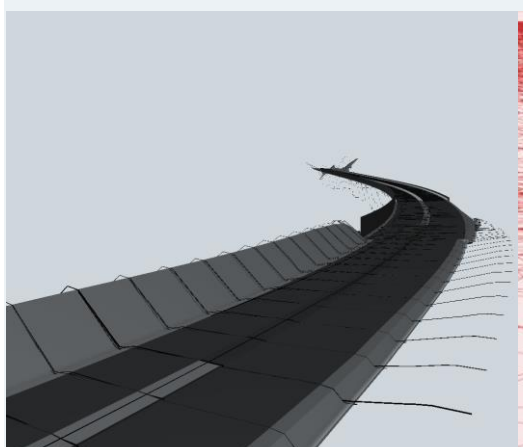
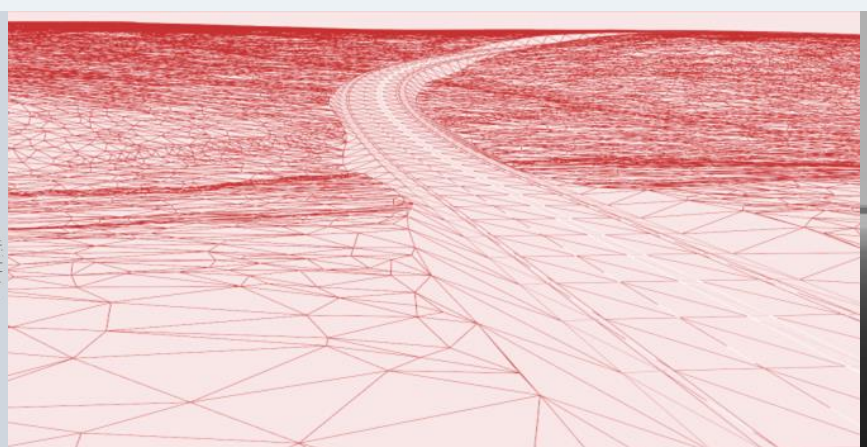
Schüßler-Plan

5D CONFERENCE 2018

B87N / EILENBURG - MOCKREHNA

BIM IN FRÜHEN LEISTUNGSPHASEN ZUR TEILAUTOMATISIERTEN PLANUNG VON LINIENGEBUNDENER INFRASTRUKTUR


15.05.2018

Dr. Andreas Bach, Dirk Stiehler, Joachim Hager

AGENDA

Schüßler-Plan

1. BIM from Clients and Contractors Perspective
2. Requirements for BIM in Road and Infrastructure Design
3. Pilot Project B87N
4. Route Finding, Modeling and LOI
5. Modell and alternative Designs
6. Interpretation and Automatisation (4D, 5D)
7. Lessons Learned and Discussion

- Client

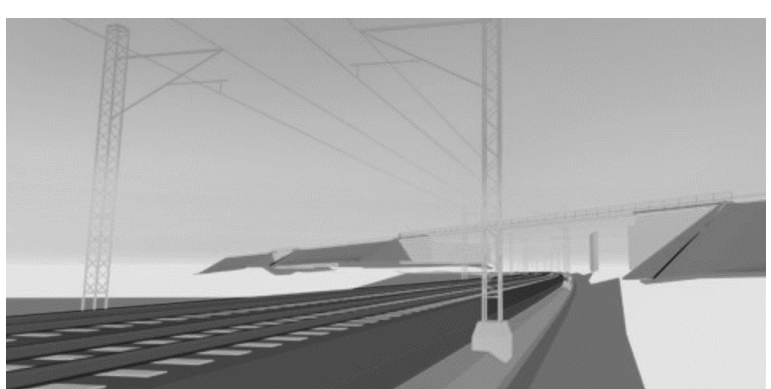
  Deutsche Einheit Fernstraßenplanungs und -bau GmbH

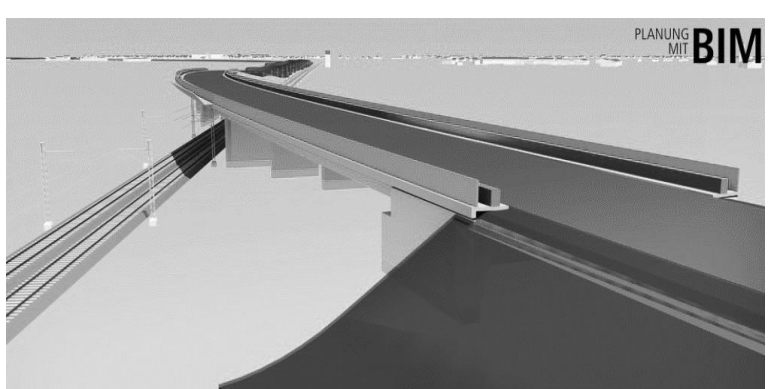
- Contractor

  Schüßler-Plan

DEGES

Schüßler-Plan

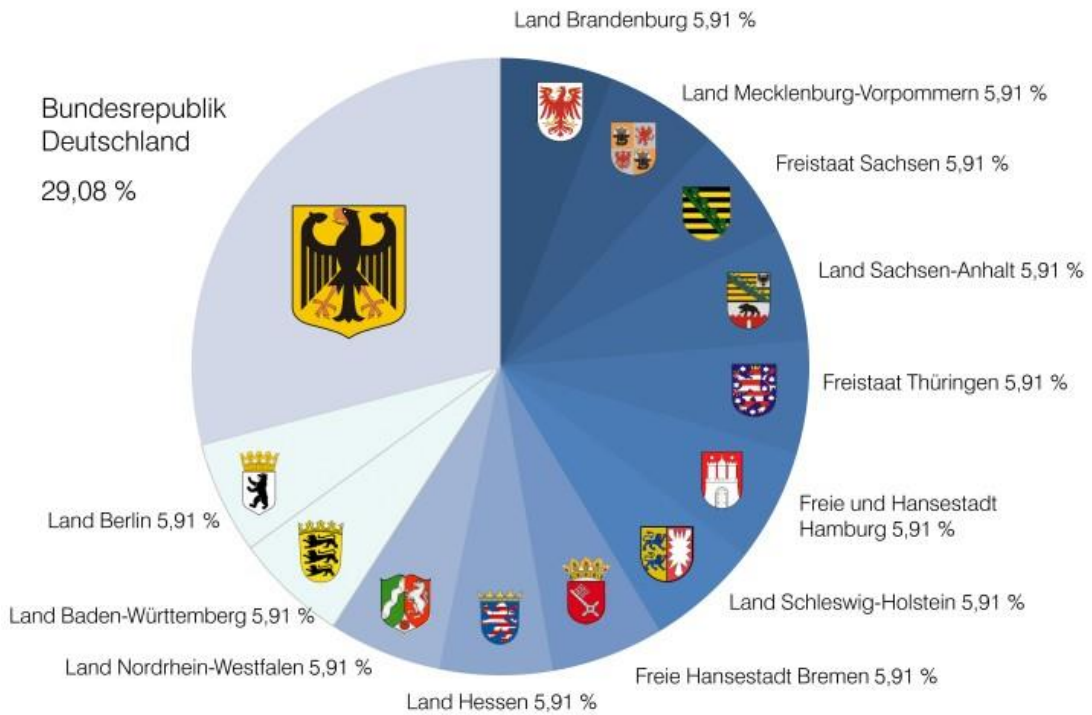




DEGES

Deutsche Einheit Fernstraßenplanungs und -bau GmbH

- Projektmanagement Association
- Founded by Ministry of Transport and Federal States
- Management of Design, Construction and Delivery of Infrastructure to Clients
- Responsible for 2.300km Federal Highways
- Volume of Projects 22 Billion €
- 300 Employees



BIM FROM CLIENTS AND CONTRACTORS PERSPECTIVE

CLIENT DEGES - BIM PROJECTS

DEGES

First Generation

1 - Talbrücke Auenbach iZd B107

2 - Brücke Petersdorfer See iZd A19

Second Generation

3 - B87 – Abschnitt Eilenburg – Mockrehna

4 - Bauwerke iZd B31

5 - Tunnelkette A44

additional BIM-Projects

6 - Talbrücke Schwelmetal iZd A1

7 - ÖPP-Projekt A10/A24

8 - Ersatzneubau der Rudolf-Wissel-Brücke iZd A100

9 - Ersatzneubau der Westendbrücke iZd A100

10- B178 – A4-Nostitz (BA1.1)

11- A14 – VKE 3.2b, VKE 4

12- AD Funkturm iZd A100 in Berlin

13- A7 Hamburg Altona

14- Brücke über den Peenestrom iZd B111

15- Rader-Hochbrücke

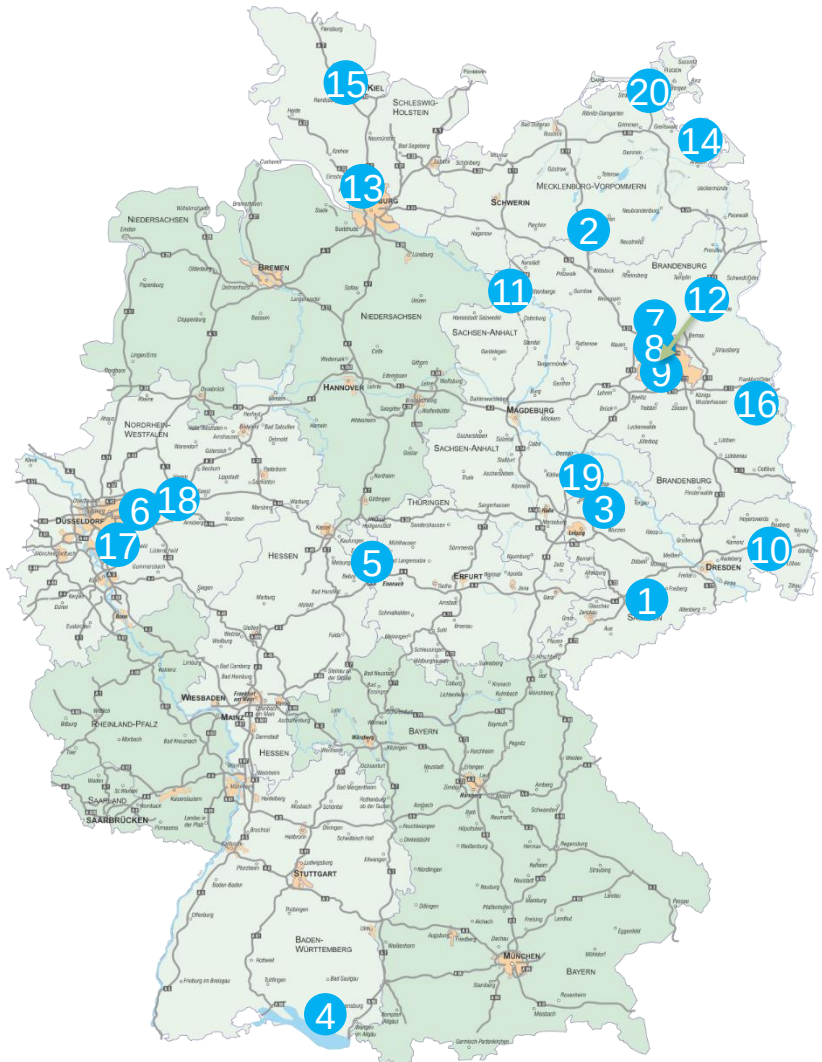
16- B112 Abschnitt Güldendorf-A12

17- A3 / A4 / A59 AD Heumar

18- B1 / B55 OU Erwitte

19- B87 – Abschnitt Leipzig – Eilenburg

20- OU Wolgast



BIM FROM CLIENTS AND CONTRACTORS PERSPECTIVE

CONTRACTOR - NUMBERS AND FACTS

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- 19 Offices in Germany, 2 Abroad
- Founded 1958
- 2018: 60 Years Successfully Established
- Over 800 Employees
- Arround 500 Projects per Year
- About 85 Mio. € Turnover / yearly
- Zertified according to DIN EN ISO 9001

all over Germany

- **WARSCHAU, KHARTOUM**

BIM FROM CLIENTS AND CONTRACTORS PERSPECTIVE

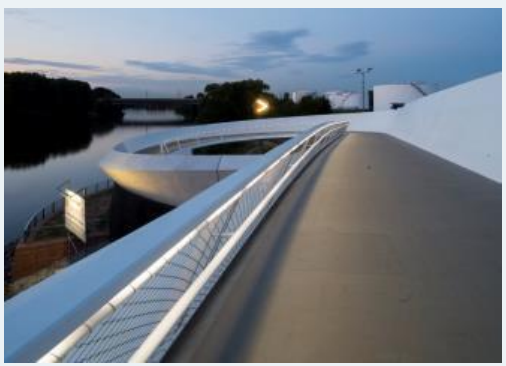
CONTRACTOR - BUSINESS AREAS

Schüßler-Plan

HIGHRISE

ROAD

BRIDGES



RAIL

AIRPORT

TUNNEL

DEVELOPMENT

GEOTECHNIC

BIM FROM CLIENTS AND CONTRACTORS PERSPECTIVE

CONTRACTOR - DIGITAL EXPERIENCE

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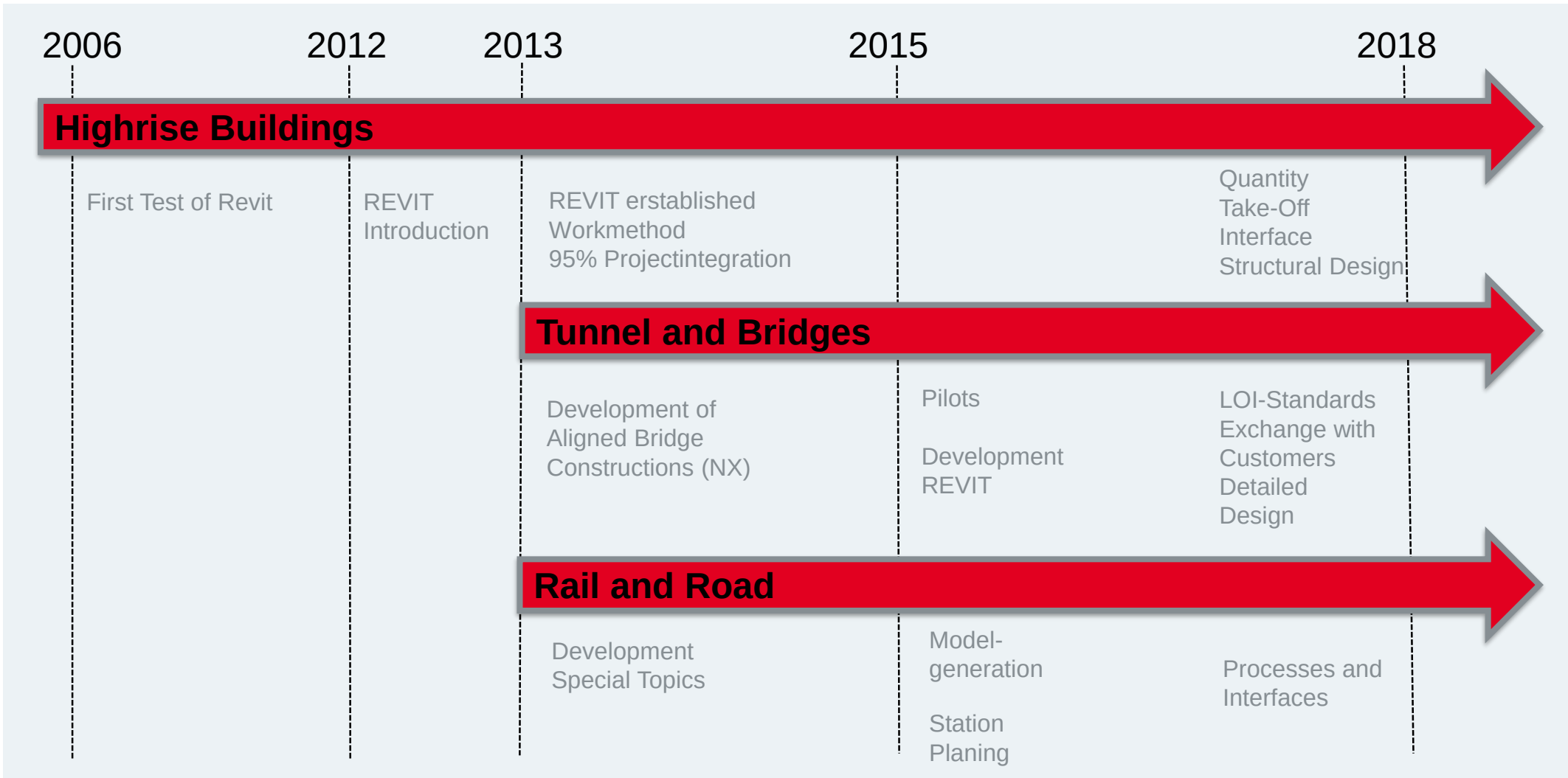

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… Convincment

- Appropriate Technology
- Attractiveness as Employer
- Attractiveness as Contractor

… Experience

- Increasing Requirements regarding Quality, Documentation and Detailing

… Boundary Conditions

- Reformkommission - Bau von Großprojekten
- Stufenplan des BMVIs

Schüßler-Plan

[macobeserver.com]

Digitalization

- Fast Answers on multiple Questions
- Using Digital Data, Models and Software
- Connecting Sofware and Products

Multiple Impacts in Early Past on

- Mobility
- Information Technology
- Real Estate
- Finance Sector
- ….

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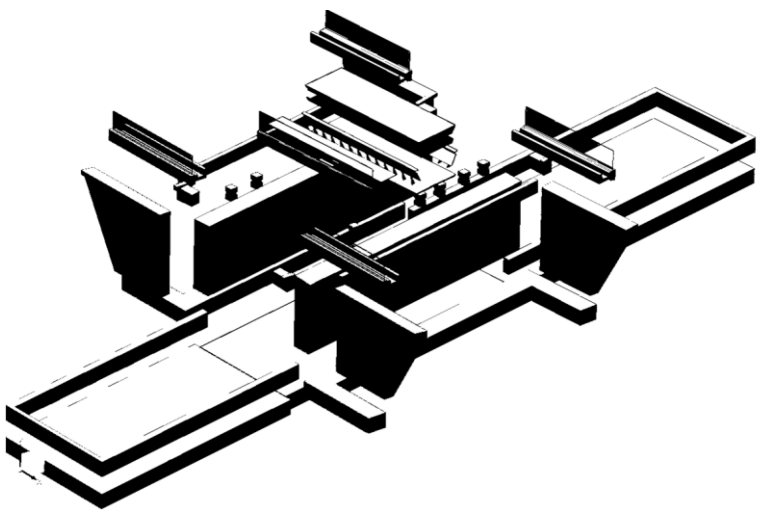
Question



Answer

Digitalization in Construction Industry

- Many Stakeholders and Softwaresolutions
- Decision in a short Period of Time
- Varying Boundary Conditions

Many Questions Exist

- Which Material Quality?
- Drawings given and on-time?
- Effects of Design Change on Cost and Time?
- ….

Fundamentals for the Derivation of Answers need to be defined

Schüßler-Plan

BIM ..

- Strategic Management Task
- Processes will change adopting BIM
- **Not an additional Service but rather a fundamental Decissison** for the Processes in the Company and the Corporation with Partners and Customers

Overall Objectives …

- Introduction and Development of Method
- Training and Convincing of Employees
- Winning Customers and Partners for Projects
- Optimization of Processes and Efforts
- **Create Synergies to compensate Additional Costs**

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Schüßler-Plan

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Schüßler-Plan

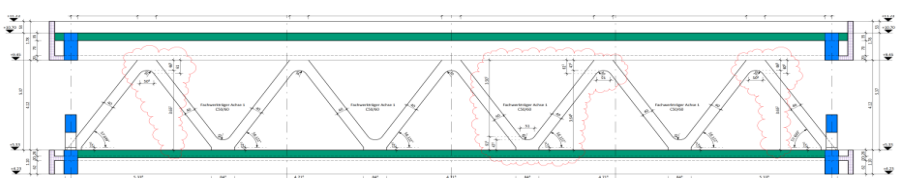
Highrise Sector

CONSTRUCTION AND CALCULATION OF STRUCTURAL SYSTEM
FOR ULTIMATE LIMIT STATE AND SERVICEABILITY

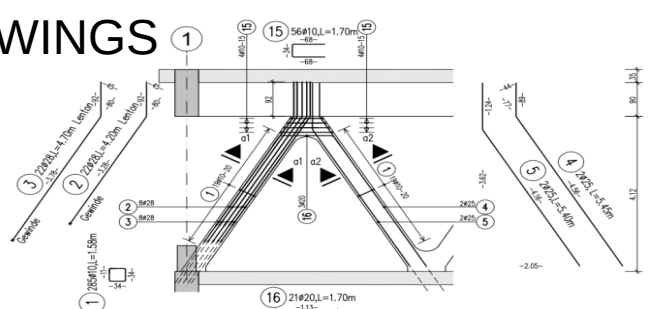
TRAGWERKSPLANUNG – ONE DISCIPLINE

CONSTRUCTION

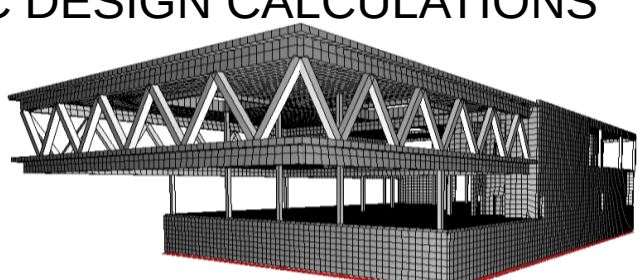
CONSTRUCTION DRAWINGS



REBAR DRAWINGS



STATIC DESIGN CALCULATIONS



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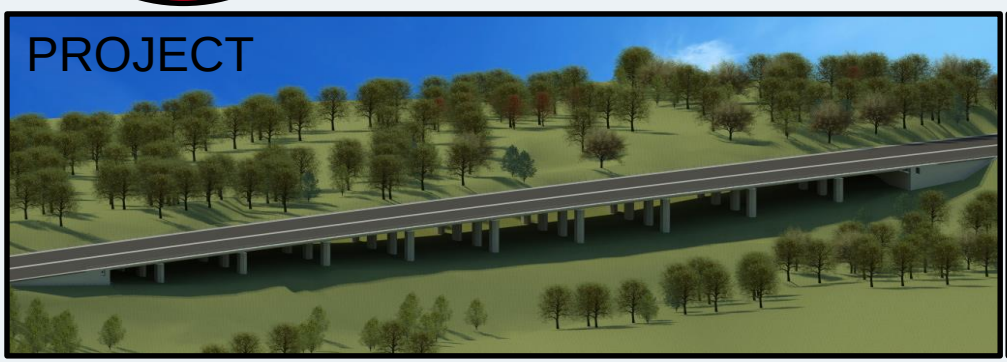
Infra-structure Sector

CONSULTING IN RELATION TO THE OVERALL PROJECT

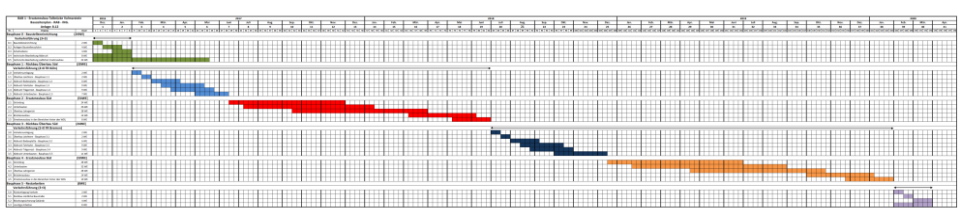
OBJEKTPLANUNG – HOLISTIC, INTEGRAL

PROJECT

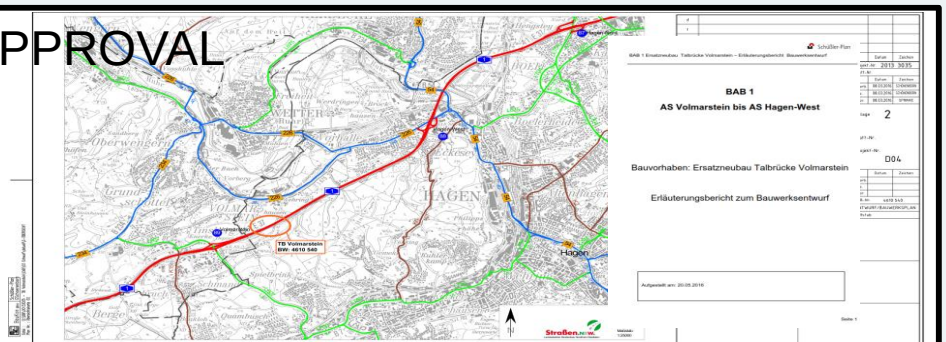


COSTS, BIDDING

BUILDING PROCESS AND LOGISTIC



APPROVAL



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HIGHRISE SECTOR

- Mainly private Investors
- Design, Construction and Maintenance by different Clients
- Small Dimension of Projects - Meters
- Project Duration Years

- Construction based on Planes
- Many geometric similar Objects
- Parametric Description of Geometry is rather simple

- Architect coordinates Disciplines

INFRASTRUCTURE SECTOR

- Mainly public Investors
- Design, Construction and Maintenance by one Client
- Large Dimension of Projects - Kilometers
- Project Duration Decades

- Construction based on Alignment
- Less geometric different Objects
- Parametric Description of Geometry is rather hard

- Civil Engineer coordinates Disciplines

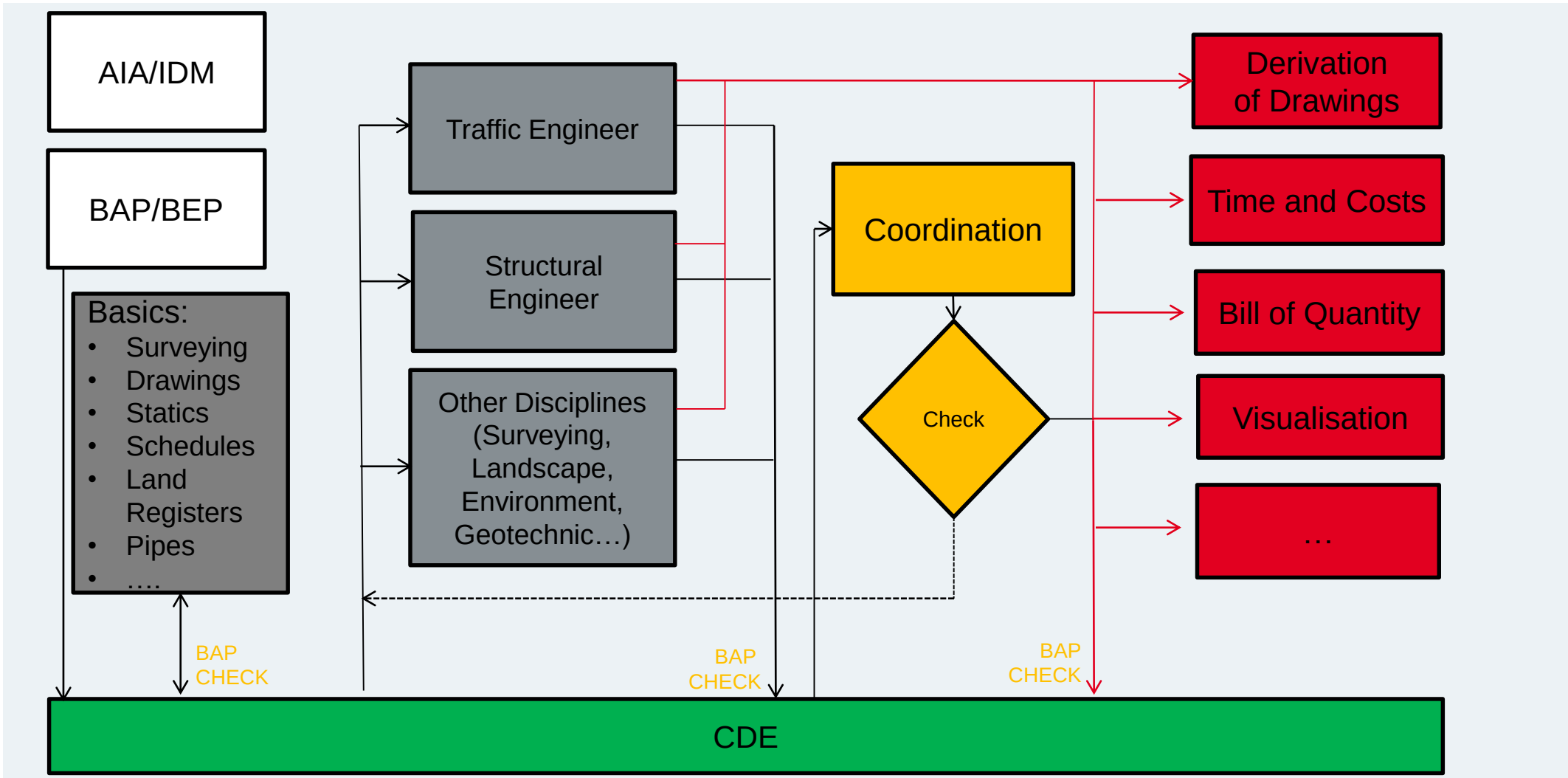
Schüßler-Plan

Schüßler-Plan

3D-Modeling	Rail and Road	Highrise, Bridge and Tunnel Structures
• Basics for Design • Geometry • Attributes • …	• PROVI • CARD/1 • VESTRA • VIS-ALL ® 3D • ….	• REVIT & DYNAMO • SIEMENS NX • ALLPLAN • …
BIM Collaboation & Analysis	**BIM Datamanagement**	**BIM Design Products (4D/5D/Bill of Quantity)**
• NAVIS WORKS • DESITE MD • SOLIBRI Model CHECKER • JT2GO • …	• SHAREPOINT • EPLASS / DOXIS • AUTODESK 360 • PLAN-IT (SP) • THINK PROJECT! • CONJECT • …	• RIB iTWO 5D • DESITE MD • EXCEL • INFRAWORKS • ….

REFERENCE PROCESS INFRASTRUCTURE

Schüßler-Plan



Schüßler-Plan

- Incomplete Exchange of Data between Software Products

➢ Establishment of **Data Format** for relevant Processes

- Model serves as Database for many Questions

➢ Definition and Qualitycontrol of Model and **Information Standards**

- Automatisation using multiple Software Products

➢ Developement of **Tools and AddOns** to allow Automatisation

Schüßler-Plan

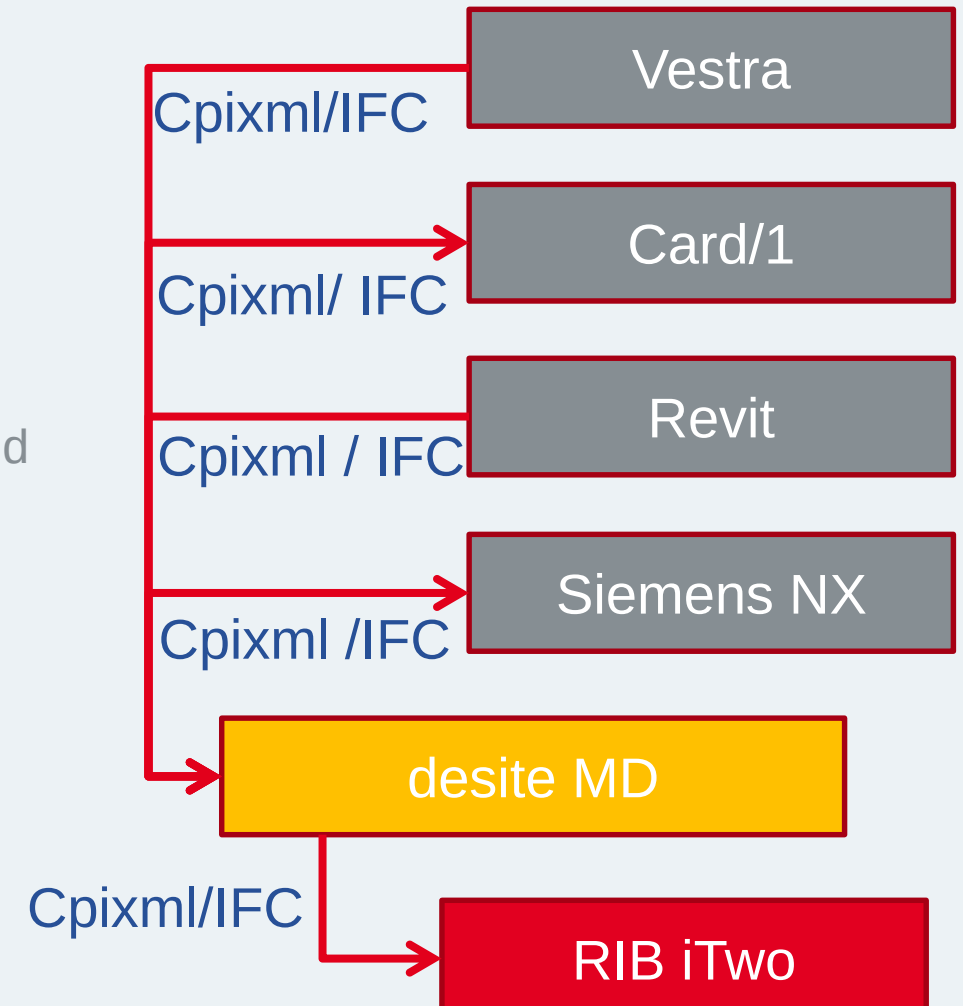
Exchange of geometric and semantic Information is mandatory (Multiple Software Usage)

CPIXML

- CPIXML = Construction Process Information
- „OPEN“ Dataformat for Derivation of Quantities and derivation of costs, binding documents
- Rather simple

IFC

- Industry Foundation Class (For Infrastructure under Development)
- Rather Complex (Classification Scheme)



Schüßler-Plan

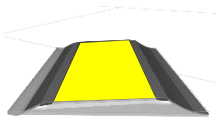
Depend on

- Processes
- Software
- Projectphase
- Use Cases
- (Dataformat)

Should be defined by Users not by third Parties or Institutions

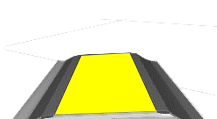
Are never Complete

Should address the Language and Needs of Engineers



Attribute
ID: cfg65e-hihc6b-ibic7-knhsd
Bauteil: Asphaltdeckschicht
Stecke: 2651
KM-Start: 1850,101
KM-Ende: 1850,111
cpiFitMatchKey: 511220011
…

! Same Information Quality for Humans but not for Computers !
Consequence: Automatisation Fails

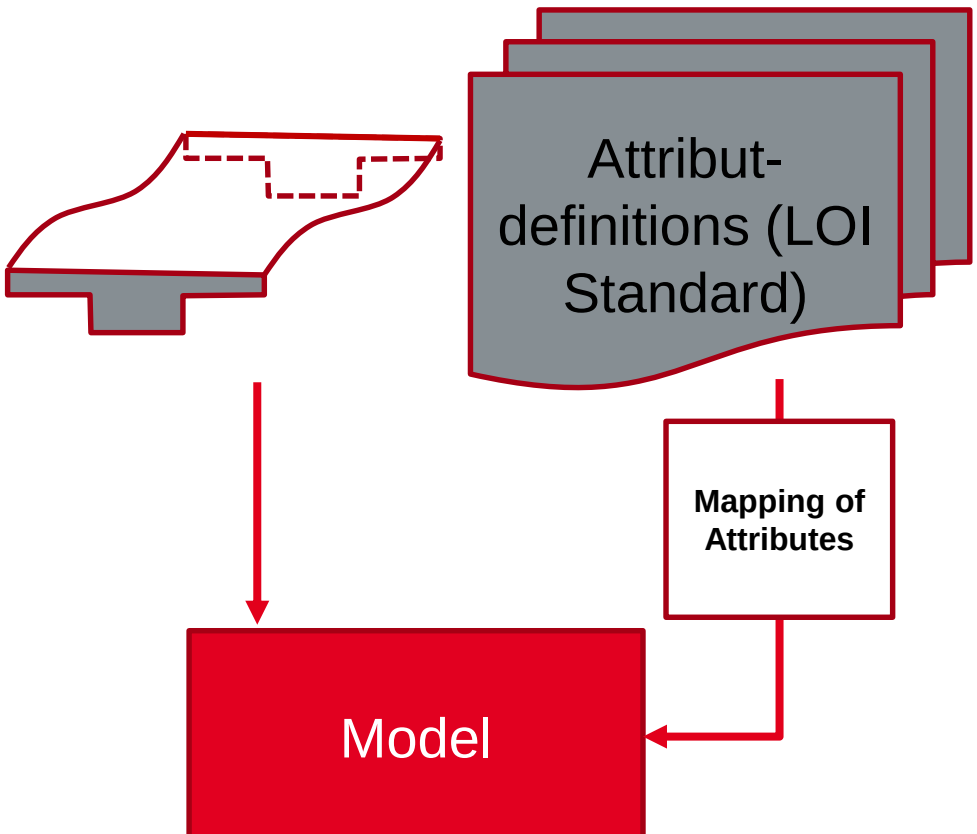


Attribute
ID: cfg65e-hihc6b-ibic7-knhsd
Typ: Asphaltdeckschicht
Bereich: 2651
Abschnitt-Anfang: 18501010
Abschnitt-Ende: 18501110
CPIFITMKey: 511220011
…

Schüßler-Plan

Database for Attributes

- Uniquely defined and stored
- Can be mapped by user in CAD Software
- Geometry is separated from Attributes
- Can be adopted easily
- Can be integrated in Design and Derivation Process



Schüßler-Plan

Construction an Coordination

Siemens NX

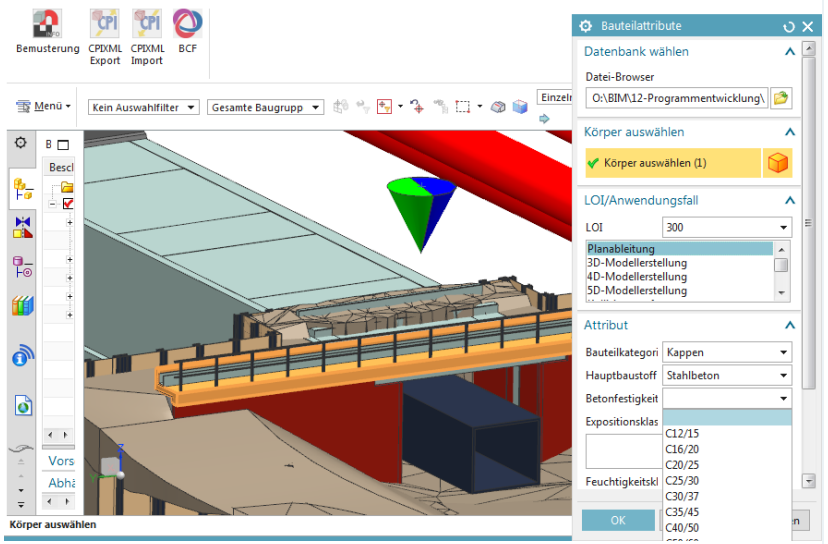
- CPIXML Import and Export
- Attribute Definition using Database
- BCF Import and Export

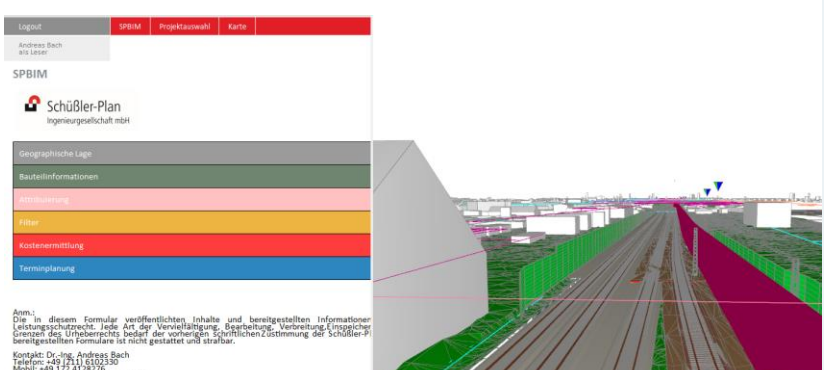
Revit

- Construction of curved Bridge Segments (DYNAMO)
- Database Managed Attribute Definition

Desite MD

- HTML Forms for better Coordination and Interpretation of Infrastructure Models (Orientation via Map, Key Information, Attribute Based Filters, Automated Construction Sequence Mapping, Quantity and Cost Export…)





Schüßler-Plan

Road and Rail Design

CARD/1

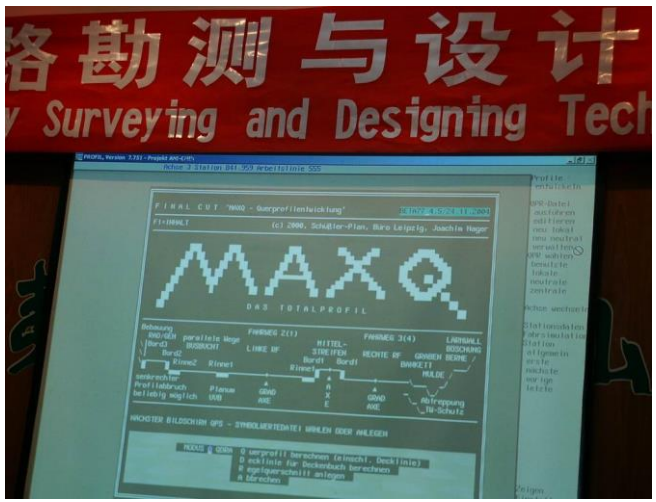
- Development of Parametric and automated Traffic Models (since 1999) including simple Bridge Models (since 2015)

Vis-All

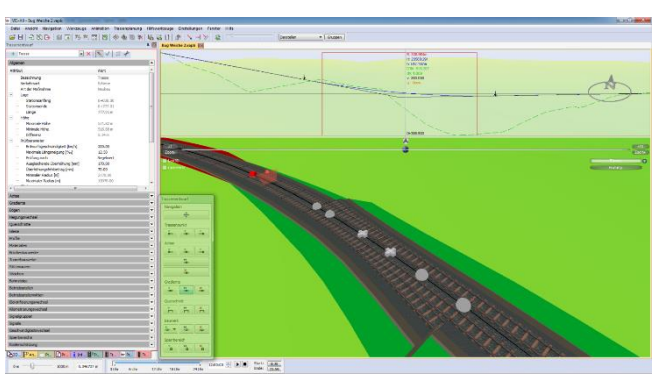
- Development of a Software for the Design and Cost Estimation of Infrastructure Projects
- Bundeverkehrswegeplan 2030 (Rail)

IBN-DOKU/INFRASTRUCTURE DATABASE

- Startup Operation of Rail Structure
- GIS Document Control



Demonstration 2004, China



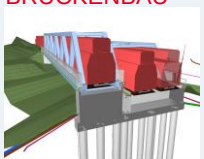
VIS-All

REQUIREMENTS FOR BIM IN INFRASTRUCTURE DESIGN
REFERENZPROJEKTE

Schüßler-Plan

WUPPERTAL-BARMEN
& OBERBARMEN
STATIONSBAU

EÜ EMSCHER
BRÜCKENBAU



EÜ BRODWEG
BRÜCKENBAU

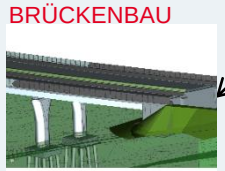
MACHBARKEITSSTUDIE
U-BAHNLINIE U5-
HAMBURG TUNNELBAU

RUDOF-WISSEL BRÜCKE
WESTEND BRÜCKE
AD FUNKTURM
BRÜCKENBAU

TALBRÜCKE VOLMARSTEIN
BRÜCKENBAU

RRX
INFRASTRUKTURPLANUNG

TALBRÜCKE GLEEN
BRÜCKENBAU

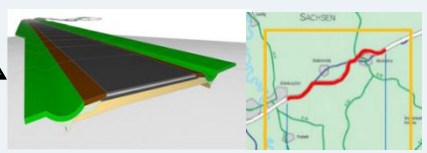


HOCHSTRAßE B44 NORD
BRÜCKENBAU

GATEWAY GARDENS
TUNNELBAU

FRANKENSCHNELLWEG
TUNNELBAU

B87n EILENBURG-
MOCKREHNA
VERKEHRSPLANUNG



HAMBURG
BERLIN
BRAUNSCHWEIG
BOTTROP
WUPPERTAL
LEIPZIG
DÜSSELDORF
MARBURG
FRANKFURT
LUDWIGSHAFEN
NÜRNBERG

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PILOT PROJECT B87N
PROJECTINFORMATIONEN

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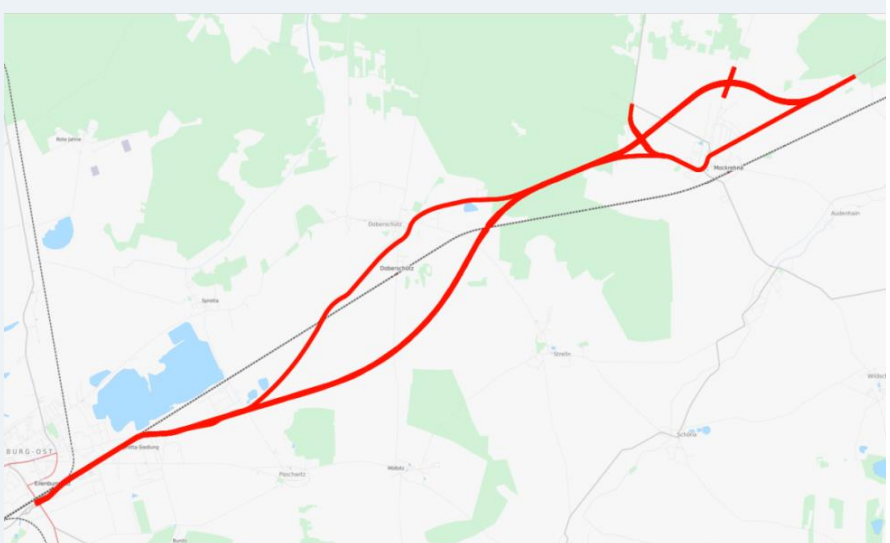
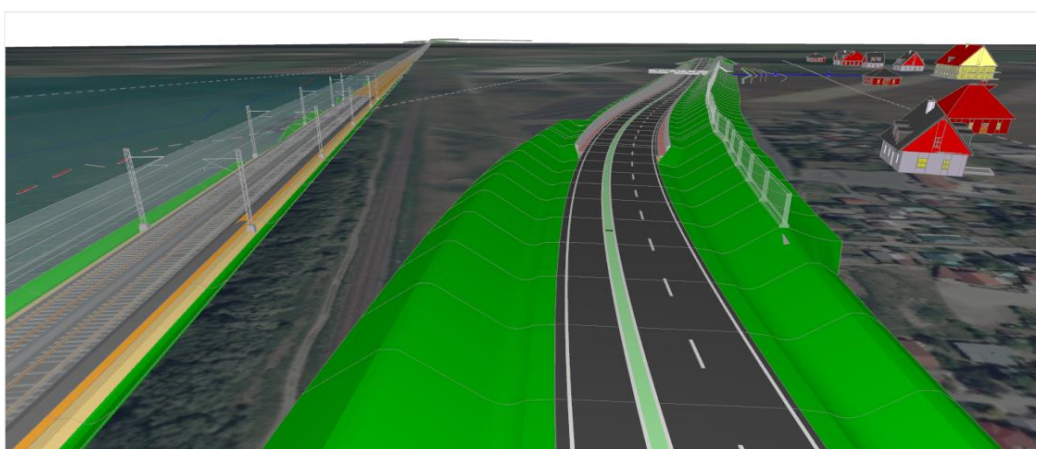
Client:	Bundesrepublik Deutschland DEGES
Project:	BIM Pilotprojekt B 87n Leipzig (A14) – Landesgrenze SN/BB SN/BB, VKE 328.2
Task:	Planing of Traffic Bypass LPH 1 & 2 (Traffic & Construction Planing)
Segment:	Eilenburg – Mockrehna
Length:	13,5 km
Crossection:	RQ 15,5
Costs:	35,5 Mio. €
Construction Time:	ca. 5 - 7 Jahre



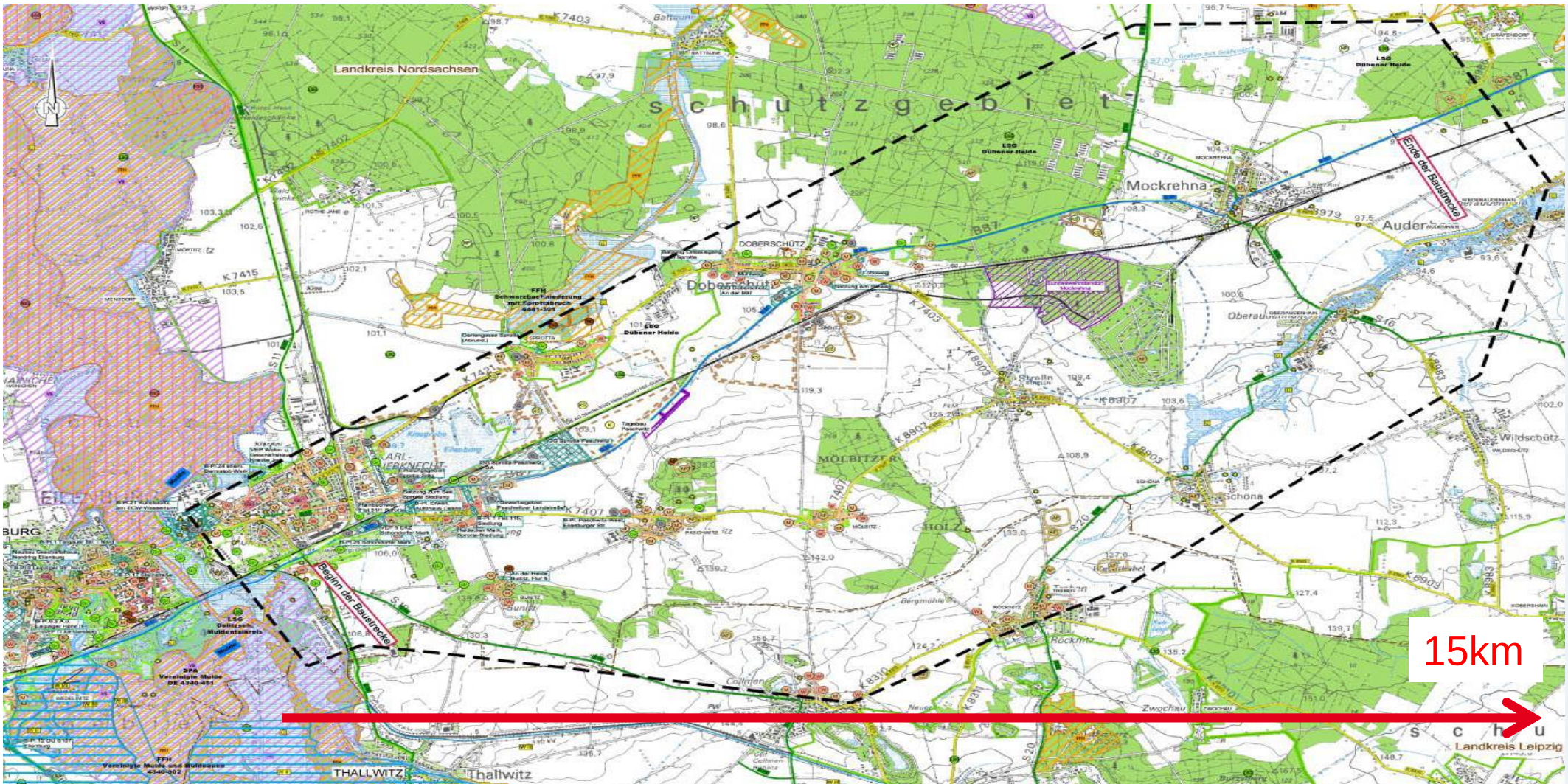
Schüßler-Plan

- BIM Execution Plan
- Coordination
- Integration of Environment
- 3D Modeling
- Collision Checks
- 4D-Modeling (Time)
- 5D-Modeling (Time & Costs)
- 6D-Livecycle
- Construction Progress Control
- Derivation of Drawings
- …..



PILOT PROJECT B87N
AREA OF INTREST

Schüßler-Plan



Schüßler-Plan

Junctions (KP)

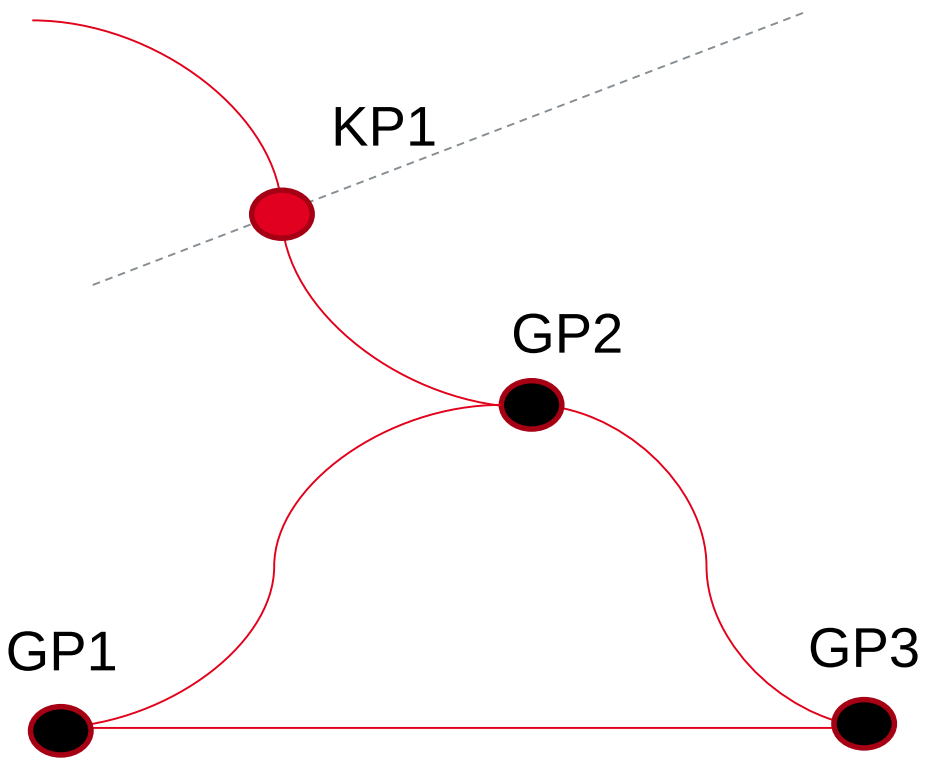
- Connectivity to other Routes

Joints (GP)

- Connectivity of alternative Lines

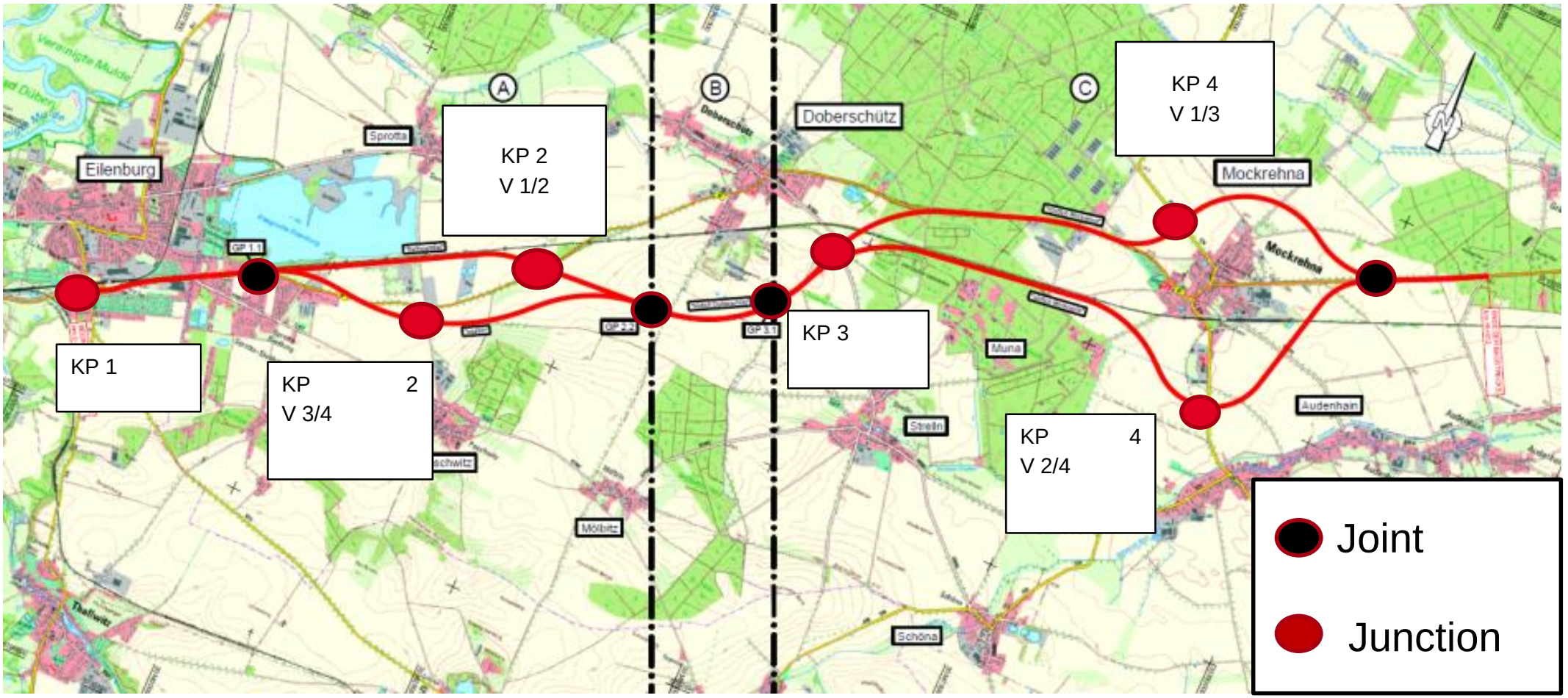
Combination using Joints and Junctions

Variant	GP 1	GP 2	GP 3	KP 1
1	x		X	
2	x	x	X	
3		x	x	x
…	…	…	…	…

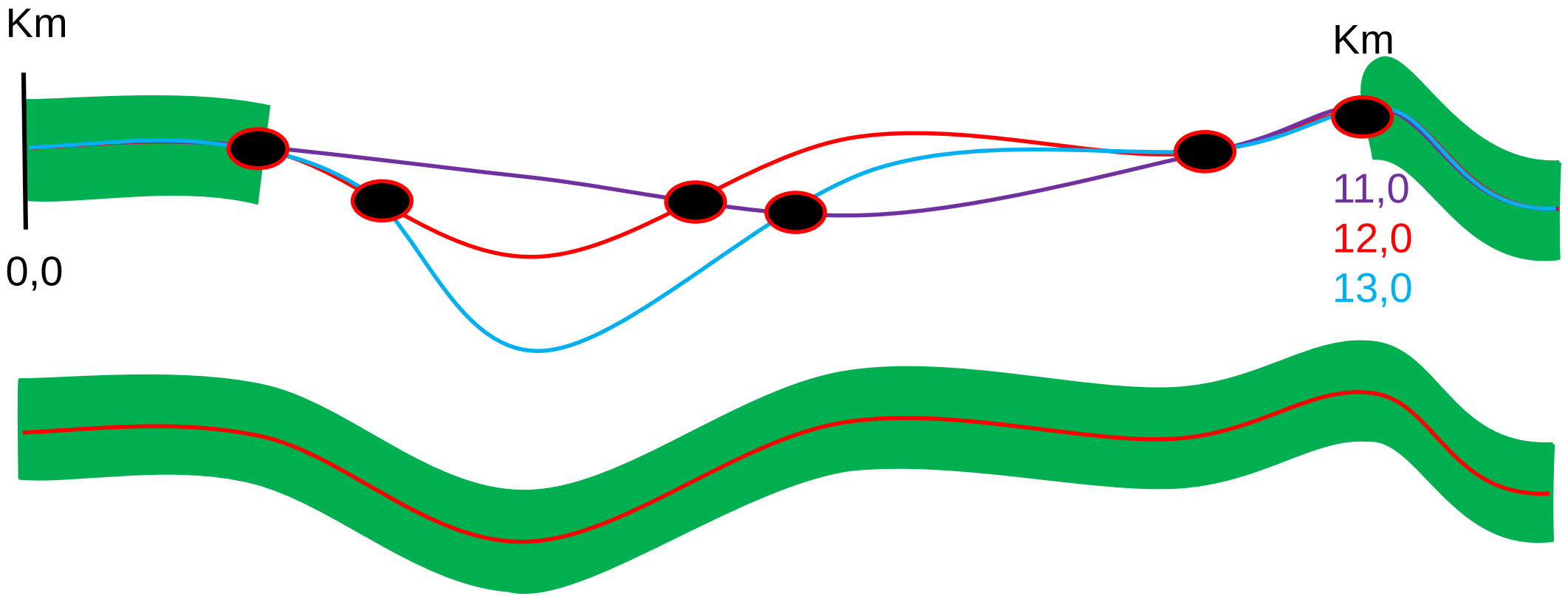


PILOT PROJECT B87N
MODULAR DESIGN USING JUNCTIONS (KP) AND JOINTS (GP)

Schüßler-Plan



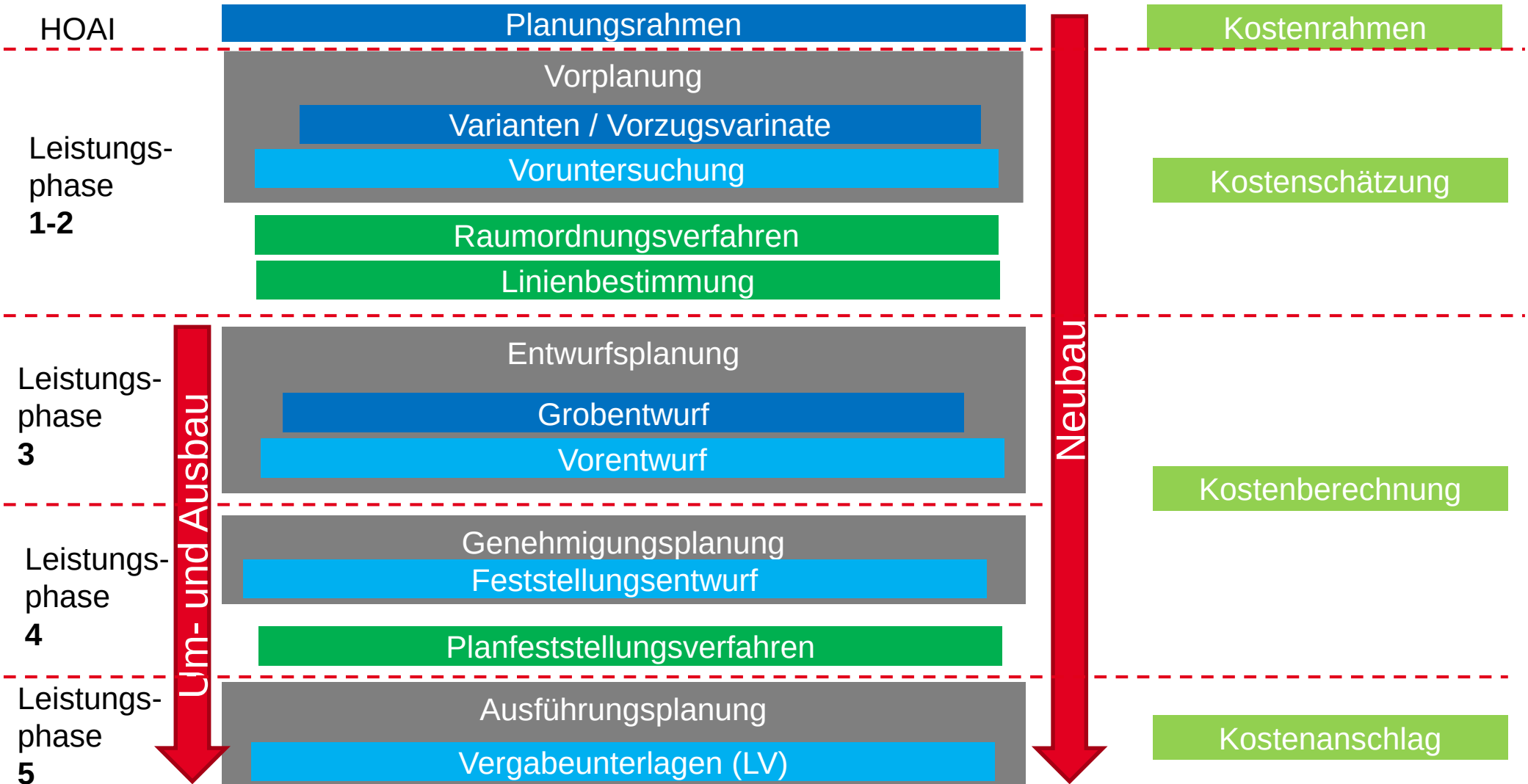
Schüßler-Plan



Alignment
3D-Object
Joints

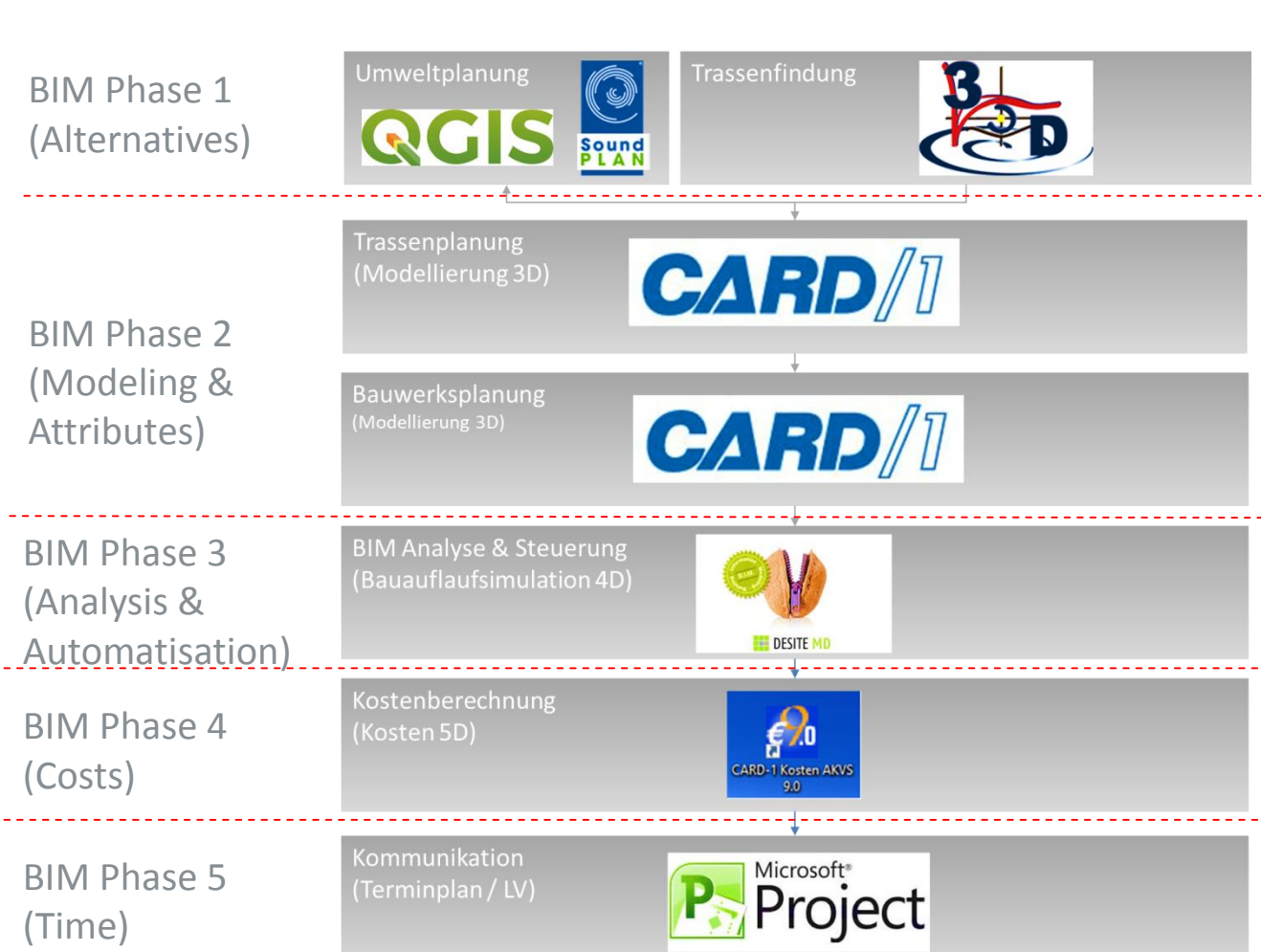
Problem: Validity of shared Line Segments
Solution: 3D-Bodies used simultan with varying Attributes
Result: 19 Variants with only 350.000 Objects in 3D

Schüßler-Plan



PILOT PROJECT B87N
BIM WORKFLOW

Schüßler-Plan



AGENDA

Schüßler-Plan

1. BIM from Clients and Contractors Perspective
2. Requirements for BIM in Road and Infrastructure Design
3. Pilot Project B87N
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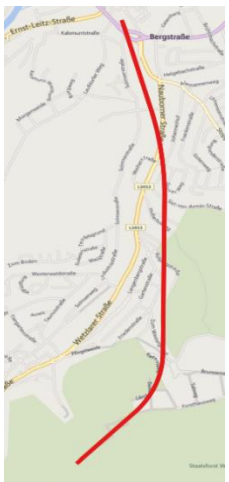
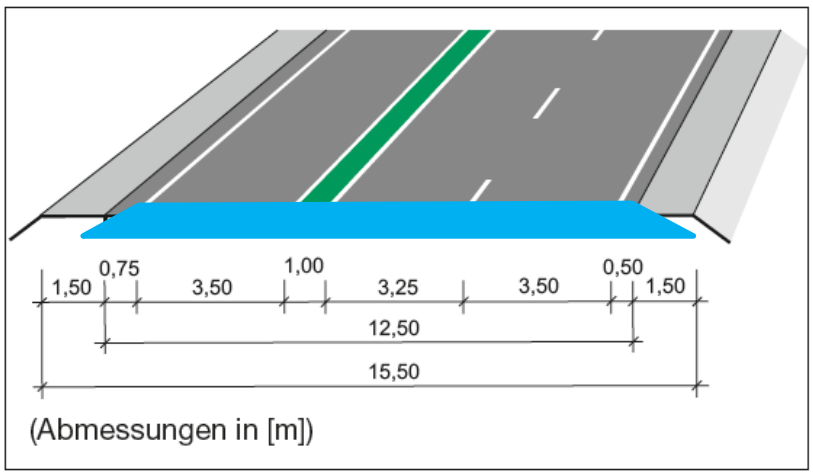
7. Lessons Learned and Discussion

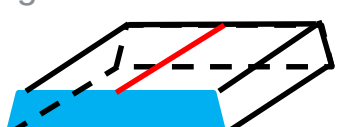
Schüßler-Plan

Conventional Design



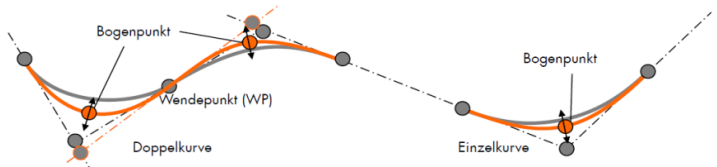


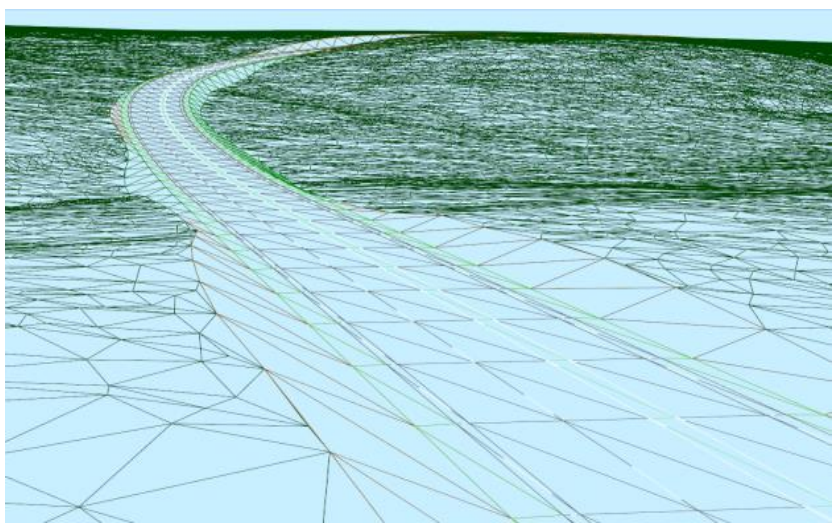
Calculation of Volume =
Curved Length x Area of Basic Crossection



Approximated Quantities

BIM Design



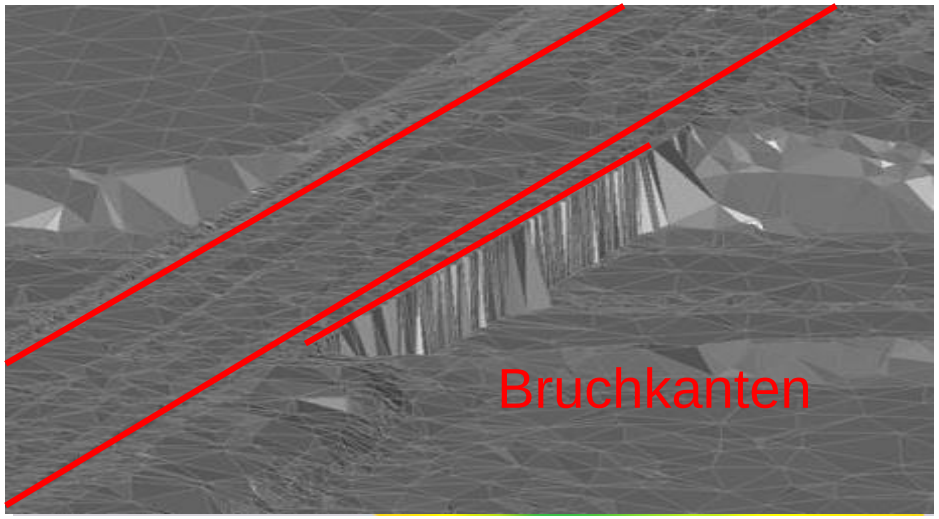


Automated and Accurate Quanties
using Crossection and Surface of Terrain

Schüßler-Plan

Terrain

- Raster-DGM
  (Cartesic Data - XYZ-Points)
- REB-Data
  (ASCII – Format)
- SRTM-Data
  (Shuttle Radar Topography Mission = Fernerkundungsdaten)
- Point Cloud



Terrain Textur – Ortho Maps

- Topographic Map (TK: DTK25-V)
  (Data from BfG / Survey Department)

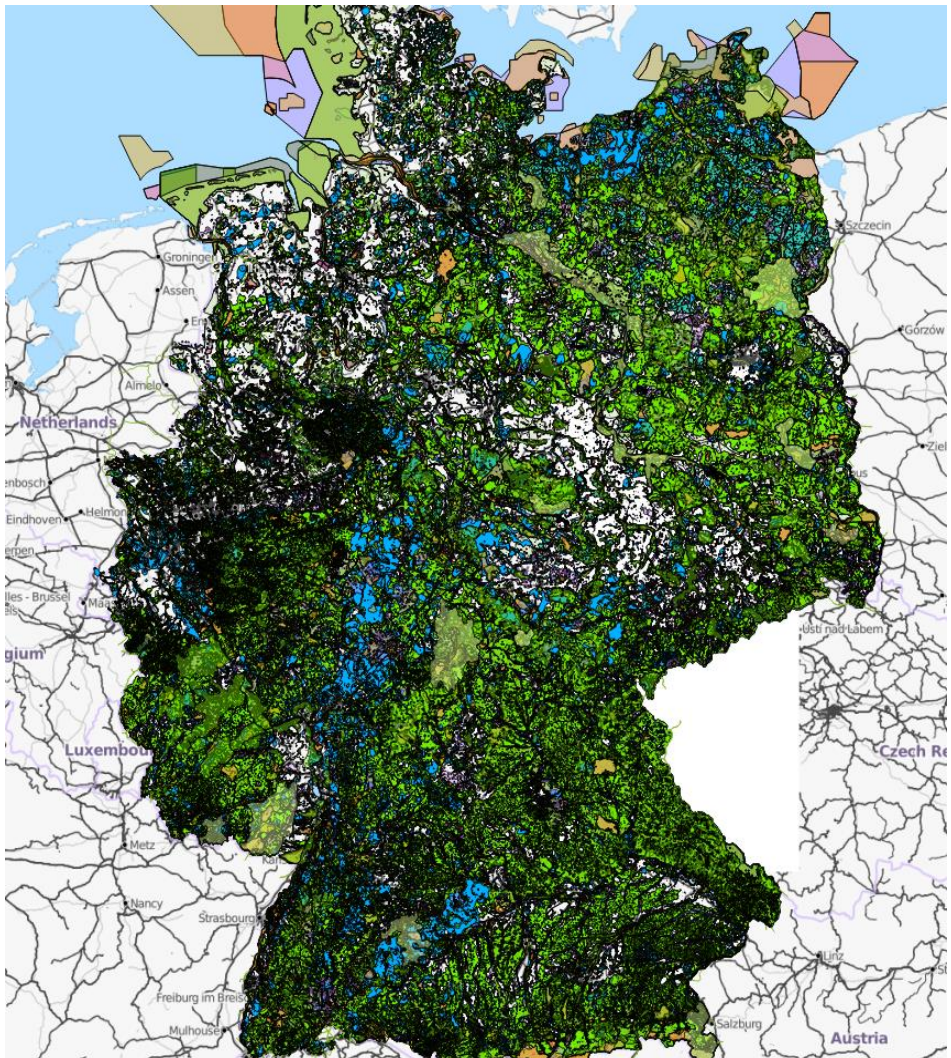
Schüßler-Plan

Terrain Textur – Ortho Images

- Digitale Ortho Pictures (DOP 40 / DOP 20)
  (Data from BfG / Survey Department)

Protected Areas - Environment

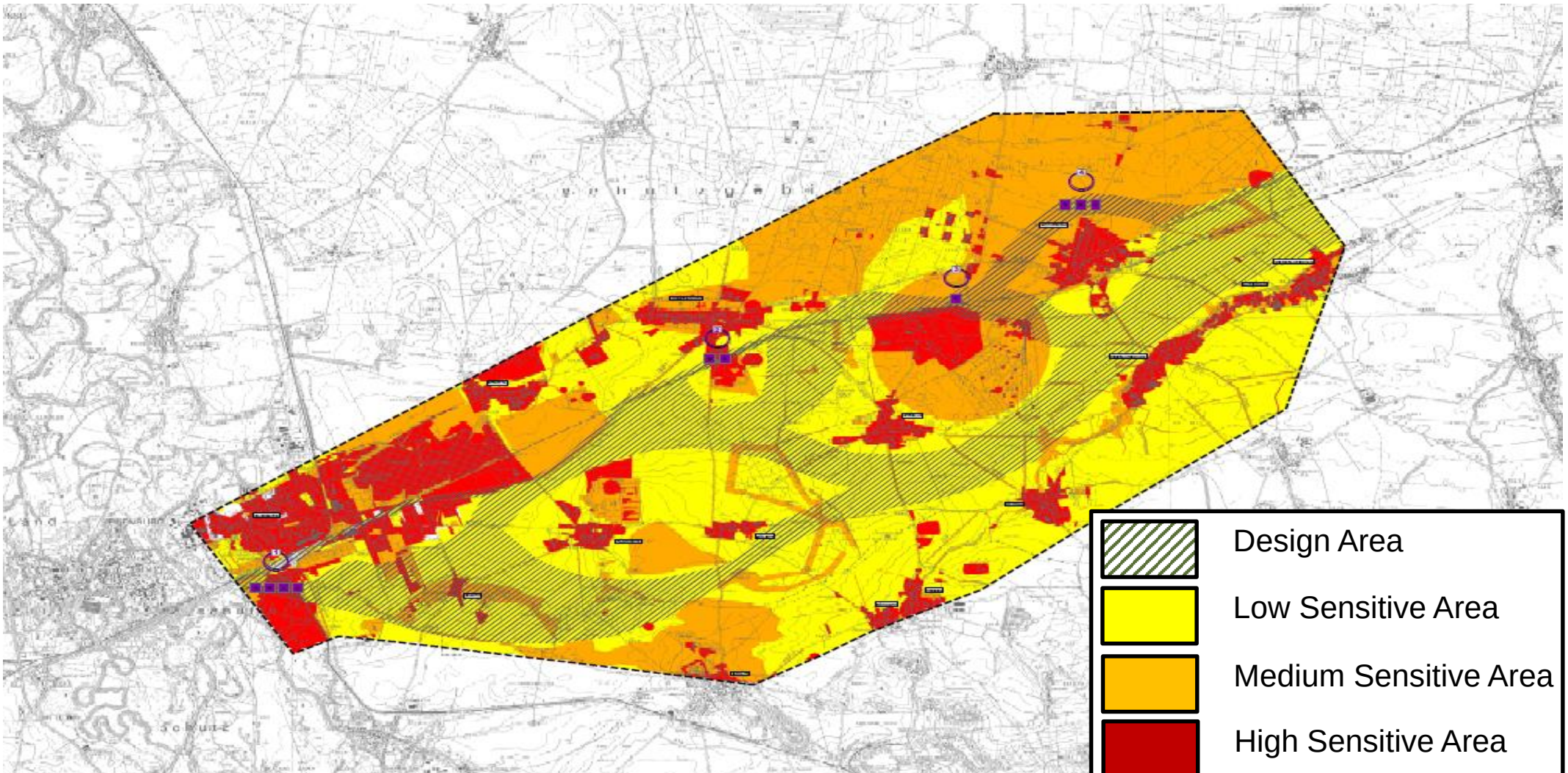
- Biologic reservated Areas
- Nature Preserve
- European Bird Reserve
- National Parks
- Flooded Areas
- World Haritage
- Water Protection Areas
- …



BIM USE CASES, ALIGNMENT

SPATIAL RESISTANCE – ENVIRONMENTAL PERSPECTIVE

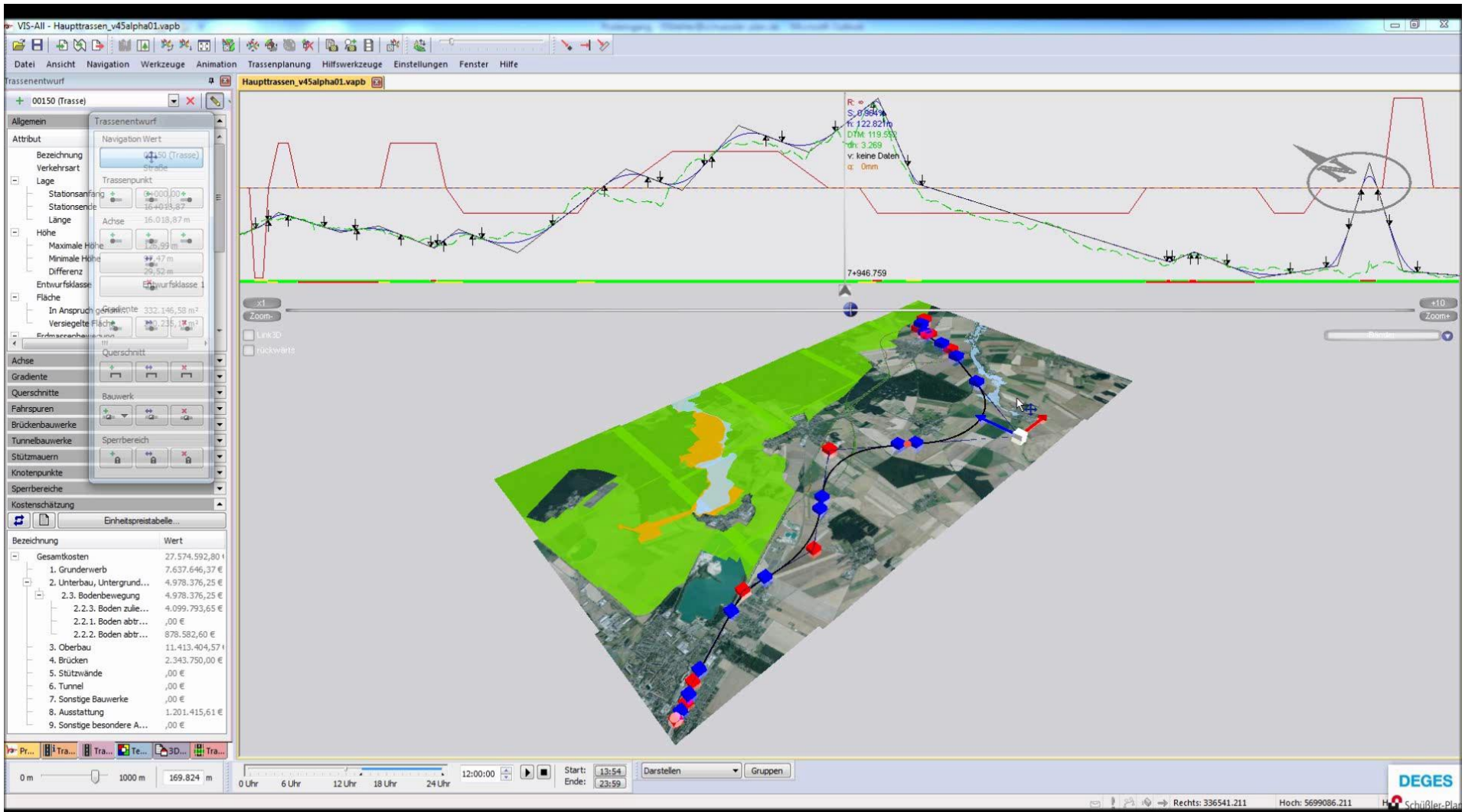
Schüßler-Plan



BIM USE CASES, ALIGNMENT

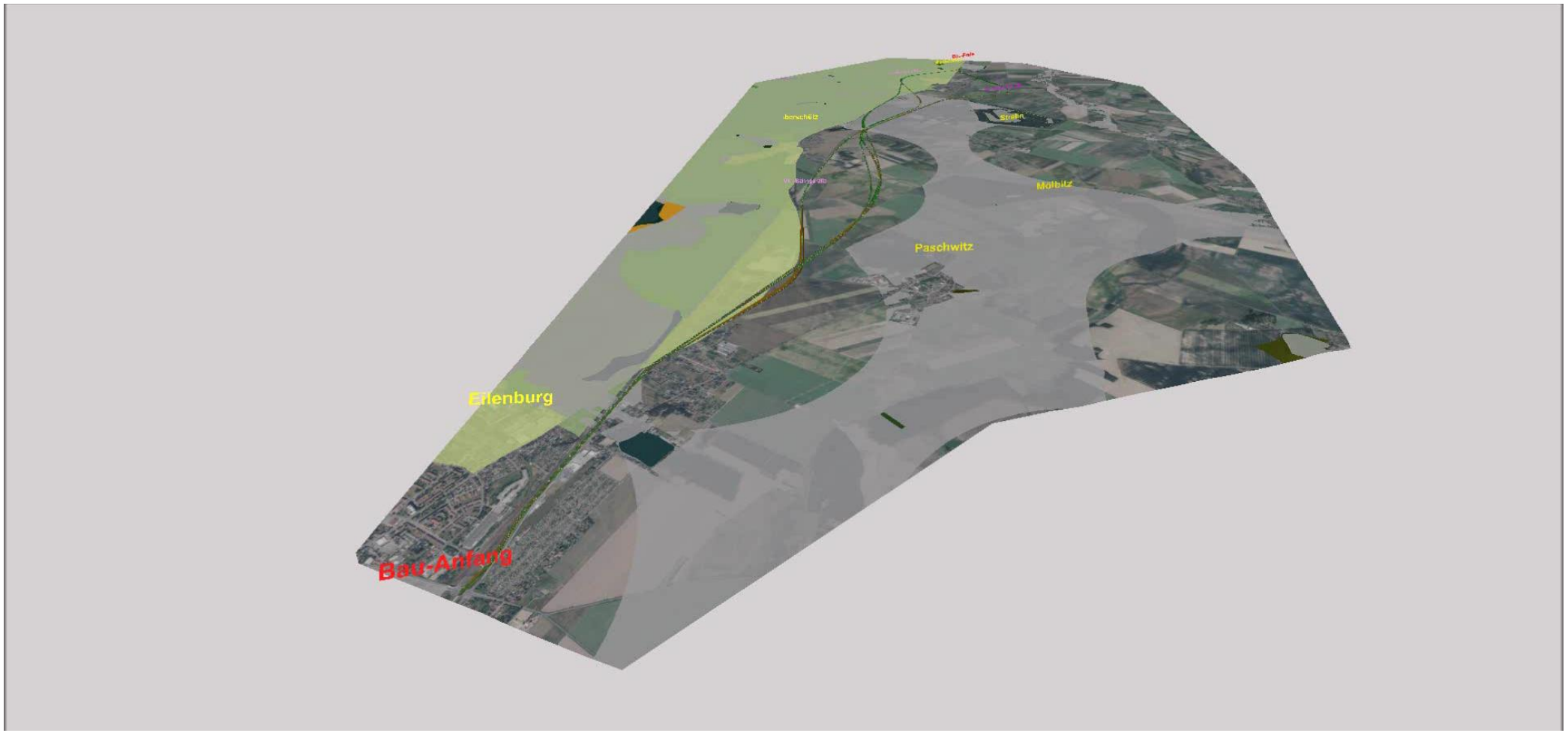
4 MAIN VARIANTS – EXAMPLE OF SOFTWARE USE

Schüßler-Plan



BIM USE CASES, ALIGNMENT
4 MAIN ALTERNATIVES FOR PROJECT B87N

Schüßler-Plan



Schüßler-Plan

Name

- CPI XML [Brücken_A00110.cpixml] (1)
- CPI XML [M15060_T98G53.cpixml] (1)
- CPI XML [M15050_G22T98.cpixml] (1)
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- CPI XML [M13111_V04G51.cpixml] (1)
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- CPI XML [M13091_BAG11.cpixml] (1)
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- CPI XML [M13055_BAG11.cpixml] (1)
- CPI XML [M13050_BAG11.cpixml] (1)
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- CPI XML [M13030_G31G32.cpixml] (1)
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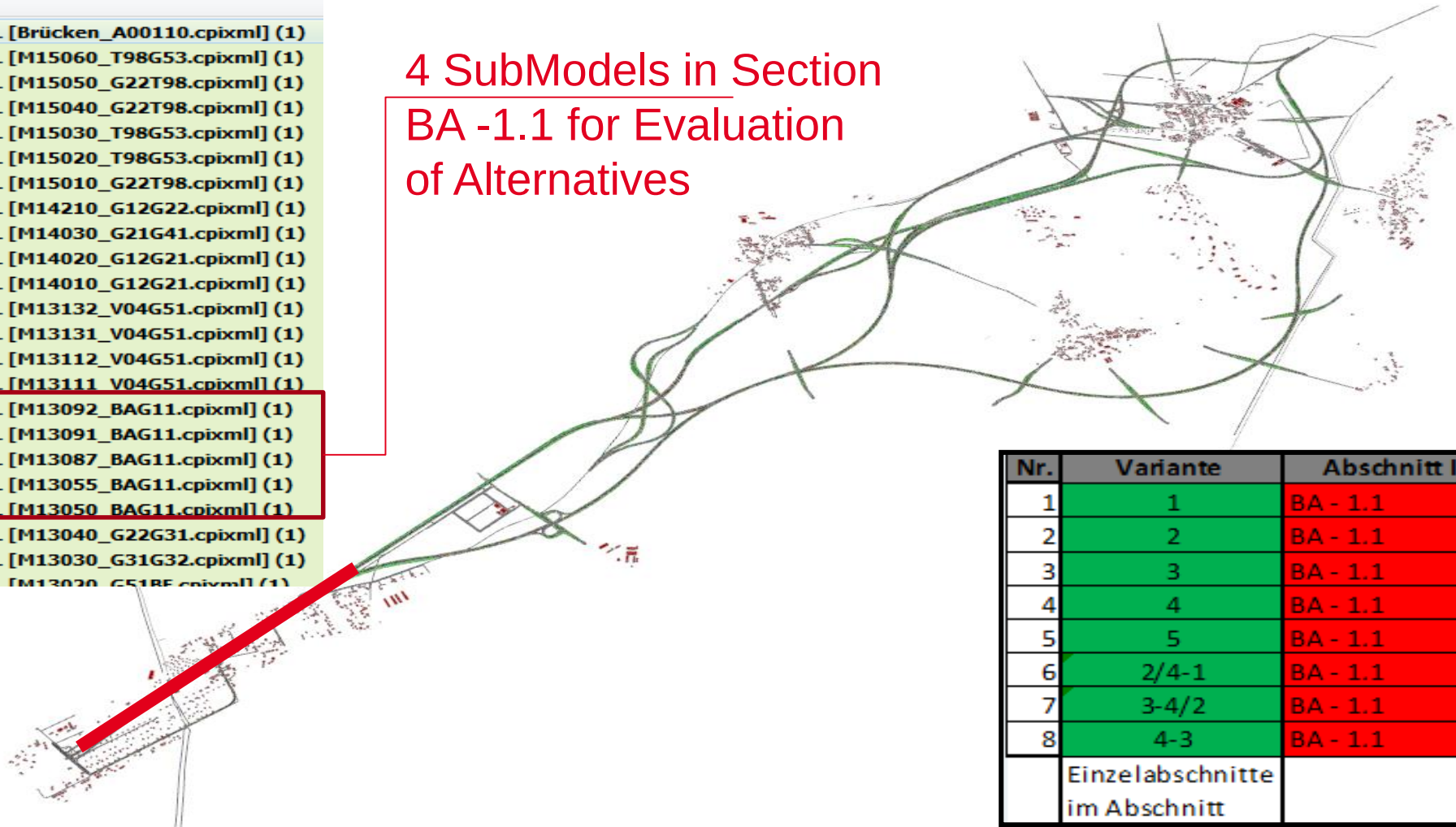
4 SubModels in Section BA -1.1 for Evaluation of Alternatives



Nr.	Variante	Abschnitt I
1	1	BA - 1.1
2	2	BA - 1.1
3	3	BA - 1.1
4	4	BA - 1.1
5	5	BA - 1.1
6	2/4-1	BA - 1.1
7	3-4/2	BA - 1.1
8	4-3	BA - 1.1
	Einzelabschnitte im Abschnitt	1

AGENDA

Schüßler-Plan

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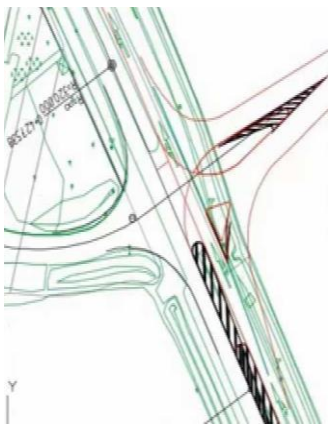
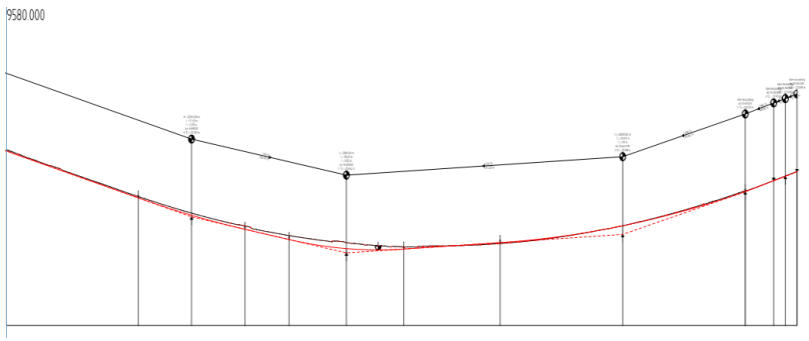
Schüßler-Plan

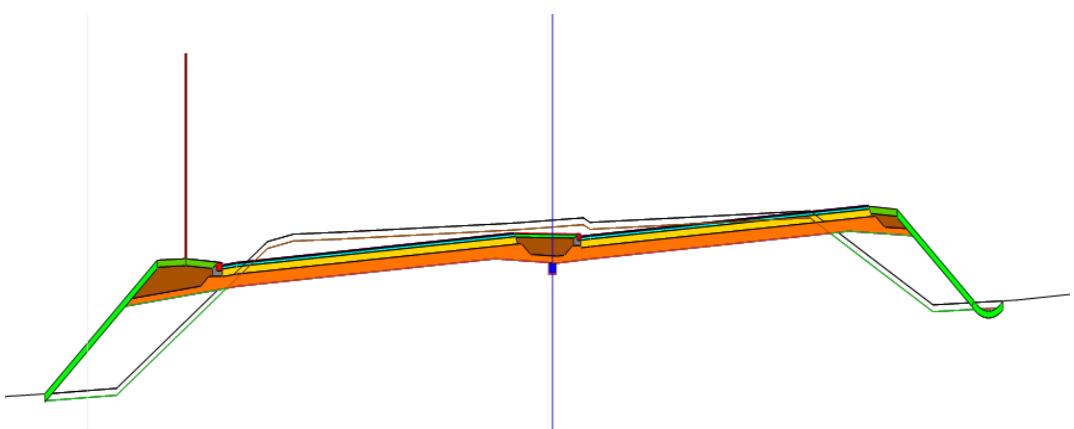
Alignment



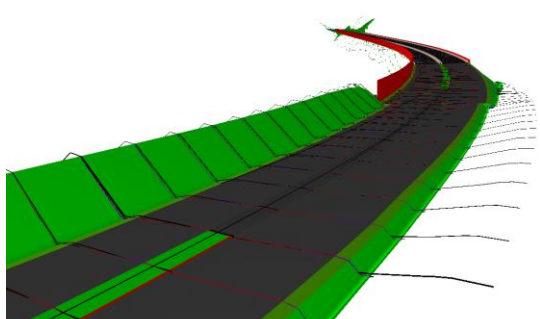
Gradient



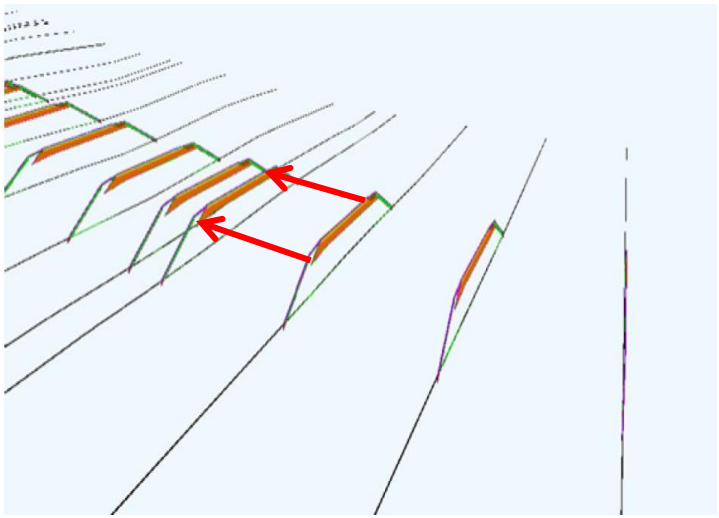
Cross-Section

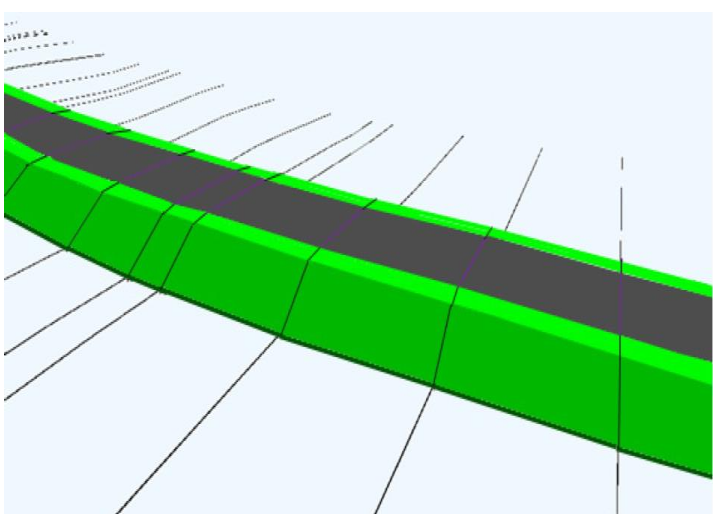


3D-Model



Schüßler-Plan





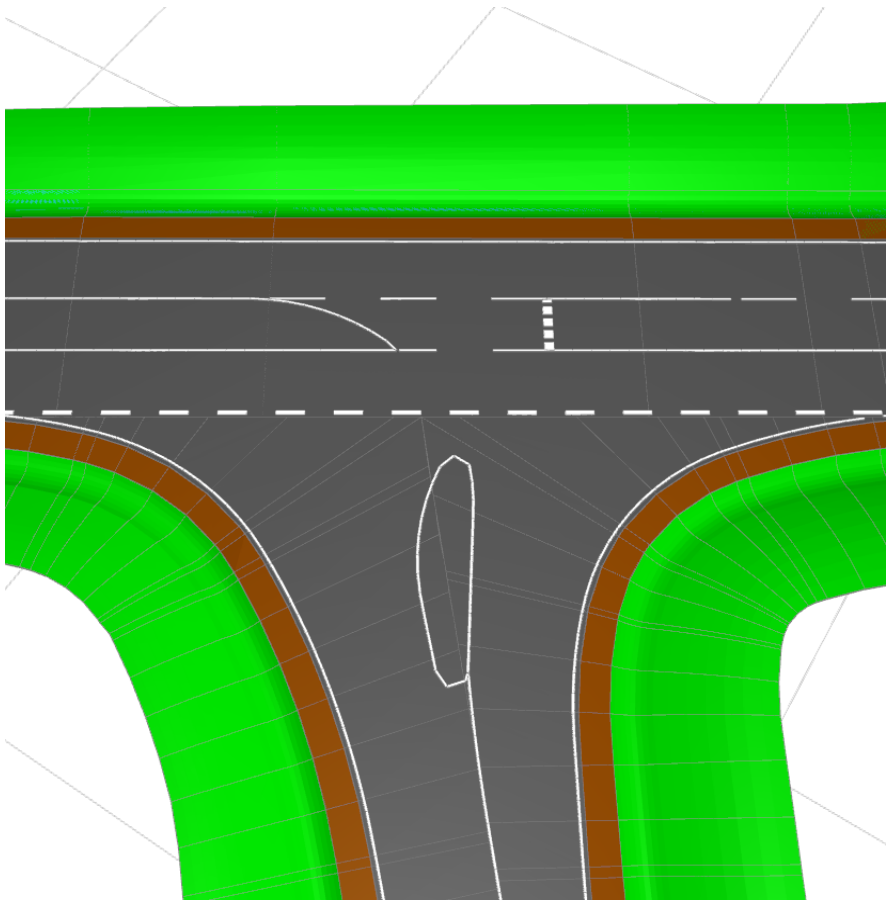
Calculation of Cross-Section

↓

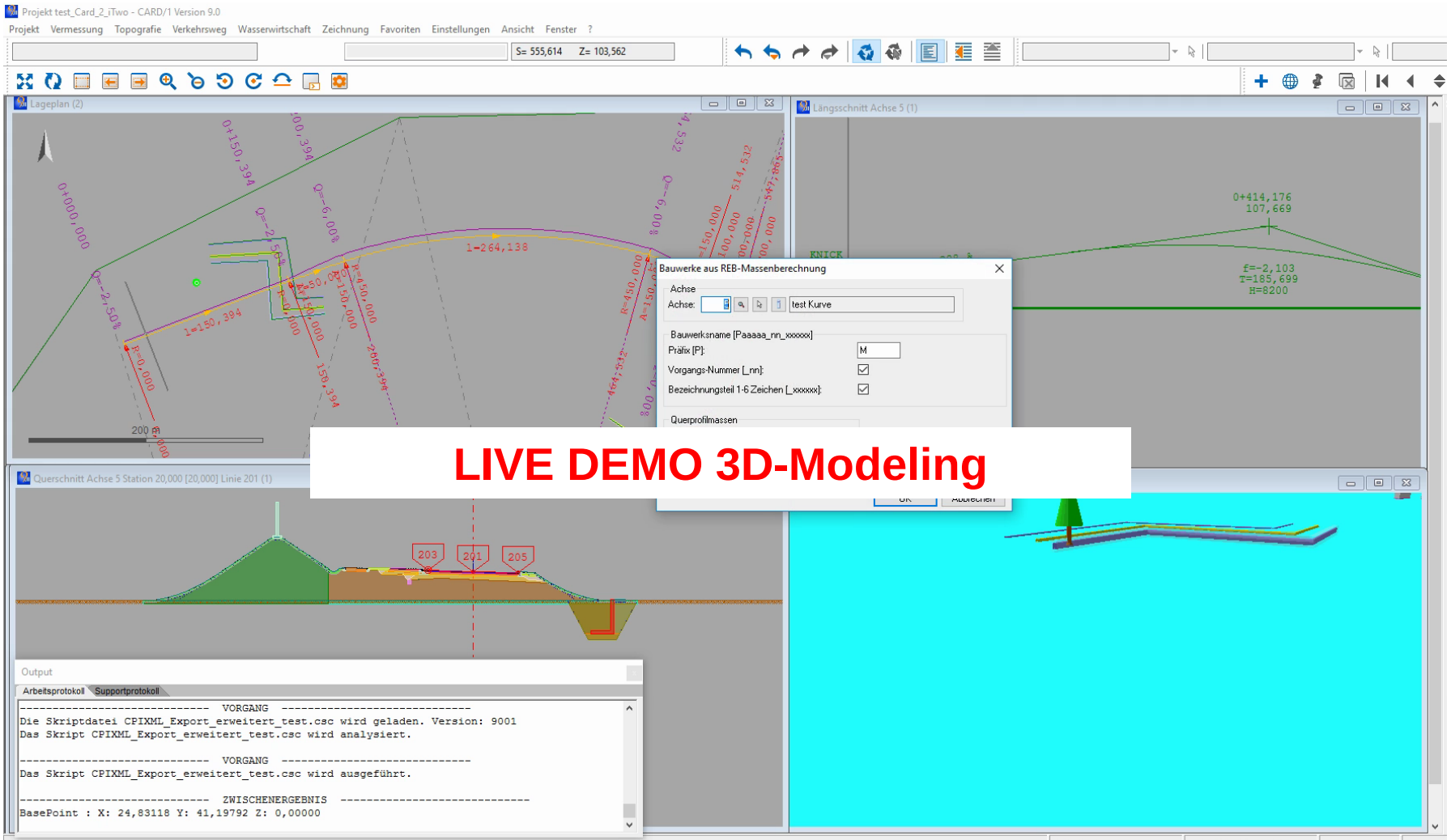
Linear Connection of Cross-Sections

↓

Calculation of Geometry and Export

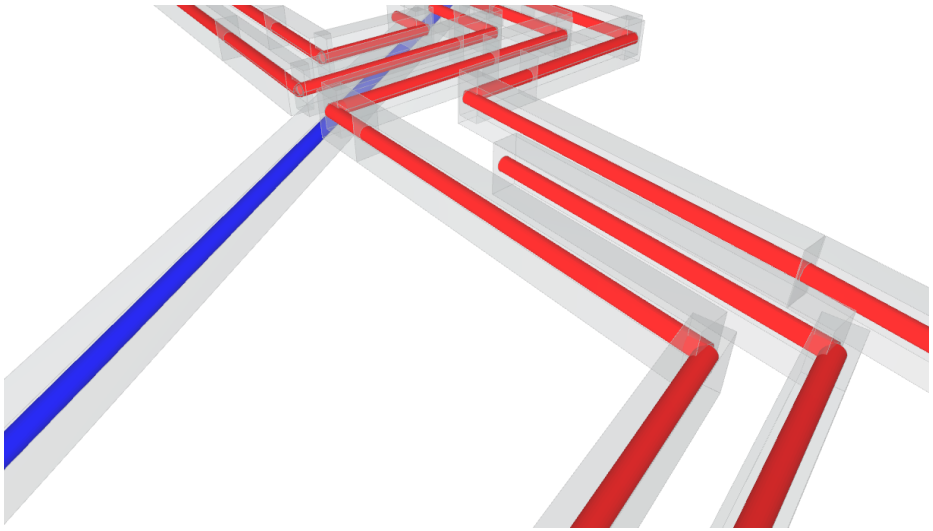


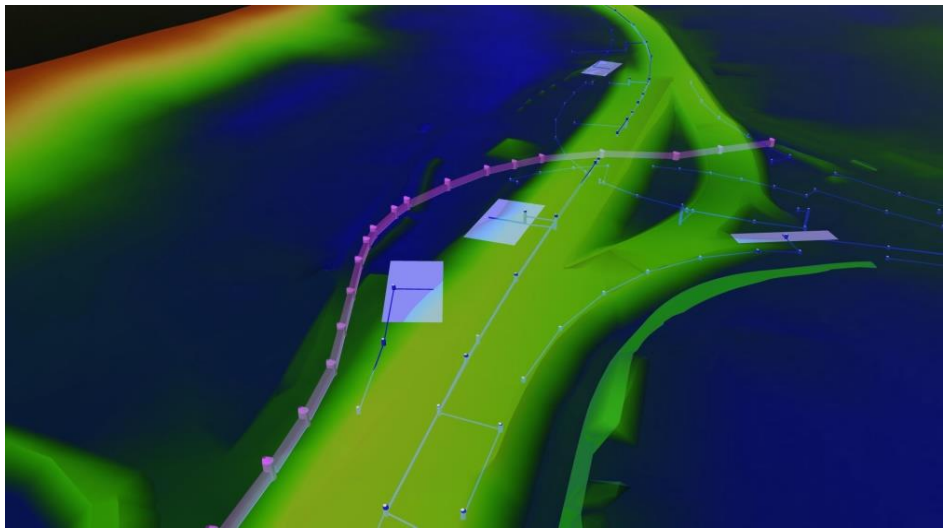
Schüßler-Plan

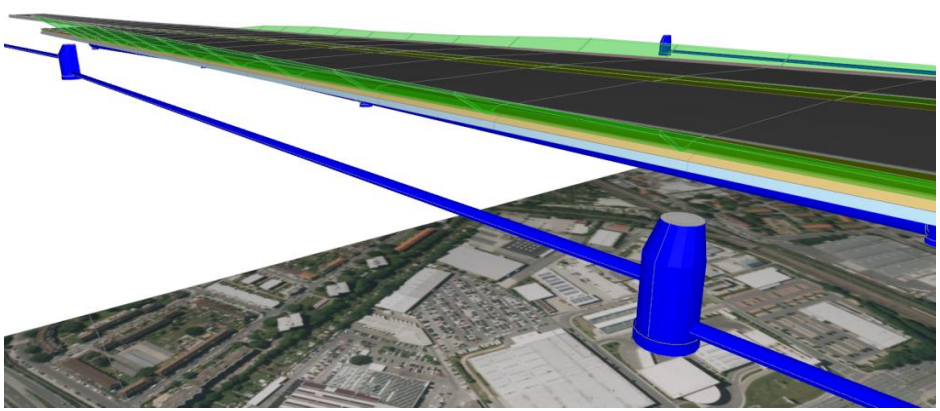


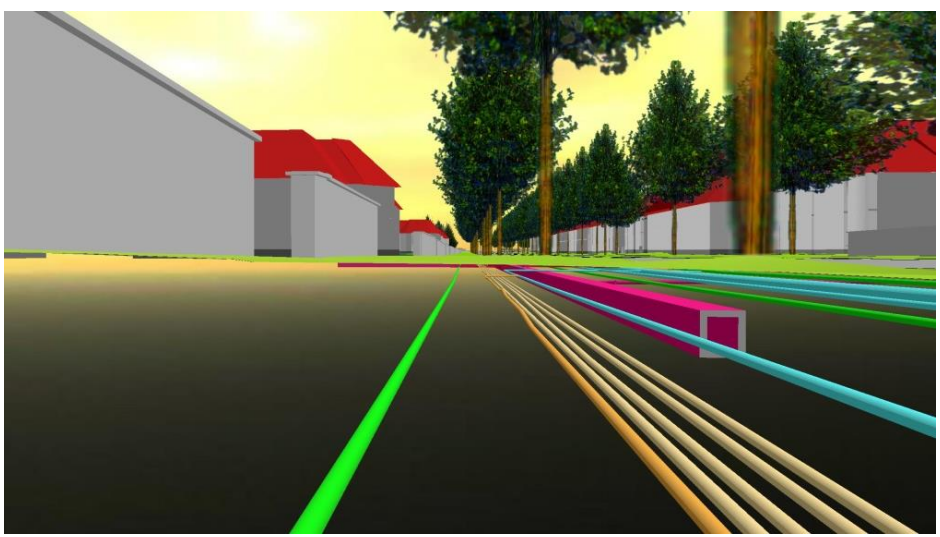
MODEL AND ALTERNATIVE DESIGNS
PIPES

Schüßler-Plan



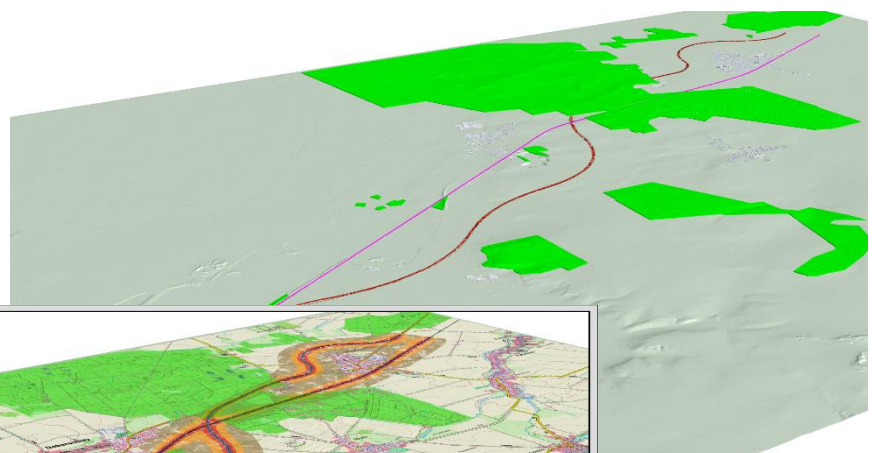


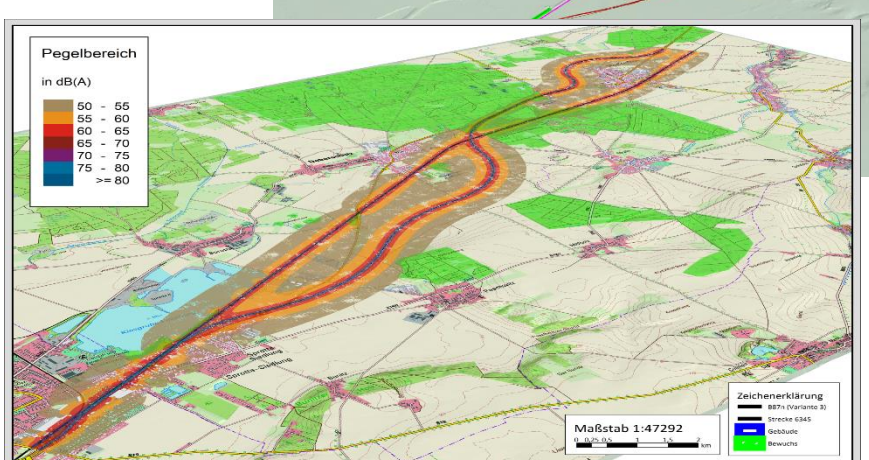




Schüßler-Plan

Traffic Modeling *CARD/1* ↔ Noise Emission *Soundplan* ↔ GIS Transformation *QGIS* ↔ Coordination *Desite MD*

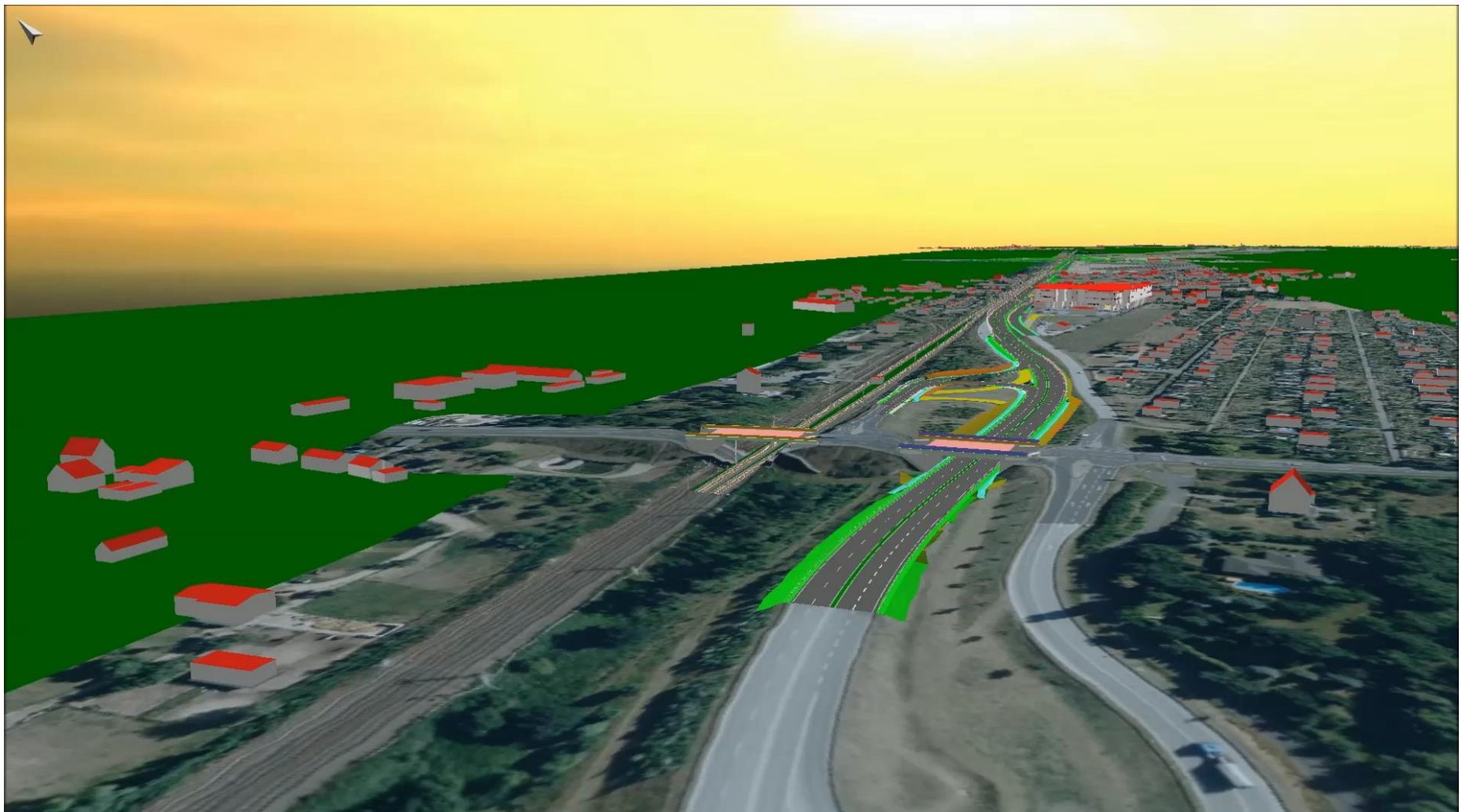




Verkehrslärmanalyse, Variante 3

Verkehrslärmbelastung (dB(A), Tag)	Anzahl betroffener Gebäude
50-55	584
55-60	259
60-65	134
65-70	52
70-75	20
75-80	1
Summe	**1050**

Schüßler-Plan



AGENDA

Schüßler-Plan

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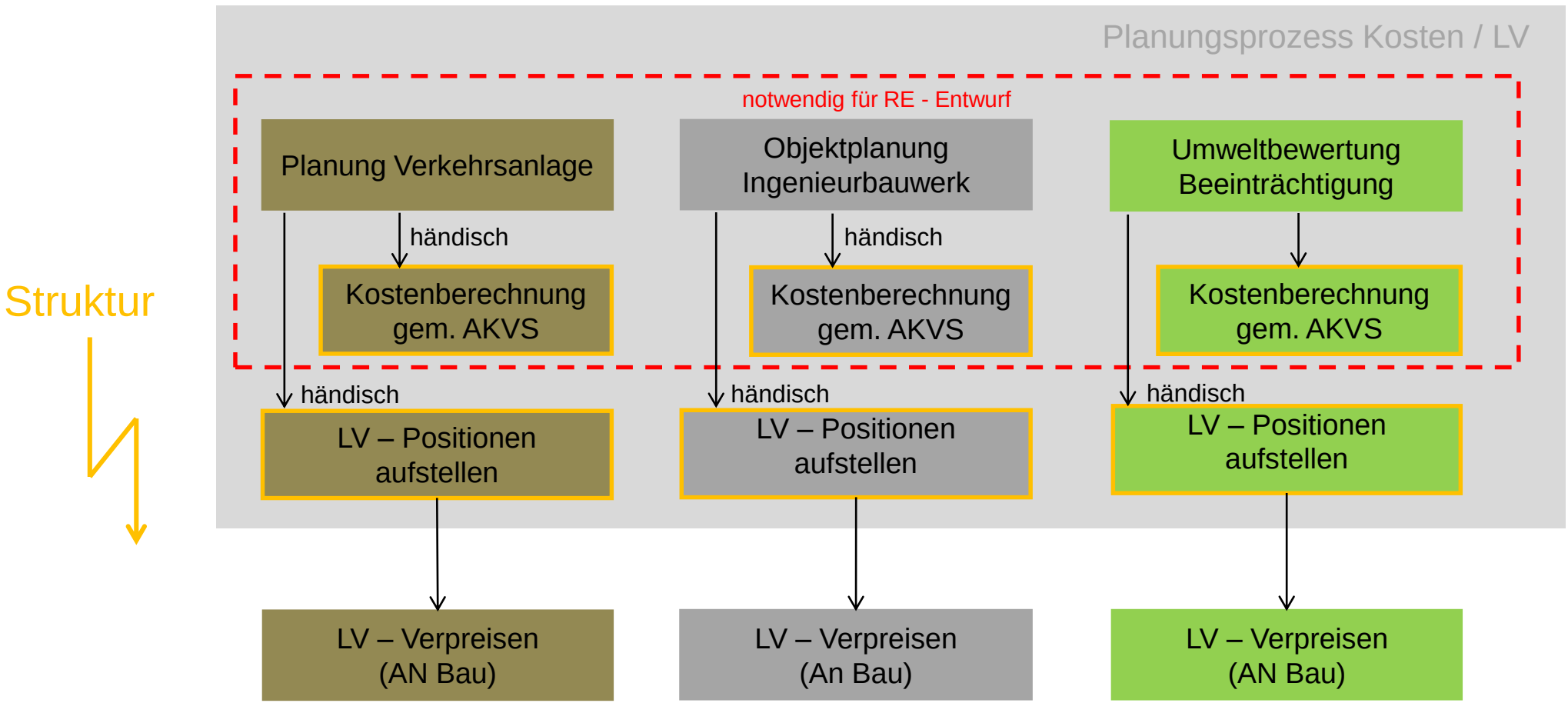
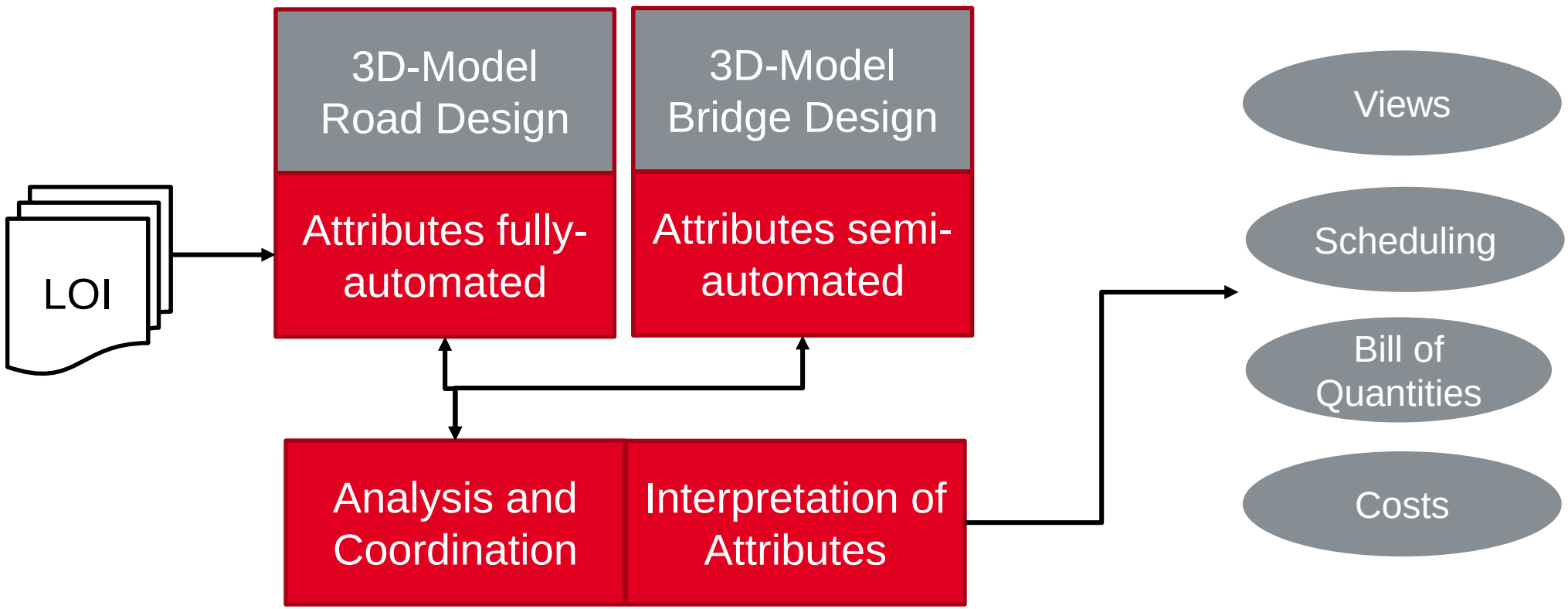
Schüßler-Plan



Goal: Automatisation of Processes!

Schüßler-Plan



INTERPRETATION AND AUTOMATISATION (4D, 5D)

ATTRIBUTE DEFINITIONS - EXAMPLES

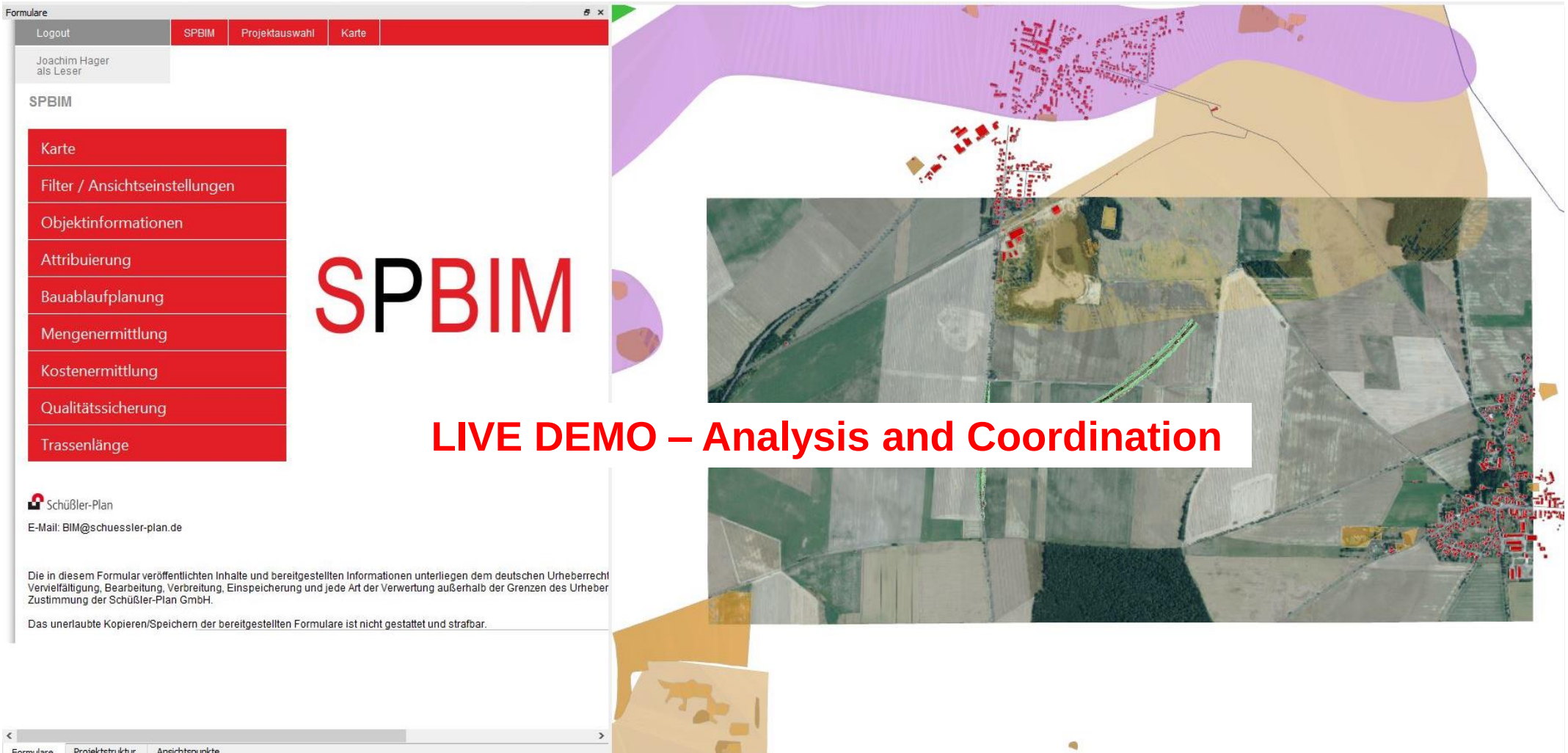
Schüßler-Plan

Bezeichnung	ATTRIBUT Strecke	Werte als Text oder Double Beispiele:	Definition
Achsbezeichnung	Infra_Alignment	130	xs:string
Dimension	Infra_Dimension	m3	xs:string
Berechnungsnorm	Infra_Norm	VB21.003	xs:string
Positionsnummer	Infra_NormBoQItem	100002.3	xs:string
Volumen	Infra_NormVolume	5,0056 [m3]	xs:double
Quelle	Infra_ObjectSource	Querprofil	xs:string
Beschreibung Bauteilfamilie	Infra_QTODescription	FB_Deckschicht	xs:string
Beschreibung Bauteil	Infra_QTOProfMeaning	St_1_OB_Decke	xs:string
Horizontdefinition	Infra_RefAlignment_3DHorizon		xs:string
von Station	Infra_StationFrom	650,0000 [m]	xs:double
bis Station	Infra_StationTo	660,0000 [m]	xs:double
Art	Infra_Type	SOLID	xs:string
Materialdefinition	Material	&Asphalt	
Definition AKVS (INFO)	cpiFitMatchAKVS	5.113.3.030.10	xs:string
Definition LV (INFO)	cpiFitMatchLV	5.113.3.030.11	xs:string
Automatisierung	cpiFitMatchKey	5113303010	xs:string
Beschreibung AKVS	cpiFitMatchTextAKVS	Splittmastixasphalt 4 cm	xs:string
Beschreibung LV	cpiFitMatchTextLV	Splittmastixasphalt 4 cm, 11 S	xs:string

Crossection
Material
Scheduling, Costs,
Bill of Quantities

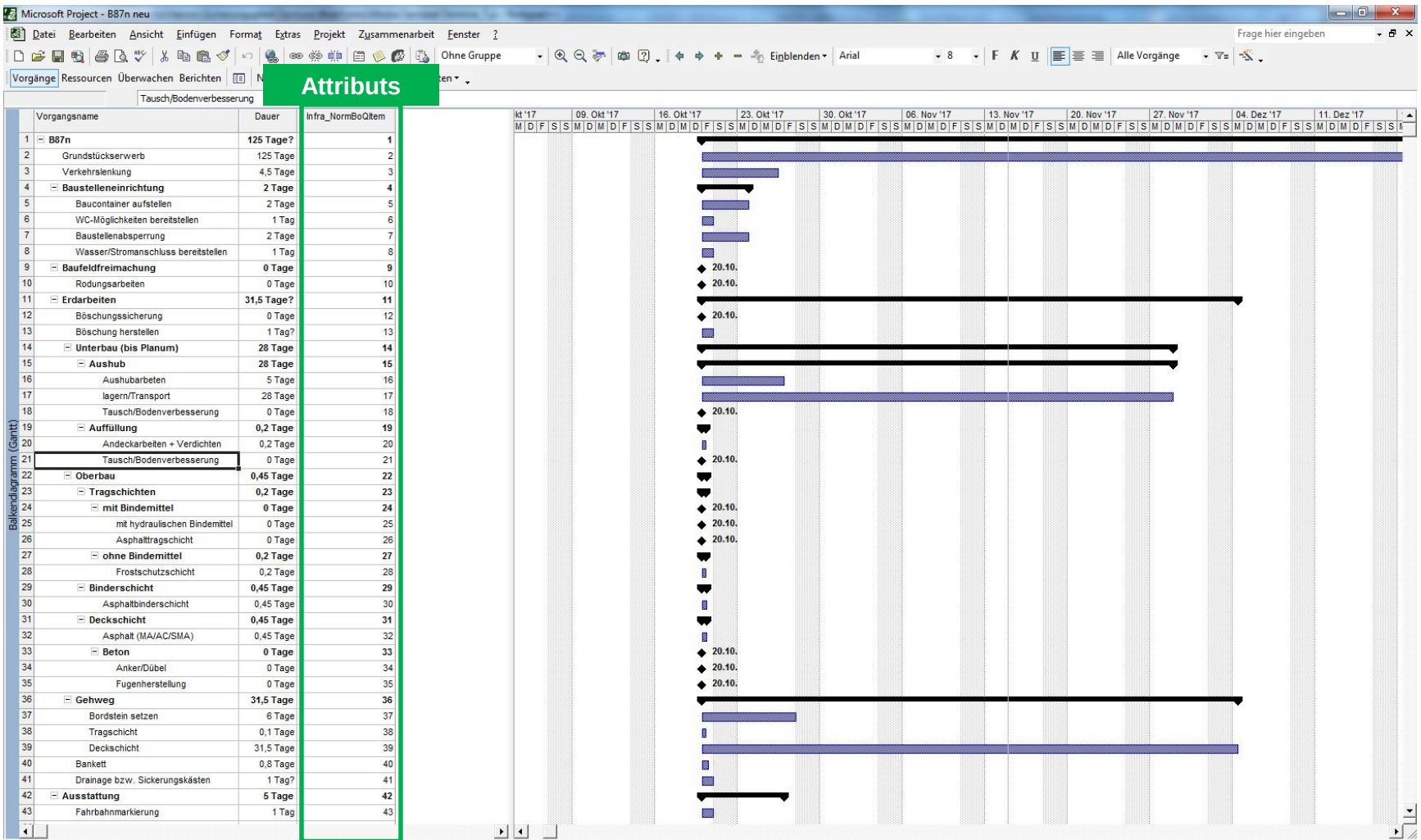
INTERPRETATION AND AUTOMATISATION (4D, 5D)
COORDINATION

Schüßler-Plan



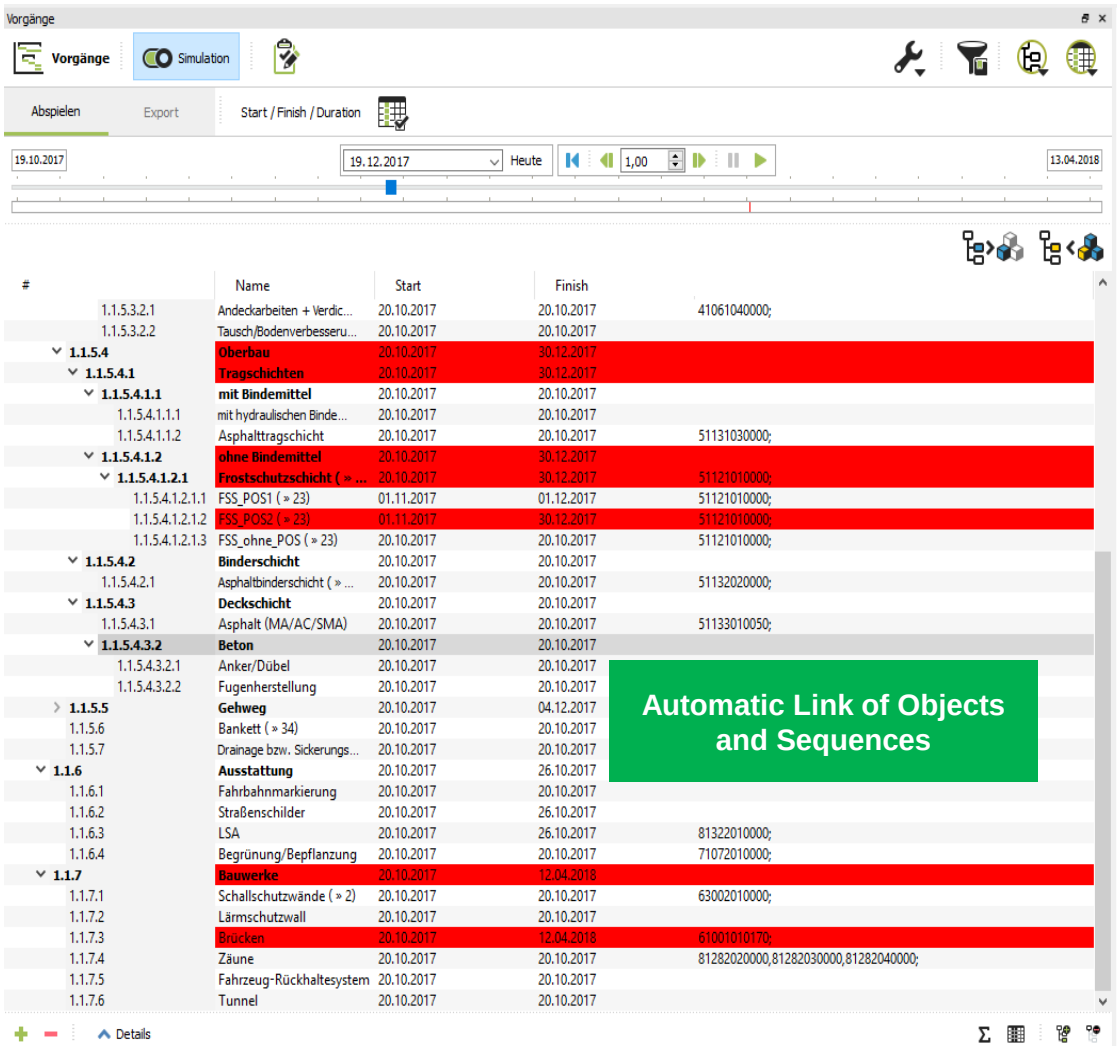
INTERPRETATION AND AUTOMATISATION (4D, 5D)
ATTRIBUTS FOR SCHEDULING

Schüßler-Plan



INTERPRETATION AND AUTOMATISATION (4D, 5D)
AUTOMATED LINKS

Schüßler-Plan

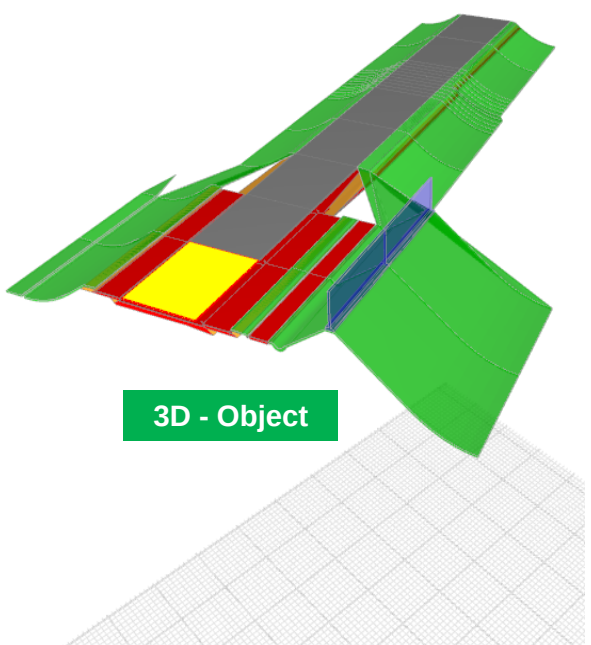


#	Name	Start	Finish	
1.1.5.3.2.1	Andeckarbeiten + Verdic...	20.10.2017	20.10.2017	41061040000;
1.1.5.3.2.2	Tausch/Bodenverbesseru...	20.10.2017	20.10.2017	
1.1.5.4	**Oberbau**	20.10.2017	30.12.2017	
1.1.5.4.1	**Tragschichten**	20.10.2017	30.12.2017	
1.1.5.4.1.1	**mit Bindemittel**	20.10.2017	20.10.2017	
1.1.5.4.1.1.1	mit hydraulischen Binde...	20.10.2017	20.10.2017	
1.1.5.4.1.1.2	Asphalttragschicht	20.10.2017	20.10.2017	51131030000;
1.1.5.4.1.2	**ohne Bindemittel**	20.10.2017	30.12.2017	
1.1.5.4.1.2.1	**Frostschutzschicht (» ...**	20.10.2017	30.12.2017	51121010000;
1.1.5.4.1.2.1.1	FSS_POS1 (» 23)	01.11.2017	01.12.2017	51121010000;
1.1.5.4.1.2.1.2	FSS_POS2 (» 23)	01.11.2017	30.12.2017	51121010000;
1.1.5.4.1.2.1.3	FSS_ohne_POS (» 23)	20.10.2017	20.10.2017	51121010000;
1.1.5.4.2	**Binderschicht**	20.10.2017	20.10.2017	
1.1.5.4.2.1	Asphaltbinderschicht (» ...	20.10.2017	20.10.2017	51132020000;
1.1.5.4.3	**Deckschicht**	20.10.2017	20.10.2017	
1.1.5.4.3.1	Asphalt (MA/AC/SMA)	20.10.2017	20.10.2017	51133010050;
1.1.5.4.3.2	**Beton**	20.10.2017	20.10.2017	
1.1.5.4.3.2.1	Anker/Dübel	20.10.2017	20.10.2017	
1.1.5.4.3.2.2	Fugenherstellung	20.10.2017	20.10.2017	
1.1.5.5	**Gehweg**	20.10.2017	04.12.2017	
1.1.5.6	Bankett (» 34)	20.10.2017	20.10.2017	
1.1.5.7	Drainage bzw. Sickerungs...	20.10.2017	20.10.2017	
1.1.6	**Ausstattung**	20.10.2017	26.10.2017	
1.1.6.1	Fahrbahnmarkierung	20.10.2017	20.10.2017	
1.1.6.2	Straßenschilder	20.10.2017	26.10.2017	
1.1.6.3	LSA	20.10.2017	26.10.2017	81322010000;
1.1.6.4	Begrünung/Bepflanzung	20.10.2017	20.10.2017	71072010000;
1.1.7	**Bauwerke**	20.10.2017	12.04.2018	
1.1.7.1	Schallschutzwände (» 2)	20.10.2017	20.10.2017	63002010000;
1.1.7.2	Lärmschutzwall	20.10.2017	20.10.2017	
1.1.7.3	Brücken	20.10.2017	12.04.2018	61001010170;
1.1.7.4	Zäune	20.10.2017	20.10.2017	81282020000,81282030000,81282040000;
1.1.7.5	Fahrzeug-Rückhaltesystem	20.10.2017	20.10.2017	
1.1.7.6	Tunnel	20.10.2017	20.10.2017	

Automatic Link of Objects and Sequences

Woche 51 - 19.12.2017

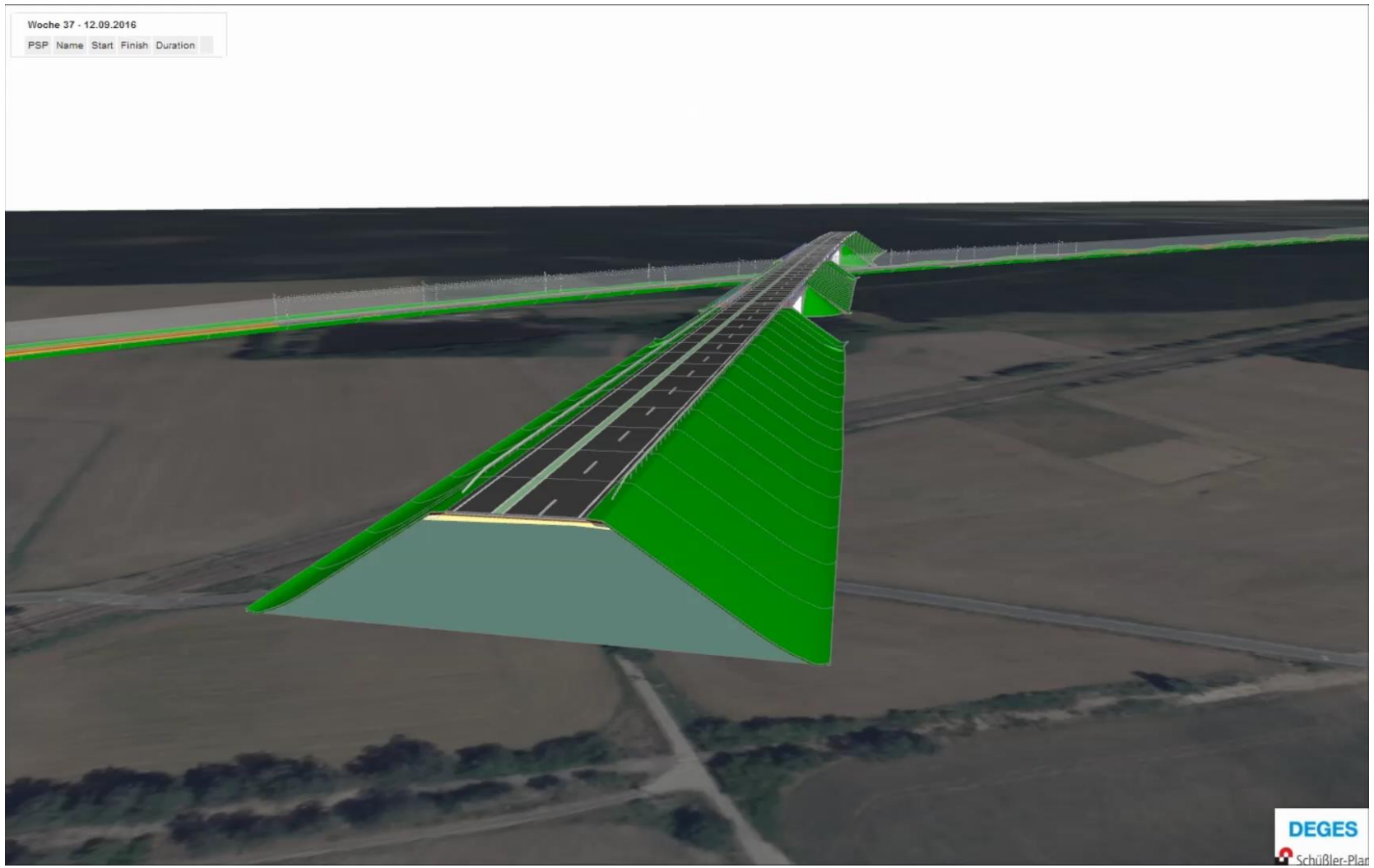
PSP	Name	Start	Finish	Duration	
1	B87n	20.10.2017	12.04.2018	125 Tage	35 %
1.1	Grundstückserwerb	20.10.2017	12.04.2018	125 Tage	35 %
1.5	Erdarbeiten	20.10.2017	30.12.2017	51 Tage	85 %
1.5.4	Oberbau	20.10.2017	30.12.2017	51 Tage	85 %
1.5.4.1	Tragschichten	20.10.2017	30.12.2017	51 Tage	85 %
1.5.4.1.2	ohne Bindemittel	20.10.2017	30.12.2017	51 Tage	85 %
1.5.4.1.2.1	Frostschutzschicht	20.10.2017	30.12.2017	51 Tage	85 %
1.5.4.1.2.1.2	FSS_POS2	01.11.2017	30.12.2017	43 Tage	82 %
1.7	Bauwerke	20.10.2017	12.04.2018	125 Tage	35 %
1.7.3	Brücken	20.10.2017	12.04.2018	125 Tage	35 %



3D - Object

INTERPRETATION AND AUTOMATISATION (4D, 5D)
VISUAL CONTROL OF CONSTRUCTION SEQUENCE

Schüßler-Plan



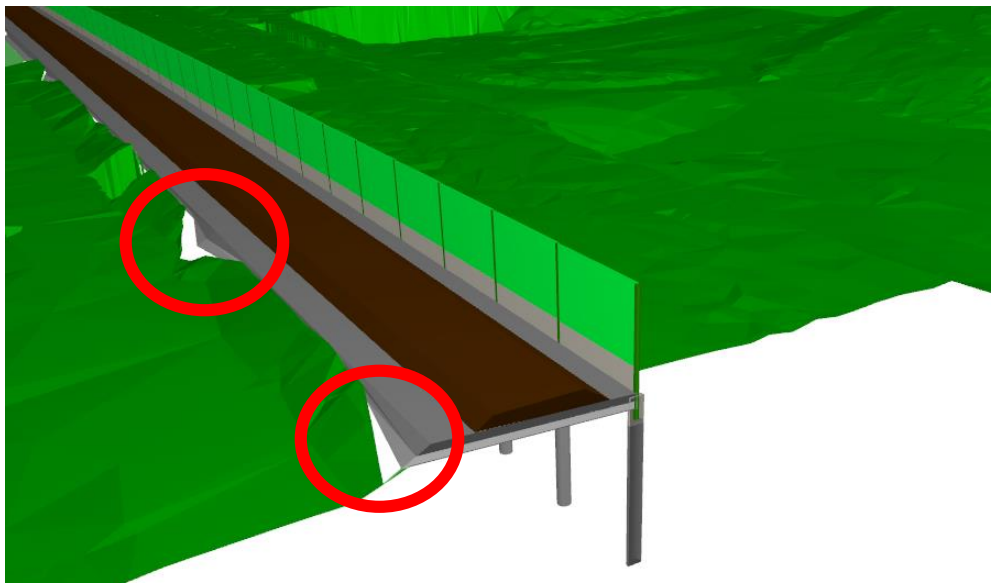
Schüßler-Plan

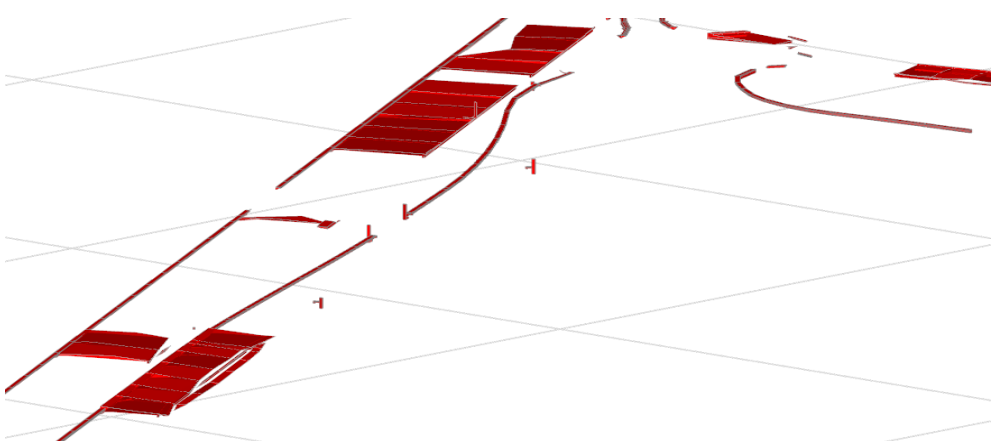
Qualtity Control

- Errors During Automatisation Process need to be checked and solved
- Quality Control of Model for

  Geometric Quality (LOG)

  Information Quality (LOI)
- Needs to be automated (~500.000 Objects)





Schüßler-Plan

Modeling
(Design Software)

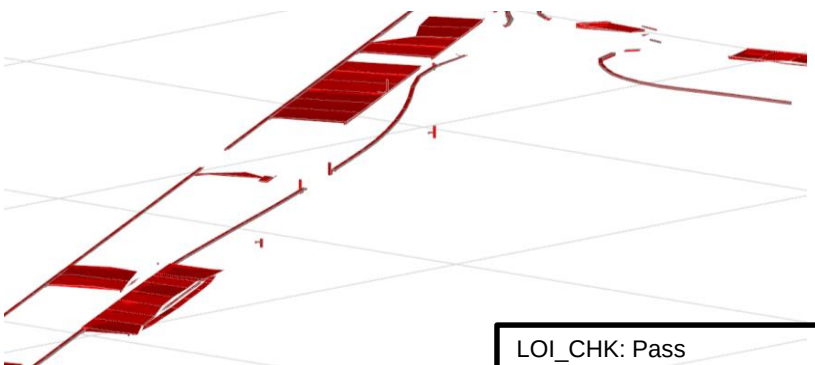
Coordination
(Coordination Software)

Final Attribute Definition
(Design Software & Coordination Software)

Quality Control of Model
(Coordination Software or Other Software)

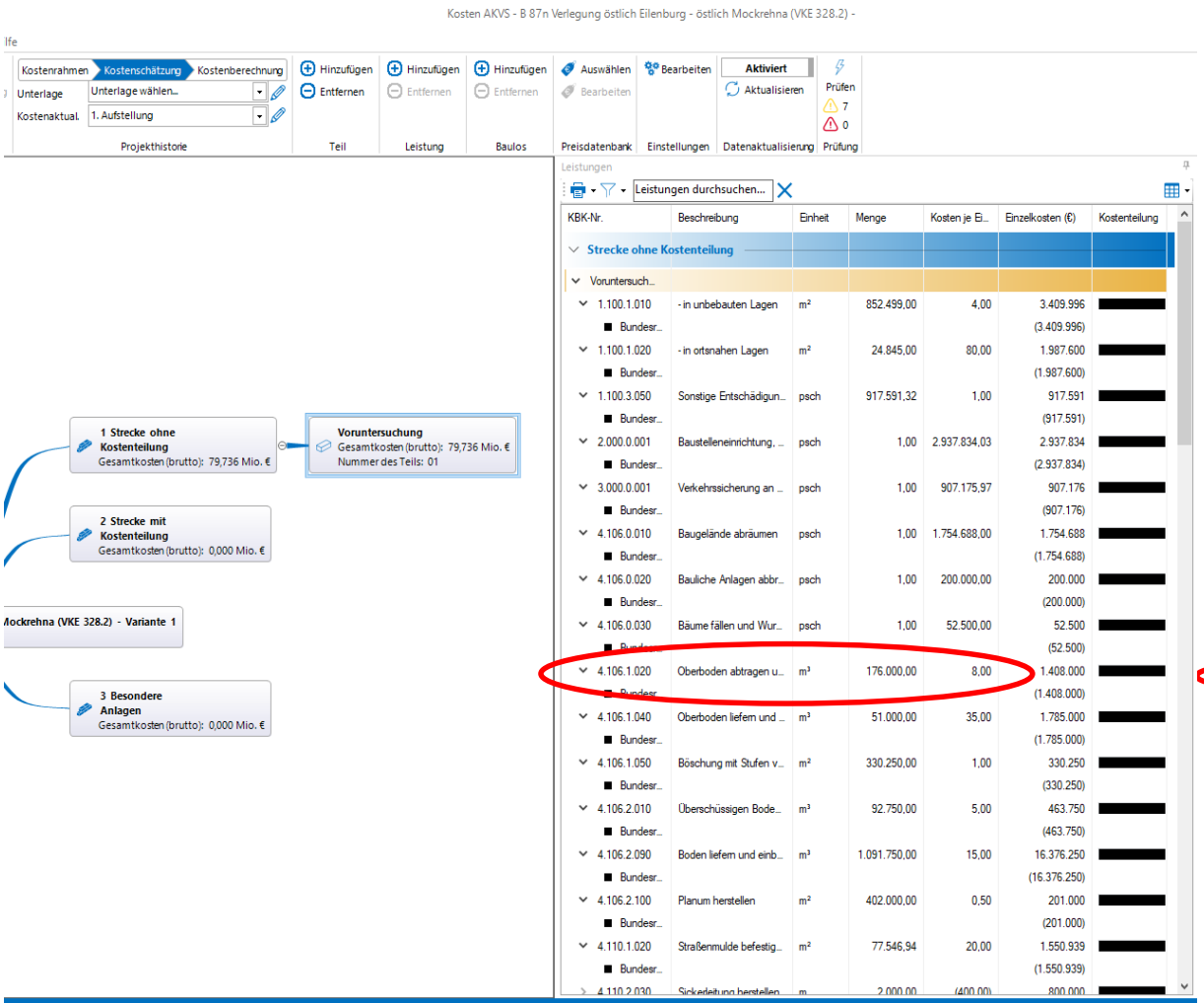
Interpretation and Automatisation
(Other Software)

Results of Quality Check



INTERPRETATION AND AUTOMATISATION (4D, 5D)
COST ESTIMATION ACCORDING TO AKVS 2014

Schüßler-Plan

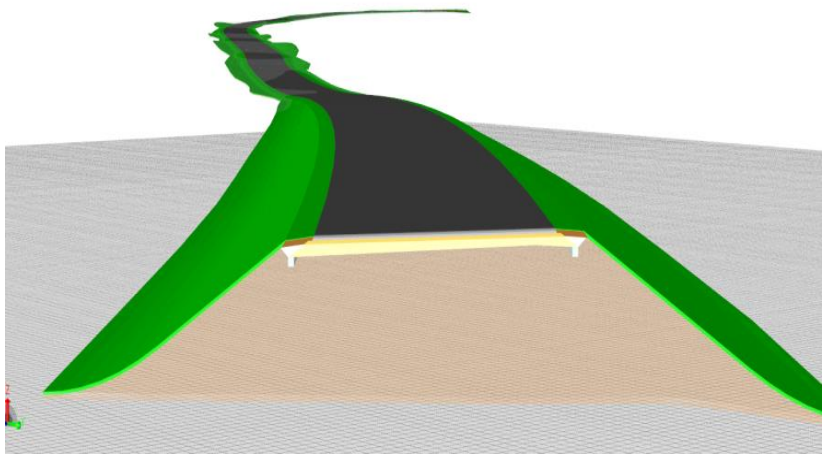


Berechnung der Einzelkosten				Blatt E
Bezeichnung des Projektes Bezeichnung des Teilprojektes Bezeichnung der Straßenbaumaßnahme	B87 Voruntersuchung			
Bezeichnung des Bauwerks/ der Leistung	Variante 1			
Stationierung				
Länge: 15,654 km	Kostenschätzung	Projis-/Identnummer: 11922-V1	Bauwerks-Nr. (ASB):	
Träger der Baumaßnahme:	Bundesrepublik Deutschland			

Bezeichnung des Hauptteils:	1 Strecke ohne Kosteneilung			
Bezeichnung des Teils:	01 Voruntersuchung			
KBK - NR.	Einheit	Beschreibung	Menge	Kosten je Einheit €	Einzel-kosten €
4. Erdbau (Untergrund, Unterbau, Entwässerung von Straßen), Bodenerkundung, Entsorgung					
4.106 Erdbau					
4.106.0 Vorarbeiten					
4.106.0.010	psch	Baugelände abräumen 2€ je m² Grunderwerbsfläche	1	1.754.688,00	1.754.688
4.106.0.020	psch	Bauliche Anlagen abbrechen Pauschale	1	200.000,00	200.000
4.106.0.030	psch	Bäume fällen und Wurzelstöcke roden 2100m Trassenlänge durch Waldgebiet zu 25.000€/m	1	52.500,00	52.500
4.106.1 Oberboden					
4.106.1.020	m³	Oberboden abtragen und beseitigen	176.000	8,00	1.408.000
4.106.1.040	m³	Oberboden liefern und andecken	51.000	35,00	1.785.000
4.106.1.050	m²	Böschung mit Stufen versehen	330.250	1,00	330.250
4.106.2 Bodenbewegung					
4.106.2.010	m³	Überschüssigen Boden der Bodenklasse 2 bis 5 lösen und weiterverwenden	92.750	5,00	463.750
4.106.2.090	m³	Boden liefern und einbauen	1.091.750	15,00	16.376.250
4.106.2.100	m²	Planum herstellen	402.000	0,50	201.000
4.110 Entwässerung von Straßen					
4.110.1 Mulden- und Grabenbefestigung					
4.110.1.020	m²	Straßenmulde befestigen	77.546,94	20,00	1.550.939
04.110.2 Sickeranlagen					
4.110.2.030	m	Sickerleitung herstellen Herstellung eines Sickerbeckens (500m³) bei km 1+550 zu 100€/m³ Herstellung einer Entwässerungsleitung (DN300/400) der Länge 1.500m zu 500€/m	2.000	400,00	800.000

INTERPRETATION AND AUTOMATISATION (4D, 5D)
BILL OF QUANTITY / LV IN EARLY PHASES POSSIBLE

Schüßler-Plan



Struktur	Schlüssel	Matchkey	Bezeichnung	
	-		**Ausstattung**	
	1		Deckschicht	
§	1.10	5113303012	Asphalt	QTO(Typ:="Volumen";ME:="m³")
§	1.20	5113202013	Binder	QTO(Typ:="Volumen";ME:="m³")
§	1.30	5113104013	Tragschicht	QTO(Typ:="Volumen";ME:="m³")
§	1.40	5112202012	STS	QTO(Typ:="Volumen";ME:="m³")
§	1.50	5112101016	FSS	QTO(Typ:="Volumen";ME:="m³")

Struktur	Schlüssel	Bezeichnung	Menge	ME
	-	**Ausstattung**		
	1	Deckschicht		
§	1.10	Asphalt	390,736	m3
§	1.20	Binder	785,208	m3
§	1.30	Tragschicht	988,424	m3
§	1.40	STS	1.561,885	m3
§	1.50	FSS	4.824,999	m3

- Attributes are interpreted
- Content is stored for Automatisation
- Documents and Dataexchange

  for Bill of Quantity and Bidding

INTERPRETATION AND AUTOMATISATION (4D, 5D)
BILL OF QUANTITY / LV IN EARLY PHASES POSSIBLE

Schüßler-Plan

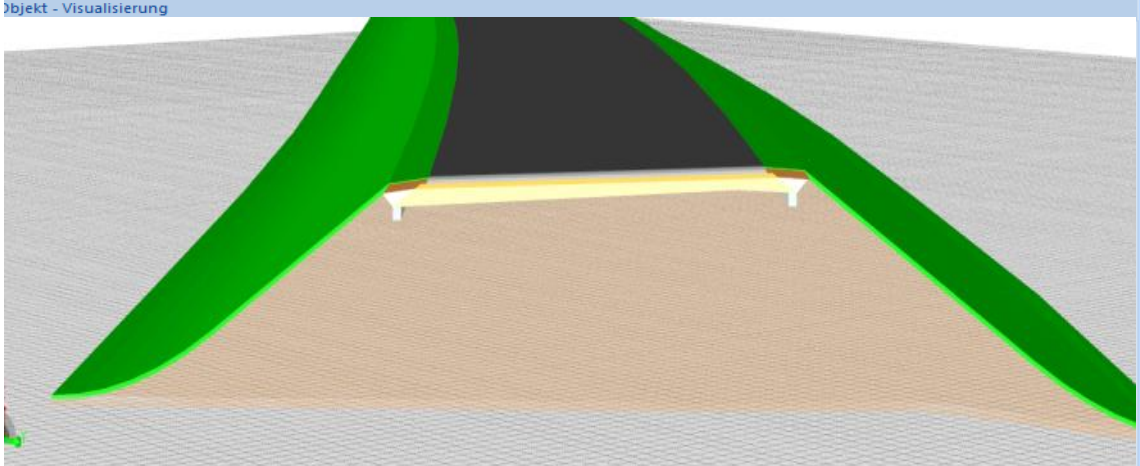
Bearbeitung (Klassisch) | **Bearbeitung (Modellorientiert)** | Auswertung

LV: 1 - Straßenbau

Struktur	OZ	Kurz-Info	Kurztext	Menge	ME	Einheitspreis	Gesamtbetrag
	1		**Straßenbau**				**195.368,00**
	1.		Allgemeine Leistungen				0,00
	2.		B 87 Streckenbau				195.368,00
	2. 0.		Baufeldfreimachung				0,00
	2. 1.		Erdbau				0,00
	2. 2.		Schichten ohne Bindemittel				0,00
	2. 3.		Asphaltbau				195.368,00
§	2. 3. 10.		Asphalt	390,736	m3	500,00	195.368,00
§	2. 3. 20.		Binder	785,208	m3	0,00	0,00
§	2. 3. 30.		Tragschicht	988,424	m3	0,00	0,00
§	2. 3. 40.		STS	1.561,885	m3	0,00	0,00
§	2. 3. 50.		FSS	4.824,999	m3	0,00	0,00
	2. 4.		Pflaster, Borde				0,00
	2. 5.		Entwässerung für Straßen				0,00
	2. 6.		Bauwerke, Durchlässe, Fundamente				0,00
	2. 7.		Landschaftsbau				0,00
	3.		Leistungen Kabeltiefbau MITNETZ				0,00

Price Definition for Bidding Documents in LPH 6 Calculation according to AKVS or KGK (KKK) difficult

Objekt - Visualisierung



Langtext | Objekt - Visualisierung

Mengensplit

Art	Objekte	Objekte Bezeichnung	LV-Menge	VA-Menge
▶ ame: 2. 3. 10.			390,736	390,736
Split	1.1.1.1.1.1	0_000-10_000	5,010	5,010
Split	1.1.1.1.2.1	10_000-20_000	5,010	5,010
Split	1.1.1.1.11.1	100_000-110_000	5,008	5,008
Split	1.1.1.1.12.1	110_000-120_000	5,012	5,012
Split	1.1.1.1.13.1	120_000-130_000	5,012	5,012
Split	1.1.1.1.14.1	130_000-140_000	5,014	5,014
Split	1.1.1.1.15.1	140_000-150_000	5,012	5,012
Split	1.1.1.1.16.1	150_000-160_000	5,012	5,012
Split	1.1.1.1.17.1	160_000-170_000	5,010	5,010
Split	1.1.1.1.18.1	170_000-180_000	5,009	5,009
Split	1.1.1.1.19.1	180_000-190_000	5,010	5,010
Split	1.1.1.1.20.1	190_000-200_000	5,011	5,011
Split	1.1.1.1.3.1	20_000-30_000	5,010	5,010
Split	1.1.1.1.21.1	200_000-210_000	5,009	5,009
Split	1.1.1.1.22.1	210_000-220_000	5,009	5,009
Split	1.1.1.1.23.1	220_000-230_000	5,011	5,011
Split	1.1.1.1.24.1	230_000-240_000	4,975	4,975
Split	1.1.1.1.25.1	240_000-250_000	5,008	5,008
Split	1.1.1.1.26.1	250_000-260_000	5,015	5,015
Split	1.1.1.1.27.1	260_000-270_000	5,013	5,013

AGENDA

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1. BIM from Clients and Contractors Perspective
2. Requirements for BIM in Road and Infrastructure Design
3. Pilot Project B87N
4. Route Finding, Modeling and LOI
5. Model and alternative Designs
6. Interpretation and Automatisation (4D, 5D)
7. Lessons Learned and Discussion

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B87N

- Fundamentals in correct Format and Coordinate System are necessary for fast Results
- Environmental Basics and Contractor should be integrated early in Project
- Traffic Planing can be automated to a high Degree and many Alternatives Checked
- Orientation in 3D-Space needs Support (Viewpoints, 3D-Objects)
- Client and Contractors want to be too precise in the Beginnig

  Focus on Objectives of Design Phase

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General

- Collaboration between different Parties is the Key and the Barrier for BIM
- Higher Degree of Interoperability for a better Import and Export of Models and Data between different Products
- Adoption of Design Changes between different Software Products (i.e. Bridge/Tunnel and Traffic Road)
- Extent Application for variety of Projects and keep it simple → General Forms for Engineers, Customized Surfaces of Software

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General

- Common Vocabulary for the Exchange of Models and Information is needed (Basic LOI)
- New Definitions of Documentation Requirements for Drawings from 3D-Models
- Regulations for Cost Evaluation in different Design Phases should have same Structure
- VOB Definitions for Quantity Evaluation should be reconsidered

Thank you for your Attention!

Contact: **bim@schuessler-plan.de**