
  - Designer
  - Contractor (construction works and fit out)
  - Operator
- Involvement of other project participants in model-based project management (checking engineer, supervising engineer, authorities, third parties...)
- Elaboration and application of existing regulations on public procurement and contract law
- Introduction of standardised basics (object catalogue, property sets)
- Set up project and model structure according to intended use cases
- Facilitate cooperation and avoid errors when using interruption-free data / information (end-to-end processes)
- Use of ground model as an own discipline model and integration of relevant information into construction model
- Project life cycle: Increasing detail in the development of the project and selection of relevant properties / information for transfer to operation (BIM2FM)



Added Value of Using Digital Tools in the Construction Phase

Added Value - Communication / Source of Information

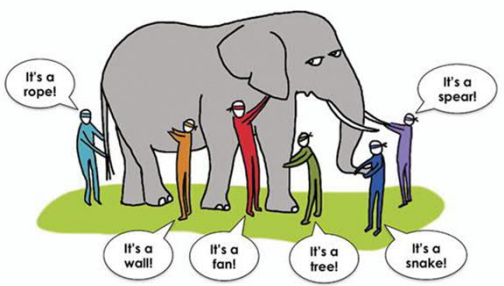
How to effectively address ideas and information?

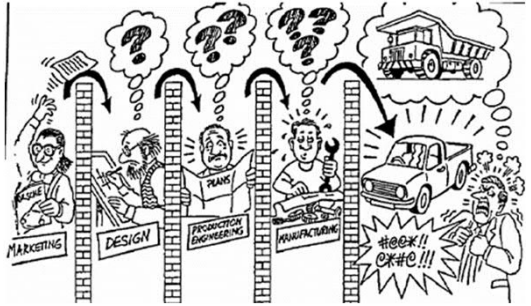
2D-world:

- Person A (Client/Designer) creates ideas by having images in mind
- Images to be captured in text, calculations and drawings
- Information & data from there will be composed again to images in the recepting person‘s mind

Avoid

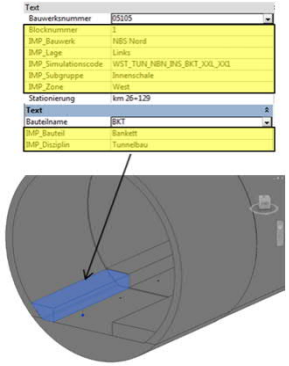
- disruption in information flow
- unintended interpretations and conclusions
- disclosure of information

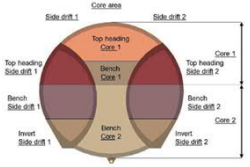


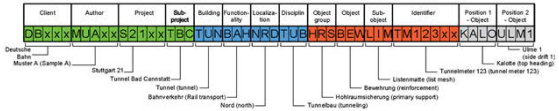


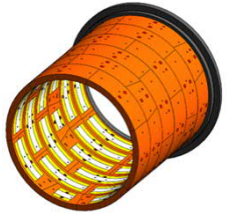
Added Value – Data Management

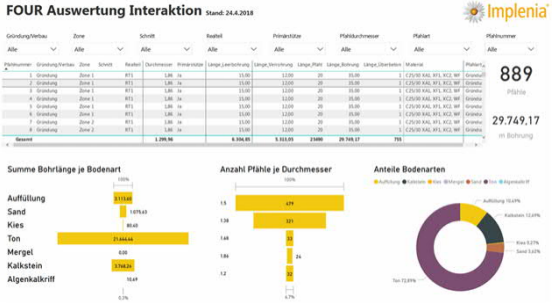
- Structured data set up and capturing
- Filter & analyse relevant data
- Visualize data to disclose information
- Provide data in real time for quick decisions
- Make data available for further processes & methods (e.g. lean construction, operation)





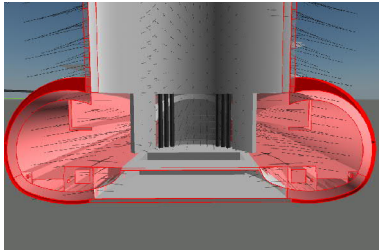




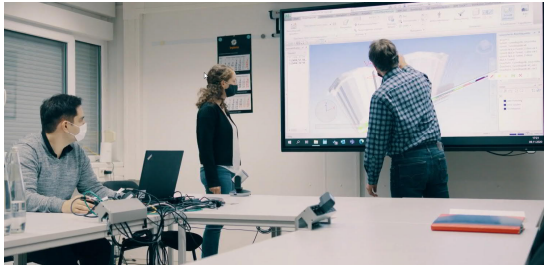


Added Value – Transparency & Collaboration

- Create a common understanding of the scope of work



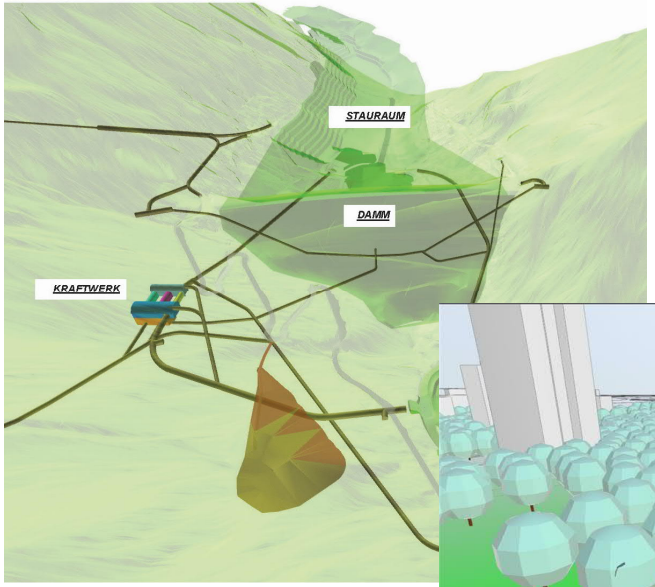
- Get all parties necessary for successful project execution as early as possible on the table

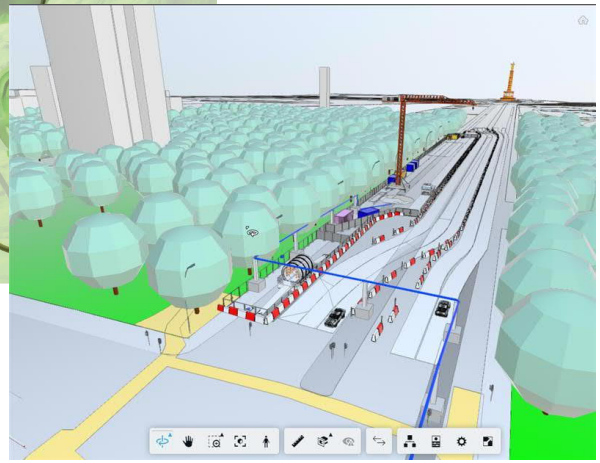


- Find collaborative contract models (e.g. ECI, IPD, …)

Added Value - Communication / Source of Information

- Quick access to the scope of work
- Discussing concepts, possible optimization & variants
- Support for public relations work
- Transferring visual information of temporary construction phases and the final structure in the existing environment





Added Value – Data Management

Implenia

Project Sandbukta-Moss-Sandstad (NO)

- Analyse overbreak as the tunnel is blasted/produced
- Merging data into one 3D model in Gemini Terrain
  - ✓ Laser scanned data
  - ✓ Drill log data
  - ✓ Theoretical blasting profile

Added Value – Data Management

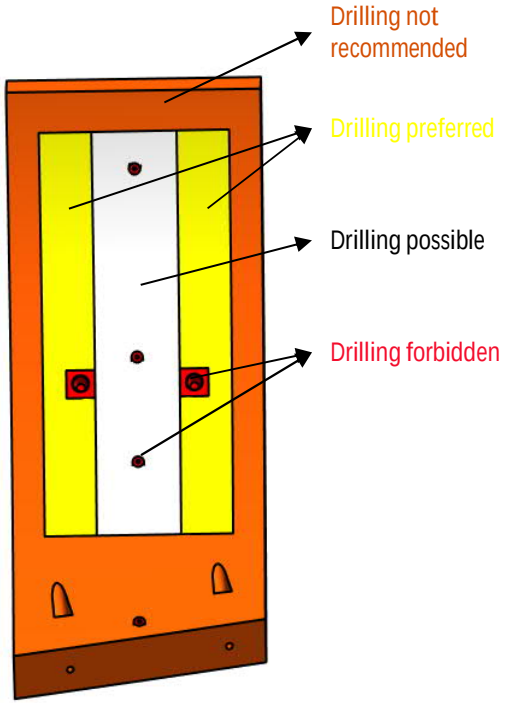
Project Sytral Lyon (FR)

As built tunnel model : new demand of the client:

→ deliver a 3D as built model of the tunnel that include drillable zone

Objectives:

- Help the fitting-out contractors to prepare their drilling work
- Enable clash detection between not drillable zone and anchors



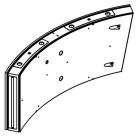
Added Value – Data Management

Implenia

Project Sytral Lyon (FR)

TPC Recorded data from TBM (TPC)

- Keystone position
- Ring type
- Segment information



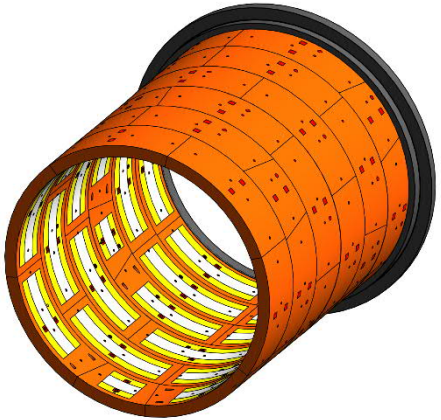
Segment collection and drill zone (-, S, E, SR, SRE)

As-built model

Combined data from both sources*

Data interpretation

Dynamo



VMT Guidance system

- ring position in tailskin

AUTODESK REVIT

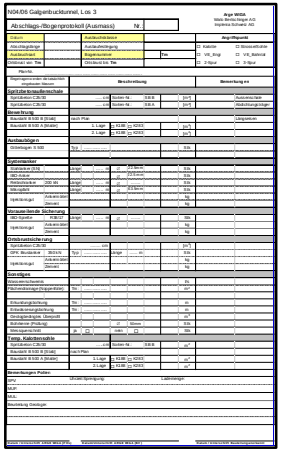
*manual step was necessary since the systems were not set up initially for as-built model generation

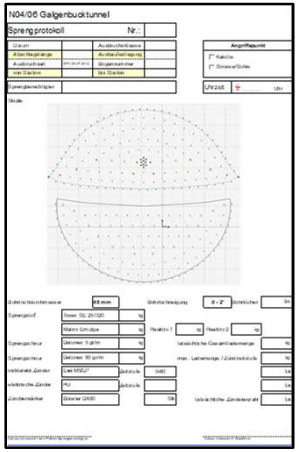
Added Value – Data Management

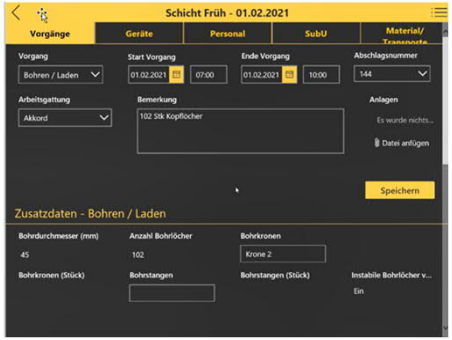
Project Kerenzerberg (CH)

- Project was selected as a pilot for digital documentation
- Usually, documentation is done with different reports
- Information on reports is redundant
- Redundancy can lead to errors in the data recording and inconsistent information

- Production data is recorded via app
- Object oriented data recording that allows linking of information

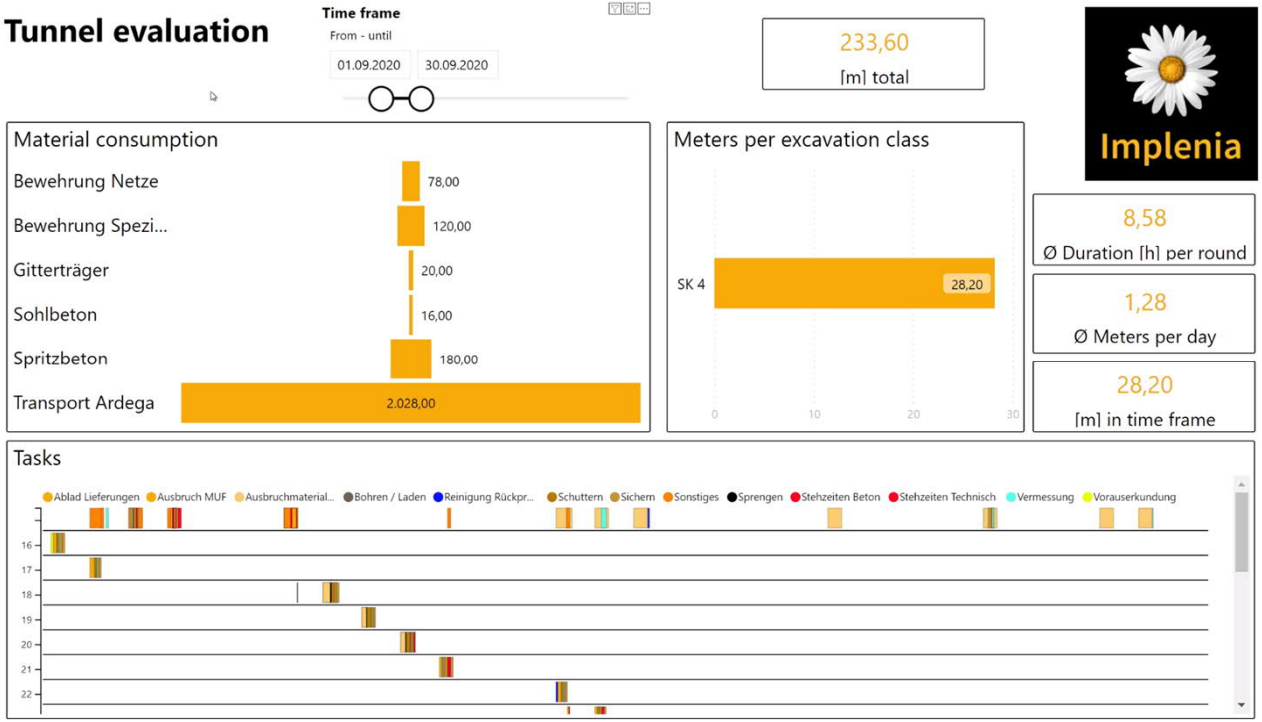






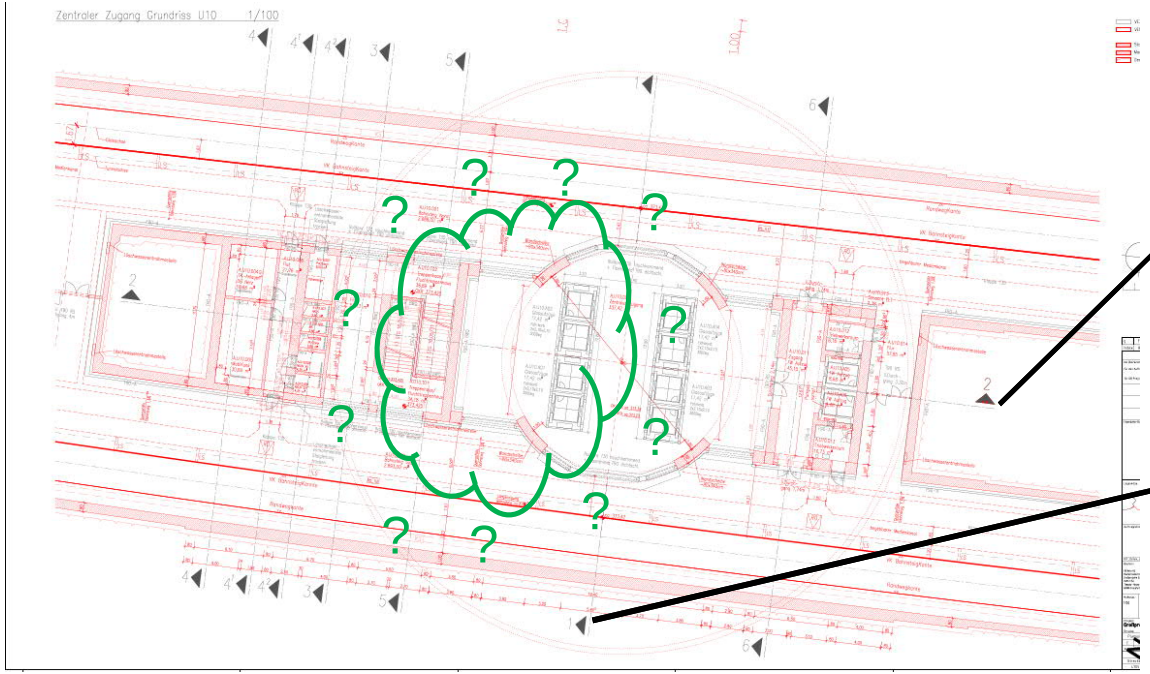
Added Value – Data Management

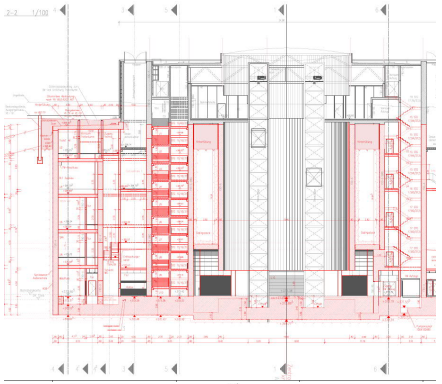
Project Kerenzerberg (CH)

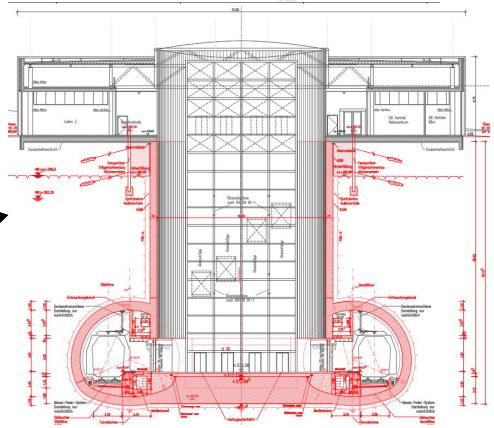


Added Value – Transparency & Collaboration

Example 2D vs. 3D

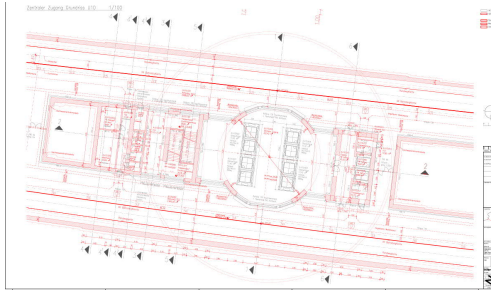


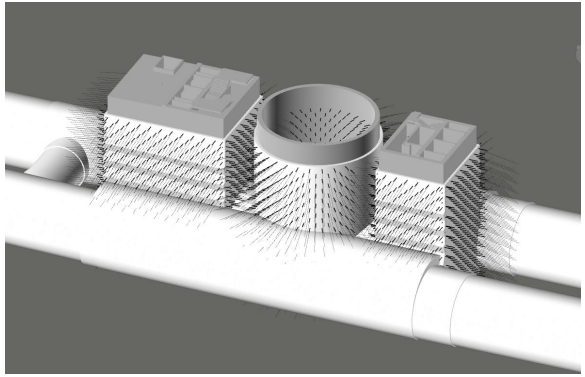


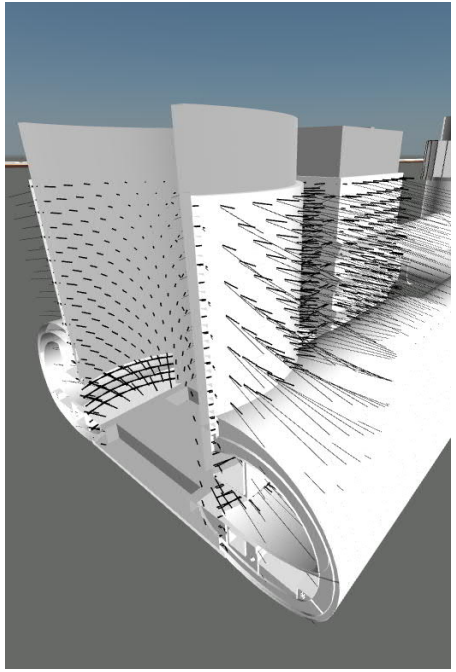


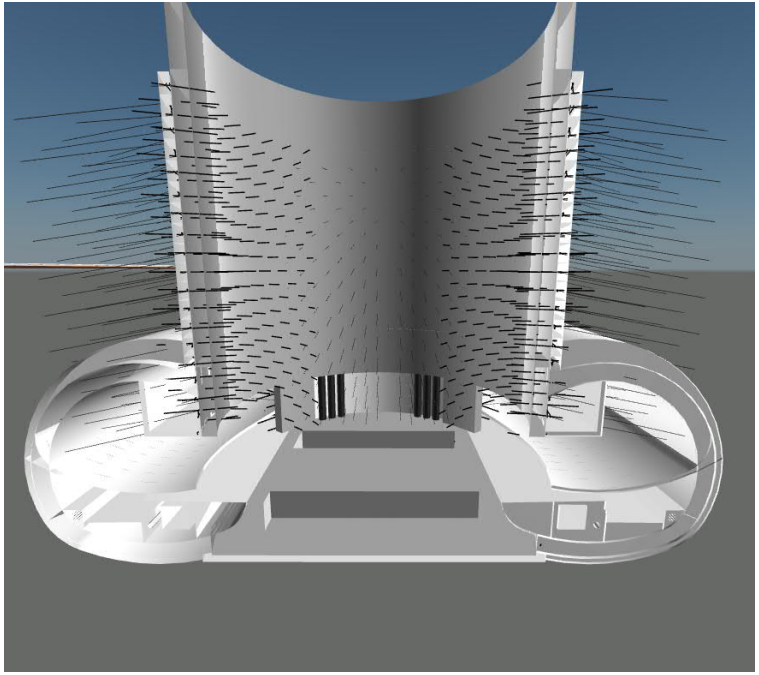
Added Value – Transparency & Collaboration

Example 2D vs. 3D





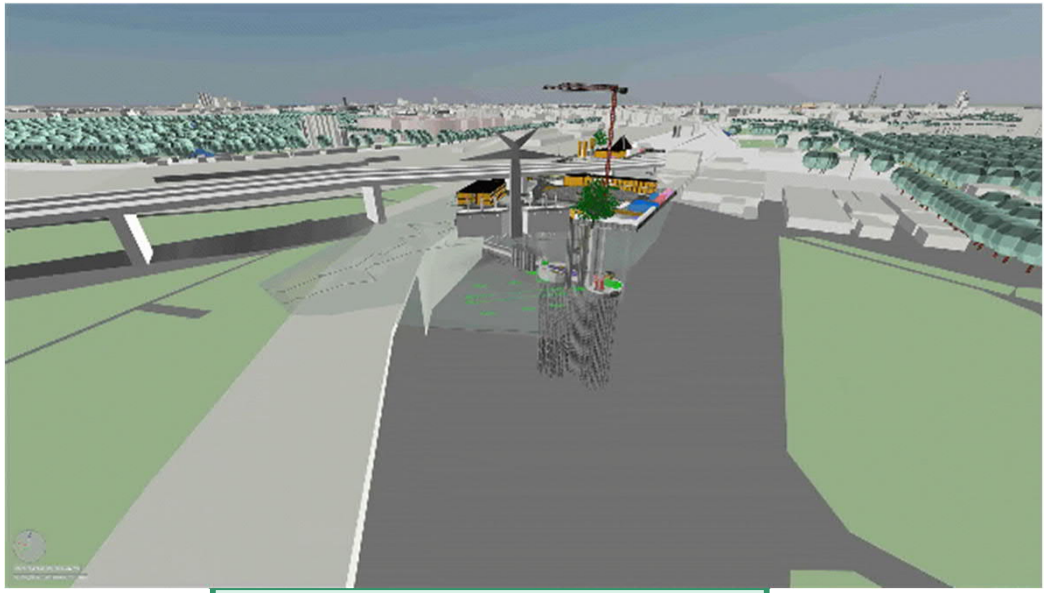




Added Value – Transparency & Collaboration

Project Kabeldiagonale Berlin (GER)

- Implenia‘s pilot project of BIM application in Germany
- Collaboration of three disciplines: Special Foundations, Civil Engineering, Tunnelling
- Use cases implemented:
  1. Common project structure on basis of DAUB recommendations
  2. Model based design
  3. Clash detection
  4. Comparison of alternatives
  5. Comparison of contractual and actual model
  6. 4D simulations
  7. QTO
  8. Planning of logistics
  9. Data capturing and monitoring
  10. Monitoring of non-conformities (HSEQ)

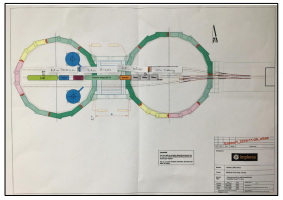


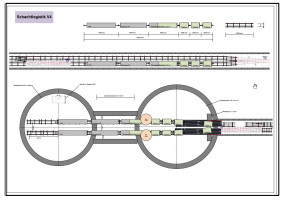
Planning of Logistics

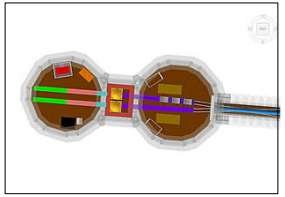
Added Value – Transparency & Collaboration

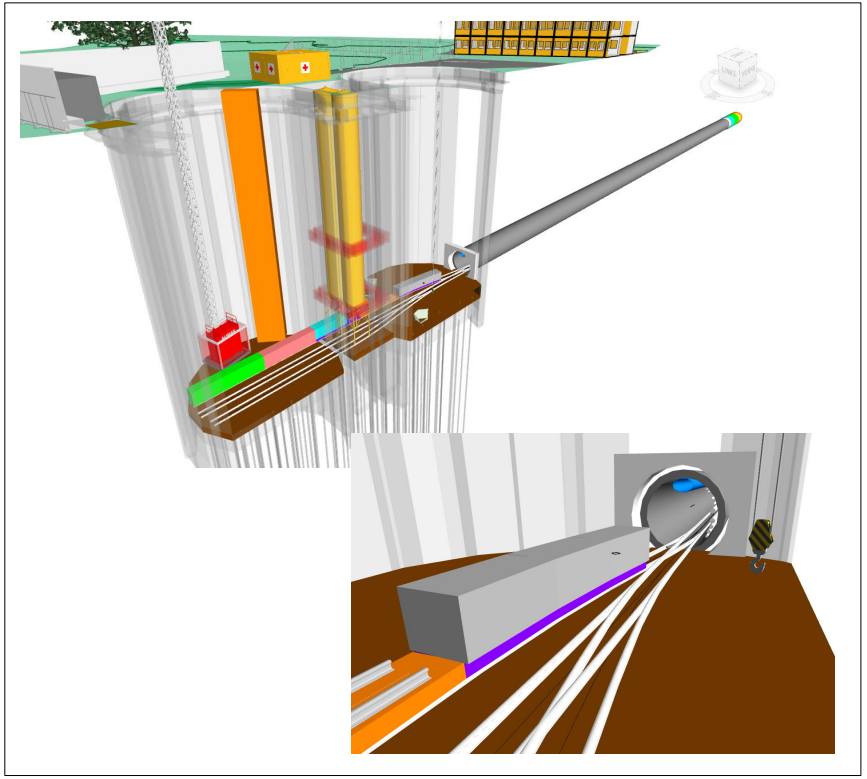
Project Kabeldiagonale Berlin (GER)

- 7 km TBM-drive & 4 shafts for cable duct in Berlin‘s underground
- Planning TBM logistics in launching shaft
- Starting traditionally with „paper tools“
- Using 3D-model for quick studies of variants









Take-Aways and Call

- Be encouraged to implement BIM at your next project
- Use existing expertise (internal and external)
- Train your colleagues (multiplier effect)
- Define your goals
- Use existing standards
- Think about logic structures
- Consider collaborative contract models
- Please, get on the road and do one step after the other!

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Example for Application of BIM in a Specific Project

Thank You for Your Appreciated Attention

Dipl.-Ing. Wolfgang Fentzloff
Implenia Construction GmbH (D)

Implenia

Webinar BIM in Tunneling

Session 2: Implementation and Realisation

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Session Chair: Dr.-Ing. Peter-Michael Mayer, Ed. Züblin AG (D)

- BIM-based Design and Tendering (Lecturer: ETH Bau-Ing. Eric Carrera, M. Sc., Swiss Tunnelling Society)
- Multidimensional Data Integration for BIM (Lecturer: Prof. Dipl.-Ing. Mag. rer. soc. oec. Dr. techn. Alexandra Mazak-Huemer, ITA-Austria)
- Example for Application of BIM in a Specific Project (Lecturer: Dipl.-Ing. Wolfgang Fentzloff, DAUB)

17:00–17:30 Discussion / Closing Remarks and Outlook

17:30 End

– QV8 Schoren: Interfaces at handover of modell from client to contractor; responsibilities of correctness of information contained in the modell (incl. parameters, properties) modell check, quality gates → contractual arrangements, information conformity