



# Beyond Design: The Construction of New Railway Stations and BIM

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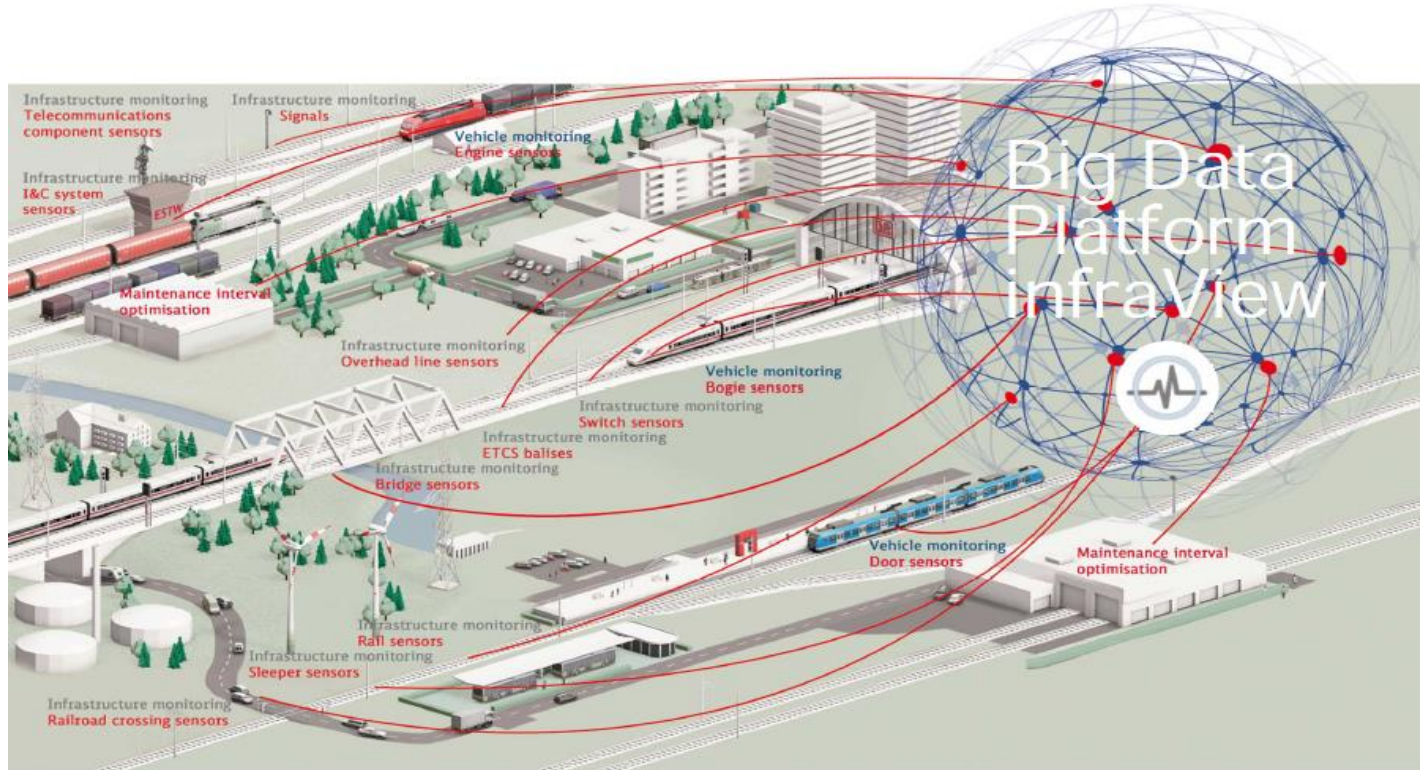


## Parallel Session 5 – Station Design 2



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# Introduction



# Building Information Modeling (BIM)

## Application areas in:

- **Local and regional transport**
- **Long-distance and high-speed transport**
- **Freight transport and logistical infrastructure**
- **Plant, industrial and harbor rail transport**

**BIM can make a significant contribution to project execution:**

- **Better planning quality**
- **Greater cost certainty/ increasing efficiency**
- **Greater scheduling reliability**
- **Better life cycle viewing**
- **Increased acceptance for infrastructure projects**

# Drafting BIM-Capable Databases

## Management and Consulting

- **Project management**
- **Project coordination**
- **Project control**
- **Interface management**
- **Construction site management and local construction supervision for individual specialty fields**
- **Quality management/ assurance**
- **Design and acceptance testing**
- **Risk management**
- **Time and cost management**

## Consulting

- **Setup of a BIM infrastructure**
- **Inventory data management**
- **Model and data structure**

## Data Acquisition (Data Entry)

- **Control point**
- **Laser scanning**
- **Tachymetric surveying**
- **Track geometry**
- **Geotechnical examinations**
- **Analysis building substance**
- **Ground-penetrating radar (railroad)**
- **Multicopter**

## Providing BIM Data Sources

- **Point cloud products**
- **TruView data**
- **Recap data**
- **3D point cloud map**
- **Georeferenced CAD status quo data**
- **Results of the construction-related examination**



# Creation and Processing of BIM-Compatible Data

## Modeling/ Data Maintenance

- 3D status quo models
- Conversion of 2D plans into a 3D model
- Digital surface model (DSM)
- Hybrid models
- Modeling of object information
- Component modeling (families)

## Engineering-Related Planning (Throughout all Service Phases)

- Track system, engineering structures, structural engineering
- Railway-related electromechanical engineering
- Mechanical, electrical and plumbing (MEP)

## Visualisation

- Object-oriented 3D modeling
- Visualisation of the planning alternatives

## Construction Operations Planning/ Simulation

## Construction Supervision Railway



## Renewal of Gladbeck-Zweckel stop, Germany

The stop at Gladbeck-Zweckel consists of two side platforms that are 120 m in length. The nominal height of the platforms is 38 cm. The side platforms will be extended to 170 m and raised to 76 cm over TOR. The plans also included constructing a barrier-free path to Feldhauser Strasse for platform 1. Work used conventional methods (2D) up until the drafting of the building permit application, and BIM has been used for further work on the existing plans.

**Customer:** DB Station & Service AG  
**Project duration:** June 2016 - December 2018

- Surveying, clarification of project requirements, preliminary design, final design, planning for building permit application, construction drawings, preparation of tender documents, involvement in awarding of tender
- BIM: Creating a digital surface model and a BIM situation model, creating 3D technical models of platforms and lighting features, merging technical models to a conflict-free overall model, partially automated SLA drafting, object-based identification of quantities

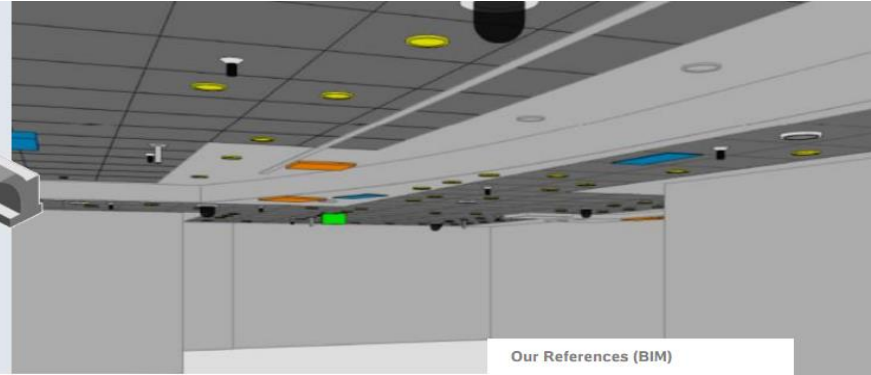
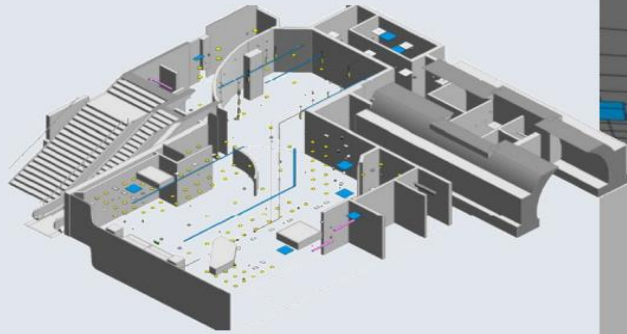
Our References (BIM)



Survey of coordination environment, Gladbeck-Zweckel stop, Germany, © Carmen Ehrenberger / Navisworks

## Real Case Studies:

### 1) Renewal of Gladbeck-Zweckel stop



Our References (BIM)

## PBM inspection at Hanover Main Station, Germany

The last major rebuilding work at Hanover's main station took place for Expo 2000. Retail facilities were installed below the rail bridge substructures, while technical rooms and access routes were enlarged. These changes made it impossible or difficult to inspect the bridge substructures. The redesign also resulted in difficulties for building inspection activities in the commercial areas of the central passenger tunnel. Checking the support and abutment elements in the retail units requires the use of alternative inspection methods. Making it possible to perform checks is intended as a means of counteracting risks affecting the safety of operations, transportation activities, and stability.

**Customer:** DB Station & Service AG

**Project duration:** July 2015 - December 2018

- Surveying
- Support for modifying construction documents and inspecting bridges
- Establishing access for bridge inspection activities
- Drafting inspection plans/instructions
- Planning demolition and modification of fittings
- BIM: 3D situation assessment, 3D model creation, visualizations, planning coordination, drafting of 2D plans based on 3D models
- Identifying areas & quantities based on 3D models



Ceiling surface, Douglas, Hanover Main Station, Germany, © Kevin Omnitz/ Revit

## Real Case Studies:

### 2) PBM inspection at Hanover Main Station





Our References (BIM)

## FIP station at Unterlüss (barrier-free access), Germany

Modern, barrier-free, and more customer-friendly stations play a crucial role in promoting the acceptance and usage of PSO services. As part of the future investment program (FIP), local transport authority LNVG has decided to make Unterlüss station barrier-free.

The category 5 station serves 898 travelers daily and is located near a nursing home for senior citizens and a hospital. The undertaking also entails the construction of a ramp to each of the island platforms, replacing the existing steps, and the platforms' extension to 215 m.

**Customer:** DB Station & Service AG

**Project duration:** August 2017 - December 2018

- Surveying, basic evaluation, preliminary design, final design, planning for building permit application
- BIM: 3D situation assessment, 3D model creation, visualizations, planning coordination, drafting of 2D plans based on 3D models, 3D proposal comparison, design review with VR technology



Coordination model of Unterlüss station, Germany, © Daniel Ast/ Navisworks

## Real Case Studies:

### 3) FIP station at Unterlüss

**New S-Bahn platform at Cologne Main Station, Germany**

The plans to upgrade the S11 line at the Cologne hub include the construction of a rail bridge that widens the existing bridge structure: It will accommodate two new tracks and an island platform with a length of 215 m. Access will be barrier-free, featuring escalators and elevators as well as stairs.

This undertaking also entails new platform roofs with a total length of 132 m, plus the installation of a new lighting and public address system.

**Customer:** DB Station & Service AG  
**Project duration:** June 2017 - July 2018

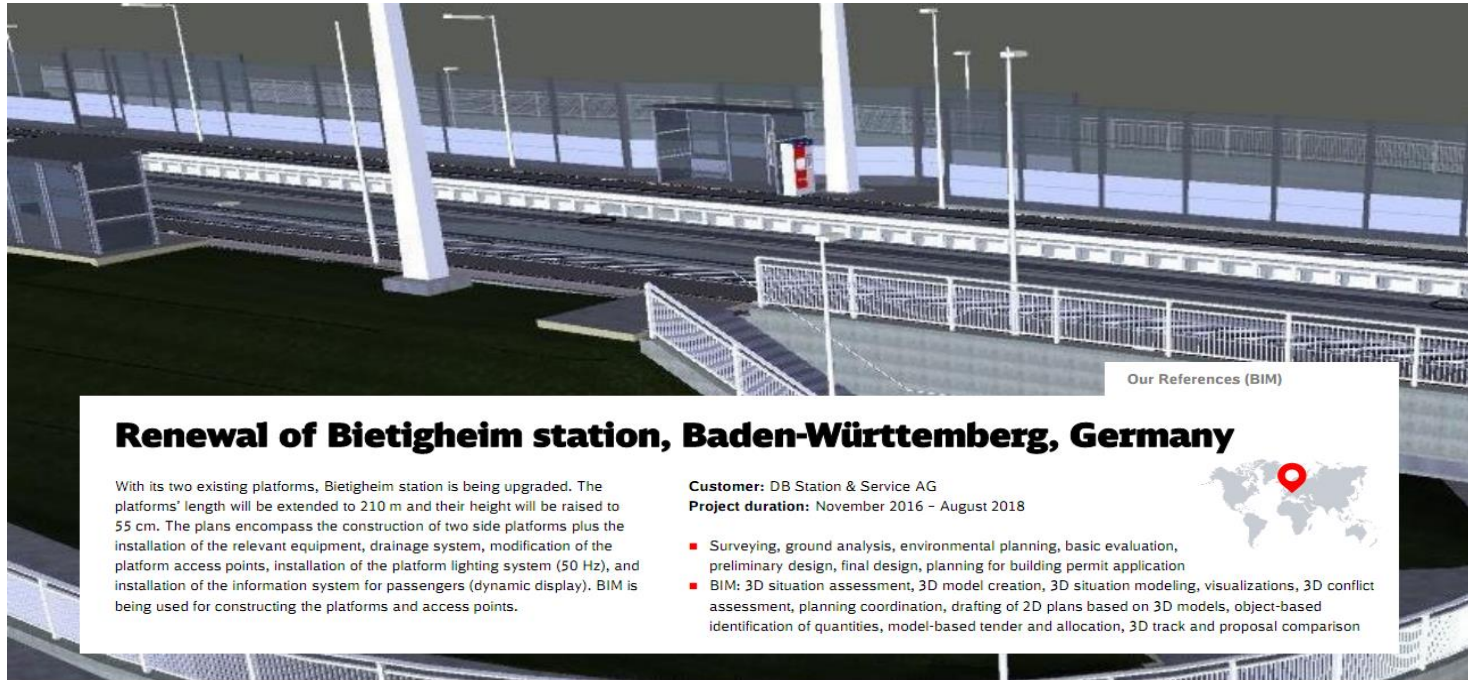
- Surveying, basic evaluation, preliminary design
- BIM: Creating a digital surface model and a BIM situation model, creating 3D technical models of platforms and lighting features, merging technical models to a conflict-free overall model, partially automated identification of quantities.

Our References (BIM)

Coordination model, Cologne Main Station, Germany, © Amir Safiri / Navisworks

## Real Case Studies:

### 4) New S-Bahn platform at Cologne Main Station



Our References (BIM)

## Renewal of Bietigheim station, Baden-Württemberg, Germany

With its two existing platforms, Bietigheim station is being upgraded. The platforms' length will be extended to 210 m and their height will be raised to 55 cm. The plans encompass the construction of two side platforms plus the installation of the relevant equipment, drainage system, modification of the platform access points, installation of the platform lighting system (50 Hz), and installation of the information system for passengers (dynamic display). BIM is being used for constructing the platforms and access points.

**Customer:** DB Station & Service AG

**Project duration:** November 2016 – August 2018

- Surveying, ground analysis, environmental planning, basic evaluation, preliminary design, final design, planning for building permit application
- BIM: 3D situation assessment, 3D model creation, 3D situation modeling, visualizations, 3D conflict assessment, planning coordination, drafting of 2D plans based on 3D models, object-based identification of quantities, model-based tender and allocation, 3D track and proposal comparison



Visualization: DB Engineering & Consulting

## Real Case Studies:

### 5) Renewal of Bietigheim station, Baden-Württemberg



**New stop at Kaufbeuren-Haken, Germany**

The campaign to make the Bavarian rail network denser involves building more stops. The BIM system is being used for planning the new Kaufbeuren-Haken stop on Line 5362, which runs between Buchloe and Lindau. The station will have two side platforms, with lighting and the relevant fittings. Access will take the form of steps and barrier-free ramps.

**Customer:** DB Station & Service AG  
**Leistungen:** October 2016 – March 2018

- BIM: 3D situation assessment, 3D model creation, visualizations, planning coordination, drafting of 2D plans based on 3D models, 3D proposal comparison
- Basic evaluation, preliminary design, final design, planning for building permit application

Our References (BIM)

Visualization: Hannes Eckerth, DB Engineering & Consulting

## Real Case Studies:

### 6) New stop at Kaufbeuren-Haken

## Full renewal of Wilhelmshorst station, Germany

Wilhelmshorst station on Line 6118 between Berlin and Potsdam will be fully renewed and provided with barrier-free access. New stairs, elevators and roofs will be installed. There is a preservation order on the old building, which will be incorporated into the new station. The project will be put into action in 2020.

**Customer:** DB Station & Service AG  
**Project duration:** 2017 - 2018



- Preliminary design, final design, planning for building permit application,
- BIM: 3D situation assessment, 3D situation modeling, 3D planning model, 3D conflict assessment, creation of 2D plans based on 3D models, 4D model creation, object-based identification of quantities



Visualization: DB Engineering & Consulting

## Real Case Studies:

### 7) Full renewal of Wilhelmshorst station



Our References (BIM)

## New stop at Herten-Mitte, Germany

Recommencing operations on the Hertener Bahn line entails operating passenger services on Line 2250, the section between Gelsenkirchen Buer Nord and Recklinghausen's main station, in addition to freight services. This undertaking will include the construction of a new stop that will provide the town of Herten with a PSO connection.

The new stop will feature two side platforms with lighting and the relevant equipment. Travelers can use stairs or barrier-free features to access the platforms. BIM is used for the planning process.

**Customer:** DB Station & Service AG

**Project duration:** September 2017 - February 2018



- Surveying as part of the basic evaluation and preliminary design drafting.
- BIM: Creating a digital site model and a BIM situation model. Creating 3D technical models of the platforms, access facilities, fittings, cable routing systems, and overhead lines. Merging the technical models to form an overall model

Visualization: DB Engineering & Consulting, Region Western Germany, Duisburg planning office.

## Real Case Studies:

### 8) New stop at Herten-Mitte

Hanover Hbf, Bahnhof C  
 Querprofil C1's Km 0+044, Strecke 1733  
 (Station in Betrieb) Teilplanung C1'ehinger über Baureihe 16, ca. km 0+032 - km 0+051, 1x18 m)

Our References (BIM)

## Renewal of Hanover Main Station, Germany

Hanover's main station is the most important transport hub in northern Germany. It is to be modified and expanded to meet urban planning requirements, handle higher levels of traffic, and deliver what today's passengers need from a modern, barrier-free, and user-friendly train station. The renewal project for the station covers all of its structures and systems, which have been evolving for over 150 years: Transportation, engineering, and buildings. It involves the complete overhaul of the station's 59 engineering structures underneath the six platforms, the renewal of platforms and their roofs, the drainage system, access facilities (6 elevators and 12 escalators), technical equipment, and buildings (kiosk, platform supervisors' room). In addition, the planners have also established access for bridge inspection activities as part of an inspection plan.

**Customer:** DB Station & Service AG  
**Project duration:** June 2014 – December 2016

- Overall coordination, surveying, basic evaluation, preliminary design
- BIM: 3D situation assessment, 3D model creation, 3D situation modeling, visualizations, 3D conflict assessment, planning coordination, drafting of 2D plans based on 3D models, 3D proposal comparison, phase-compatible 4D simulation, design review with VR technology

Hanover Main Station, Germany © Dr. Katja Maaser

## Real Case Studies:

### 9) Renewal of Hanover Main Station



Our References (BIM)

## FIP station at Nörten-Hardenberg, Germany

Modern, barrier-free, and more customer-friendly stations play a crucial role in promoting the acceptance and usage of PSO services. As part of the future investment program (FIP), local transport authority LNVG has decided to make Nörten-Hardenberg station barrier-free.

The category 5 station serves 1,000 travelers daily. The undertaking entails the through station's renewal as a stairs-free station, the installation of elevators, and the addition of floor guidance on the platforms for visually impaired travelers.

**Customer:** DB Station & Service AG  
**Project duration:** August 2017 - December 2018



- Surveying, basic evaluation, preliminary design, final design, planning for building permit application
- BIM: 3D situation assessment, 3D model creation, visualizations, planning coordination, drafting of 2D plans based on 3D models, 3D proposal comparison

Coordination model of Nörten-Hardenberg station, Germany, © Torsten Johst / Revit

## Real Case Studies:

### 10) FIP station at Nörten-Hardenberg





## Construction of new platforms at Eilenburg, Germany

Eilenburg station consists of one platform adjoining the station building and two island platforms connected by an underpass. The nominal height of the platforms is approx. 38 cm.

The island platforms are to be modernized in line with conservation-related considerations, and they will be upgraded by adding a staircase and barrier-free access facilities. The plans also encompass raising the platform height. This work utilizes the BIM planning process and covers the technical disciplines of transport facilities, construction engineering, and building construction. Technical disciplines relating to equipment will be incorporated into the visualizations in order to produce a conflict-free overall plan.

**Customer:** DB Station & Service AG

**Project duration:** January 2016 - November 2022

- Surveying, clarification of project requirements, preliminary design, final design, planning for building permit application, construction drawings, preparation of tender documents, evaluation of bids
- Drafting a digital surface model and BIM situation model, drafting and merging 3D function models for platforms, engineering structures, buildings and technical equipment, object-based identification of quantities, drafting of 2D plans based on 3D models, drafting of 4D models (description of construction process)

Our References (BIM)



Excerpt from BIM model for new platforms at Eilenburg, DB E&C Southeast Region, Marco Linke (project manager)

## Real Case Studies:

### 11) Construction of new platforms at Eilenburg

**BIM pilot project**

## Fehmarn Sound crossing, Germany

Today, traffic crossing the Fehmarn Sound uses a combined road and rail bridge. A new fixed connection between Fehmarn and the mainland is intended to meet performance and safety needs arising from future traffic expectations.

Working on planning activities together with ZPP, DB E&C among other things has been commissioned to deliver the preliminary design for the tunnel-based proposal. BIM is used parallel to conventional planning activities.

**Customer:** DB Netz AG  
**Project duration:** Ongoing since 2016

- Planning consortium with ZPP; Basic evaluation, preliminary design
- BIM: 3D situation assessment, 3D situation modeling, visualizations, 3D planning model, 3D track and proposal comparison, drafting of 2D plans based on 3D models, 4D modeling for describing the construction process, 5D modelling for describing the cost trend, object-based identification of quantities, development of a dynamo-based script for the creation of clearance gauge / tracks, creation of a "virtual reality" (real-time visualization) as a desktop or HTC-Vive variant

**Our References (BIM)**

Visualization: DB Engineering & Consulting

## Real Case Studies:

### 12) Fehmarn Sound crossing



## Railway overpass upgrading in Bernau, Berlin-Stralsund, Germany

The railway overpass at Bahnhofstrasse and Börnicker Chaussee in Bernau is to be replaced. This overpass is on Line 6081 between Berlin and Gesundbrunnen-Stralsund. The municipality has also demanded that the Börnicker Chaussee overpass be widened, which requires related services concerning transport facilities and electromechanical engineering. BIM is being used for the planning process along with conventional methods.

**Customer:** DB Netz AG  
**Project duration:** 2017 - 2020

- Preliminary design, final design, planning for building permit application, tender planning
- BIM: 3D situation assessment, 3D situation modeling, 3D conflict assessment, drafting of 2D plans based on 3D models, 4D model creation, drafting of cost trend, object-based identification of quantities, partially automated SLA drafting, model-based tender and allocation

Our References (BIM)



Visualization: DB Engineering & Consulting

## Real Case Studies:

### 13) Railway overpass upgrading in Bernau, Berlin-Stralsund




**S4 line (eastern) Hamburg–Bad Oldesloe, Germany**

(Example: Grade separation structure at Bovestrasse)  
Additional tracks will be laid along the existing line, providing passengers with a reliable local transportation service between Hamburg and Bad Oldesloe. The new line will cover 35 km and replace the current mixed operations (local and long-distance services), including problem-prone regional trains, with the new, specific-usage S-Bahn service. The project entails the construction of 5 new stations. The measures also include the construction of 2 new additional S-Bahn tracks between Hamburg and Ahrensburg and 1 additional S-Bahn track between Ahrensburg and Ahrensburg-Gartenholz, plus the partial shifting of the existing route.

**Customer:** DB Netz AG  
**Project duration:** November 2013 – June 2021

- Surveying, final design and planning for building permit application [transport facilities, structural engineering, CCS, 50 Hz, OLA / third rail (S-Bahn Hamburg), TC ]; Survey of ground at building site, incl. geotechnical advice; Planning coordination, survey of construction-related noise levels, planning construction phases/activities
- Under own initiative, BIM: 3D model creation, visualizations, planning coordination, drafting of 2D plans based on 3D models, 3D proposal comparison, 3D conflict assessment

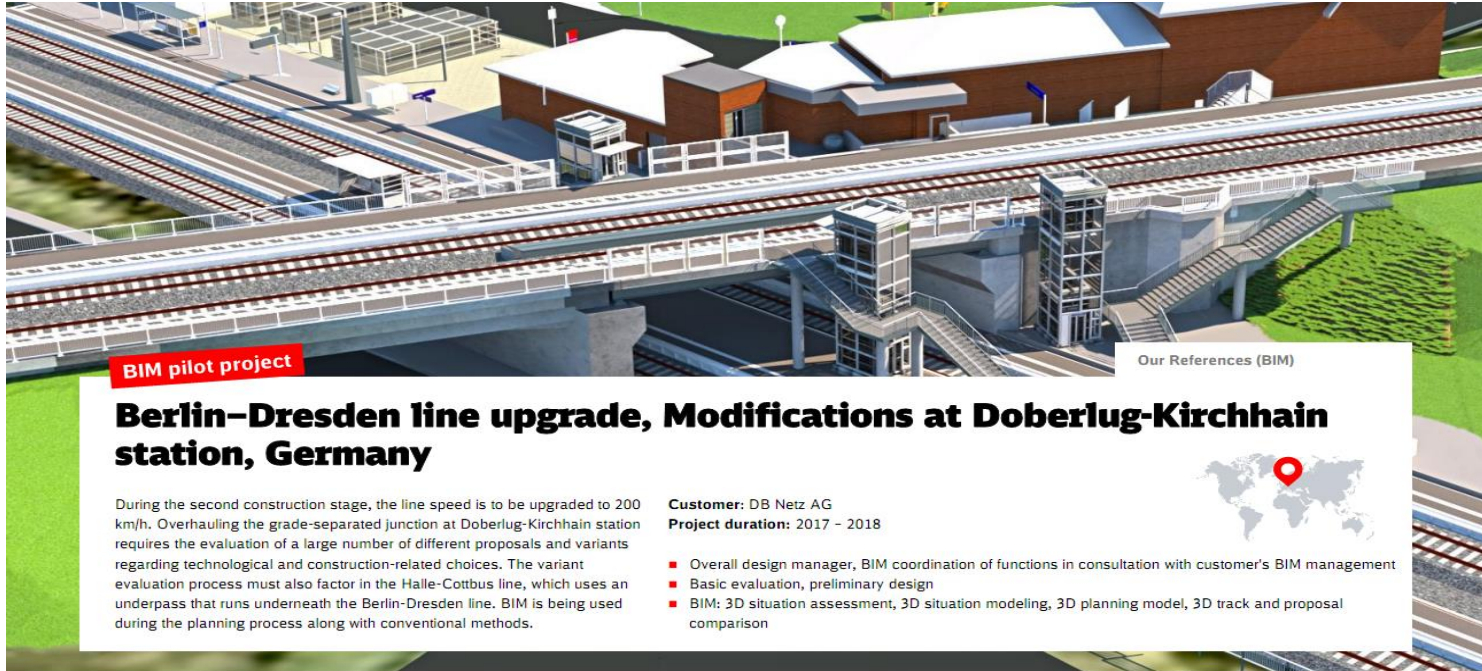
Our References (BIM)



Coordinated setting: S4 overpass at Bovestrasse, Germany, © Navisworks

## Real Case Studies:

### 14) S4 line (eastern) Hamburg–Bad Oldesloe




**BIM pilot project**

## Berlin–Dresden line upgrade, Modifications at Doberlug-Kirchhain station, Germany

During the second construction stage, the line speed is to be upgraded to 200 km/h. Overhauling the grade-separated junction at Doberlug-Kirchhain station requires the evaluation of a large number of different proposals and variants regarding technological and construction-related choices. The variant evaluation process must also factor in the Halle-Cottbus line, which uses an underpass that runs underneath the Berlin-Dresden line. BIM is being used during the planning process along with conventional methods.

**Customer:** DB Netz AG  
**Project duration:** 2017 - 2018

**Our References (BIM)**



- Overall design manager, BIM coordination of functions in consultation with customer's BIM management
- Basic evaluation, preliminary design
- BIM: 3D situation assessment, 3D situation modeling, 3D planning model, 3D track and proposal comparison

Visualization: DB Engineering & Consulting

## Real Case Studies:

### 15) Berlin–Dresden line upgrade, Modifications at Doberlug-Kirchhain station



## Railway overpass at Rude, Germany

The railway overpass on the Flensburg Friedensweg rail line across the B200 highway was built in 1965, and it requires replacement due to severe deterioration of its structure. A replacement structure will be used to renew the prestressed concrete superstructure, with its total span of 68.6 m. This new structure must factor in the angle at which the overpass is positioned, as well as being economical and minimizing disruption to traffic on the B200 and rail operations.

**Customer:** DB Netz AG

**Project duration:** November 2016 - December 2019

- Surveying, basic evaluation, preliminary design, final design, planning for building permit application
- Under own initiative, BIM: 3D situation modeling, 3D model creation, drafting of 2D plans based on 3D models, 3D proposal comparison, 3D conflict assessment

Our References (BIM)



Coordination model of Nörten-Hardenberg station, Germany, © Daniel Ast/ Navisworks

## Real Case Studies:

### 16) Railway overpass at Rude

**BIM pilot project**

## Double-tracking project Homburger Damm, Germany

As part of efforts to enhance the performance of the Frankfurt am Main rail hub, the Homburger Damm embankment will be enlarged to take a double track by constructing a single-track connection running from the Mainzer Landstrasse junction to the northern side of Frankfurt's main station. This undertaking will also include modifications to the storage sidings in the station's outlying area. The main measures are the construction of a 600 m trench with a grade separation structure, extensive alterations to the track layout, modification of the signaling and overhead line fittings, changes to the track field illumination and other electrical equipment. BIM is being used during the planning process along with conventional methods.

**Customer:** DB Netz AG  
**Leistungen:** December 2016 - December 2017

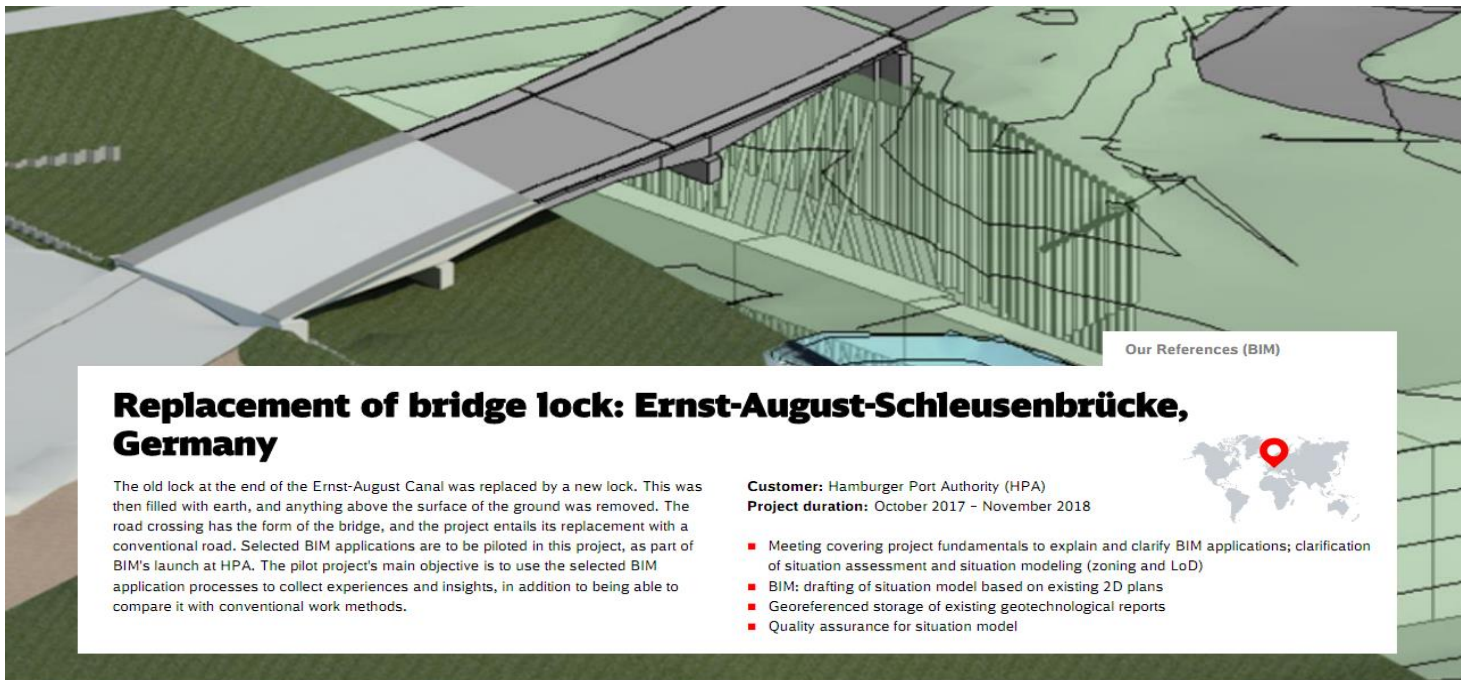
- Overall design management, BIM coordination of functional disciplines with customer's BIM management
- BIM: 3D situation assessment, 3D situation modeling, visualizations, 3D model creation (geometric model), 3D conflict assessment, planning coordination, 4D model creation (description of construction process), 5D model creation (description of cost trend), object-based identification of quantities, partially automated SLA drafting

Our References (BIM)

Visualization: Martin Münnig, DB Engineering & Consulting

## Real Case Studies:

### 17) Double-tracking project Homburger Damm




Our References (BIM)

## Replacement of bridge lock: Ernst-August-Schleusenbrücke, Germany

The old lock at the end of the Ernst-August Canal was replaced by a new lock. This was then filled with earth, and anything above the surface of the ground was removed. The road crossing has the form of the bridge, and the project entails its replacement with a conventional road. Selected BIM applications are to be piloted in this project, as part of BIM's launch at HPA. The pilot project's main objective is to use the selected BIM application processes to collect experiences and insights, in addition to being able to compare it with conventional work methods.

**Customer:** Hamburger Port Authority (HPA)  
**Project duration:** October 2017 - November 2018



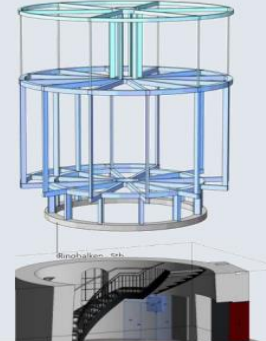
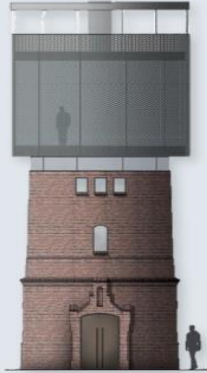
- Meeting covering project fundamentals to explain and clarify BIM applications; clarification of situation assessment and situation modeling (zoning and LoD)
- BIM: drafting of situation model based on existing 2D plans
- Georeferenced storage of existing geotechnological reports
- Quality assurance for situation model

Situation model of the lock on the Ernst-August Canal, Germany © Torsten Johst/ Navisworks

## Real Case Studies:

### 18) Replacement of bridge lock: Ernst-August-Schleusenbrücke





Our References (BIM)

## Enlargement and repurposing of Ohlsdorf water tower, Germany

Built in 1907, the water tower on S-Bahn Hamburg's premises in Ohlsdorf is now a preserved building. The tower is no longer required for its original function as a storage facility for fire water. Its owner, S-Bahn Hamburg GmbH, is therefore planning to alter the building so it can be used for different purposes – meetings, exhibitions, accommodation, courses for employees. The company plans to renovate the water tower in accordance with conservation regulations and add an extra floor.

**Customer:** S-Bahn Hamburg  
**Project duration:** July 2017 – May 2018

- Surveying, basic evaluation, preliminary design, final design, planning for building permit application
- Under own initiative, BIM: 3D situation modeling, 3D model creation, drafting of 2D plans based on 3D models, 3D proposal comparison, 3D conflict assessment, design review with VR technology



Ohlsdorf water tower, current situation and models, Germany © Anna Yakushina

## Real Case Studies:

### 19) Enlargement and repurposing of Ohlsdorf water tower



## New S-Bahn platform at Köln Messe/Deutz station, Germany

The plans to upgrade the S11 line at the Cologne hub include the alteration of Köln Messe/Deutz station by installing elevators to make it barrier-free, and enlarging it by adding a two-sided S-Bahn platform, 215 m in length, on its northern side. Stairs, an escalator, and an elevator will provide access to the new island platform. This undertaking also entails new platform roofs with a total length of 132 m, plus the installation of a new lighting and public address system.

**Customer:** DB Station & Service AG  
**Project duration:** June 2017 – July 2018

- Surveying, basic evaluation, preliminary design
- BIM: Creating a digital surface model and a BIM situation model, creating 3D technical models of platforms and lighting features, merging technical models to a conflict-free overall model, partially automated identification of quantities.

Our References (BIM)



Coordination model, Köln Messe/Deutz station, Germany, © Amir Safiri / Navisworks

## Real Case Studies:

### 20) New S-Bahn platform at Köln Messe/Deutz station

# Conclusion



## BIM benefits

- 1- Clash Detection
- 2- Constructability
- 3- Time and Cost Estimation
- 4- Integration
- 5- Quantity Take-off
- 6- Element Based Models
- 7- Communication
- 8- Operation and Maintenance

## Challenges and Barriers

- 1- Model legal ownership
- 2- How to Prevent Copying
- 3- Responsibility and Control of Data Entry
- 4- Costs of Technology Adoption
- 5- Data Protection

# Conclusion

- The transportation infrastructure is an integral part of the **economic growth** and **social development** of any country that requires a **good and efficient management** as a whole. **Aging and deteriorating infrastructure** are two major problems in a country's transport network. Traditional inspection and management systems are now inefficient due to the widespread deployment of this network and there is an urgent **need to move towards modern and automated management systems**. The use of Building Information Modeling (BIM) in conjunction with emerging technologies for infrastructure management can contribute to **more secure, stable and secure network performance** while **reducing maintenance costs** and **risks** while that it brings **significant income to all stakeholders**. Having a thorough understanding of the technology, applications, advantages and disadvantages, enhancements and limitations can help owners and clients, designers and other freight experts to have a better knowledge of the best set of automated and strategic plans. To better manage the infrastructure network through it. The whole **project life cycle (PLC)** in this abstract, a comprehensive review of the literature on building information modeling (BIM) for transportation infrastructure is presented. **The real case studies show that there is increased research and application of BIM for transport infrastructure, although limited to mainly roads, highways and bridges**. This analysis also leads to the current state of research, the use of BIM for transport infrastructure, the use of **emerging technologies** as well as fundamental gaps in research. Finally, this research presents the construction of railway stations and BIM technology facing the transportation industry, discusses the main need for collaboration and current efforts to achieve **interoperability**, and makes recommendations for promoting future research.

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**Thank you**  
for your kind attention