



ITA TUNNELLING
AWARDS 2017



Implementing BIM concepts on Karavanke tunnelling project

Marko Žibert M.Sc.Civ.Eng. – Head of tunnelling, iC group Ljubljana



ITA TUNNELLING
AWARDS 2017



Stakeholders

PGK - Planungsgemeinschaft Karawankentunnel

ASFINAG

laabmayr

IGT GEOTECHNIK UND TUNNELBAU
Ziviltechniker Gesellschaft m.b.H.

iC consulenter

DARS

DRI
upravljanje investicij

Projektantska skupina
KARAVANKE

Elea iC

LIRGO

Geoportal

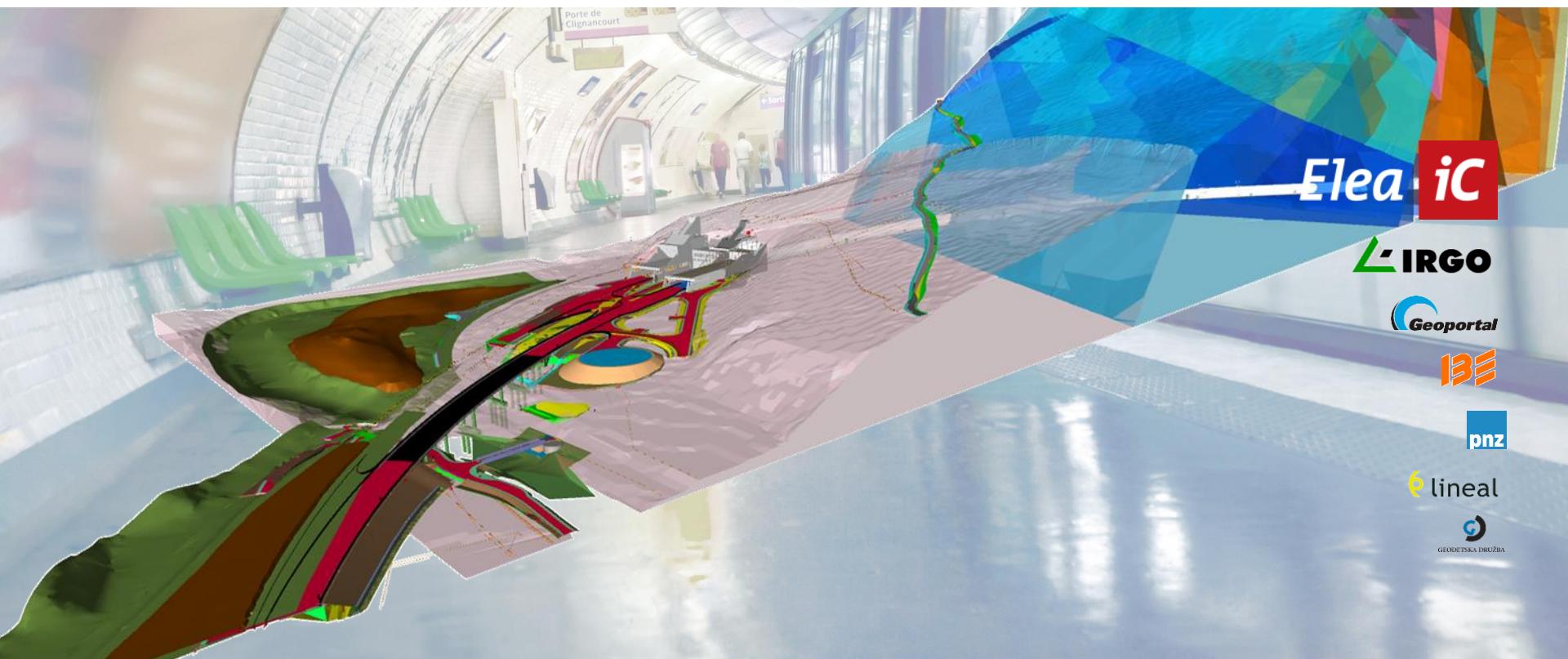
IBE

pnz

lineal

GEO

GEODETSKA DRUŽBA



ITA
AITES

PARIS – 15 November 2017

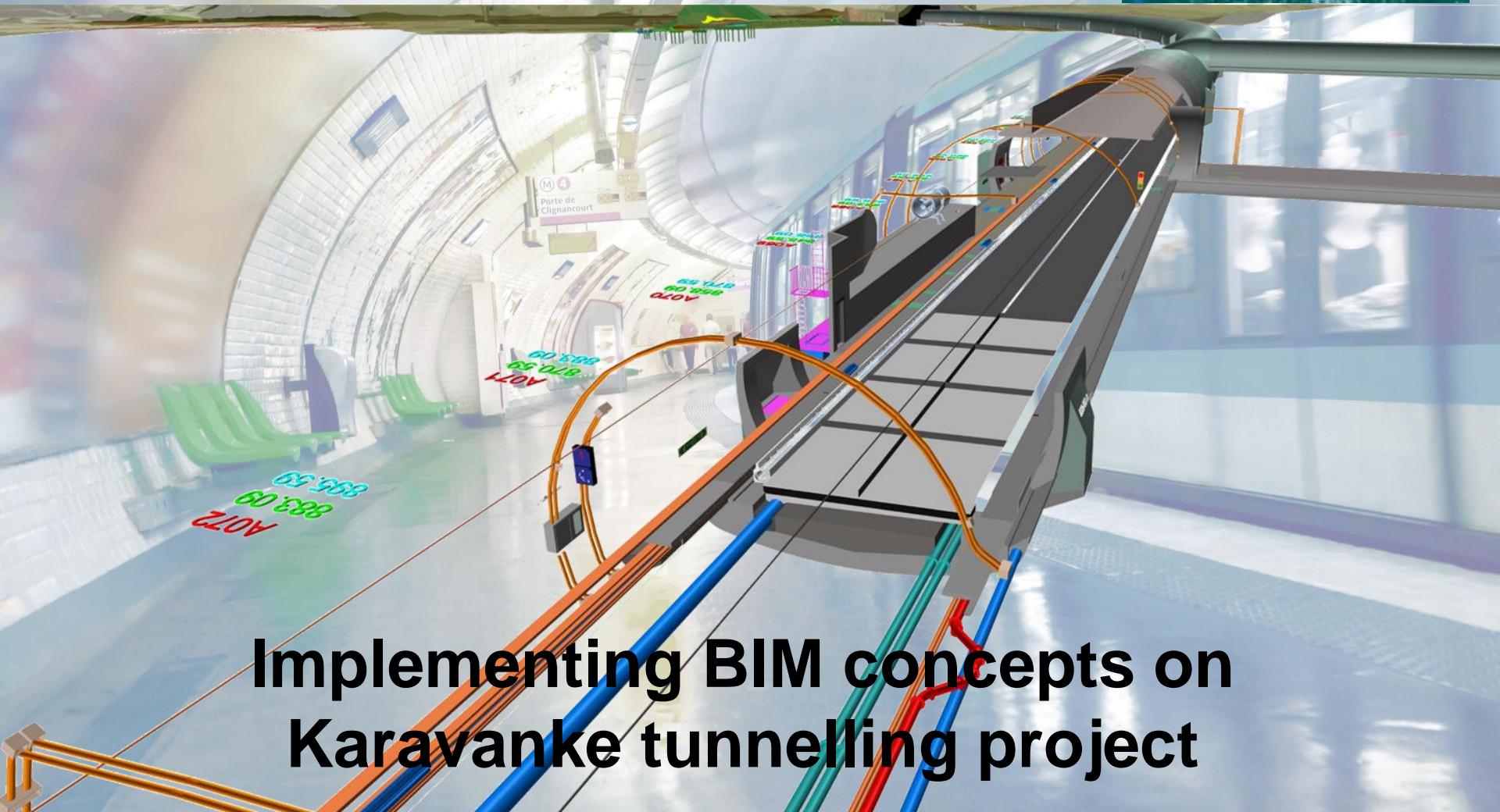
Implementing BIM concepts on Karavanke tunnelling project –
Marko Žibert

iC



ITA TUNNELLING
AWARDS 2017

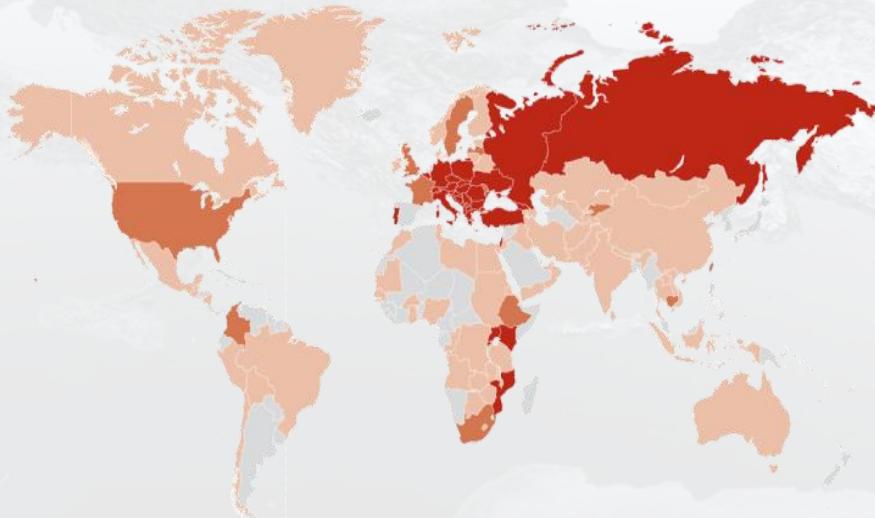
TECHNICAL
PROJECT INNOVATION
- OF THE YEAR -



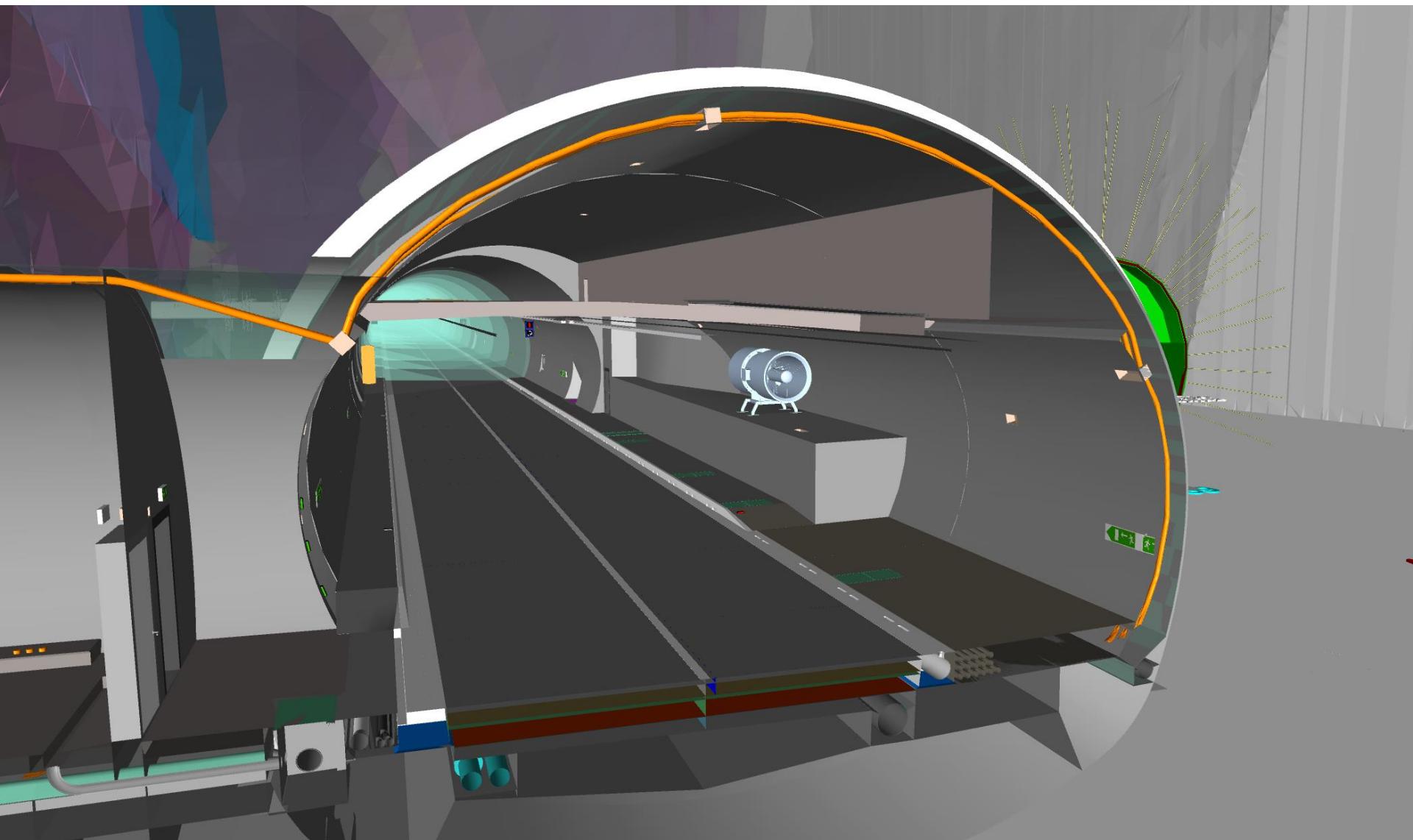
Implementing BIM concepts on Karavanke tunnelling project



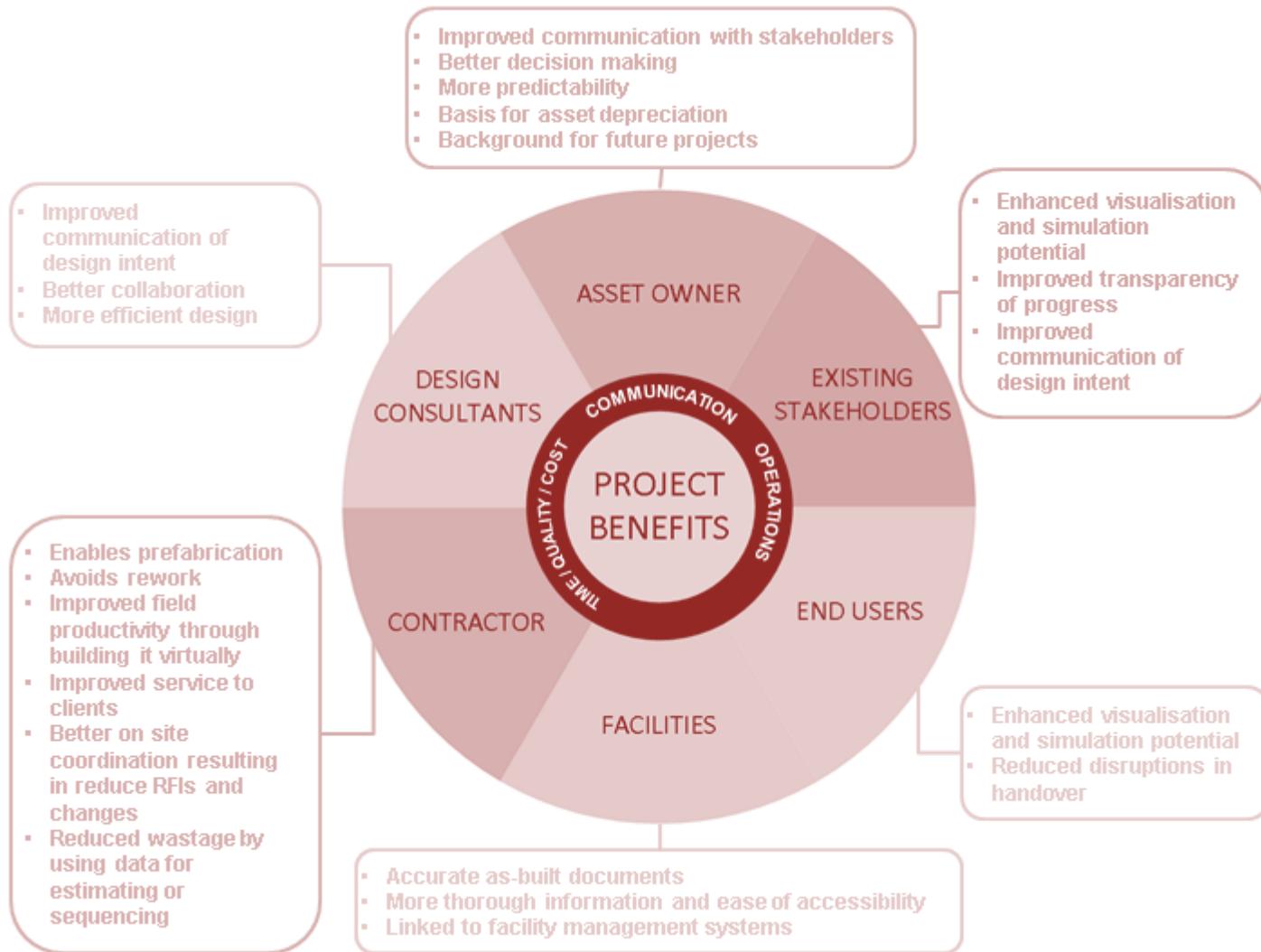
With our global know-how and competencies on site as well as **more than 450 colleagues** and our experience **in 100 countries** we provide solutions for projects worldwide.



Why using BIM? Are there any benefits?



Why using BIM? Are there any benefits?

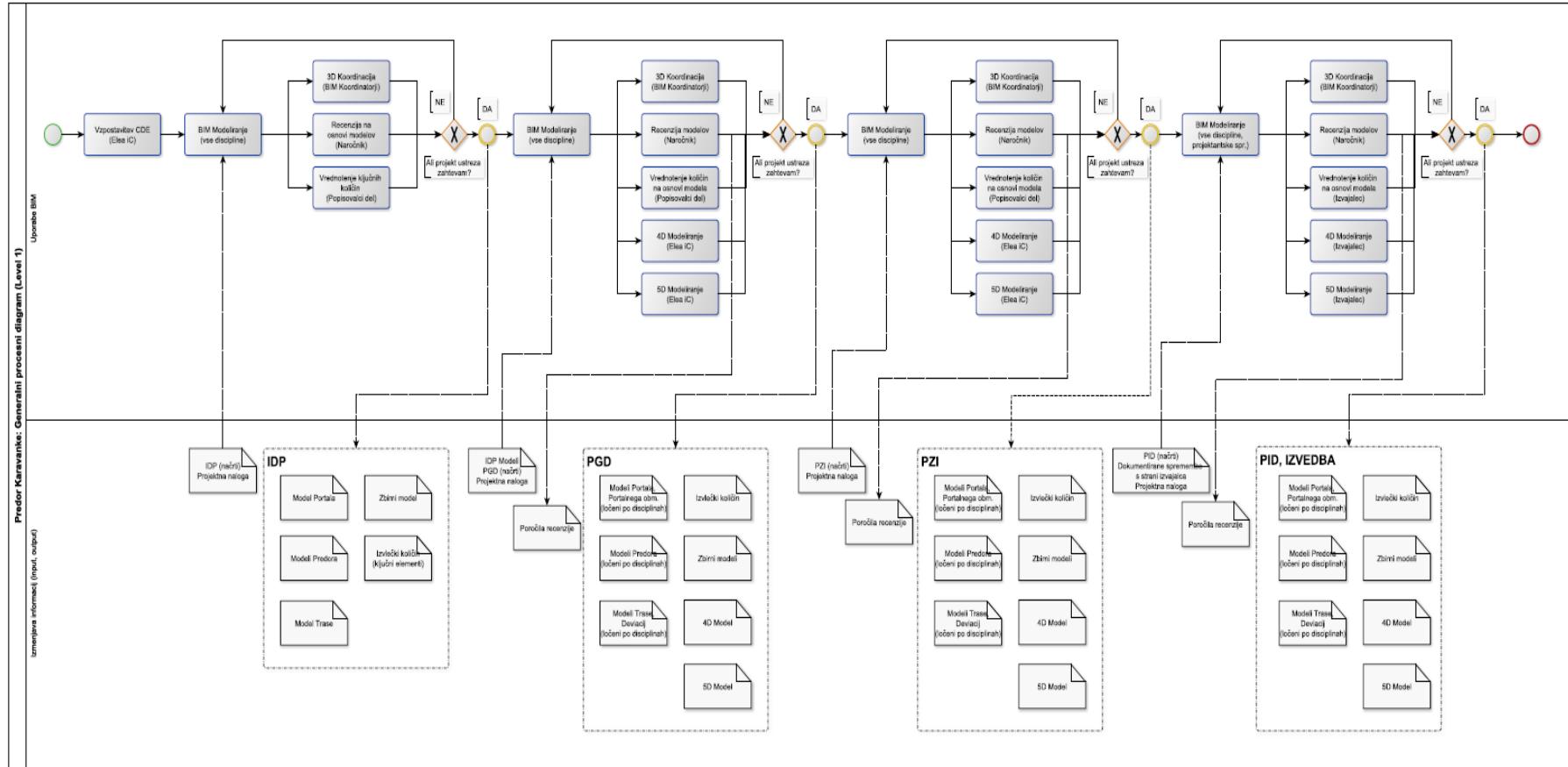


BIM Implementation planning

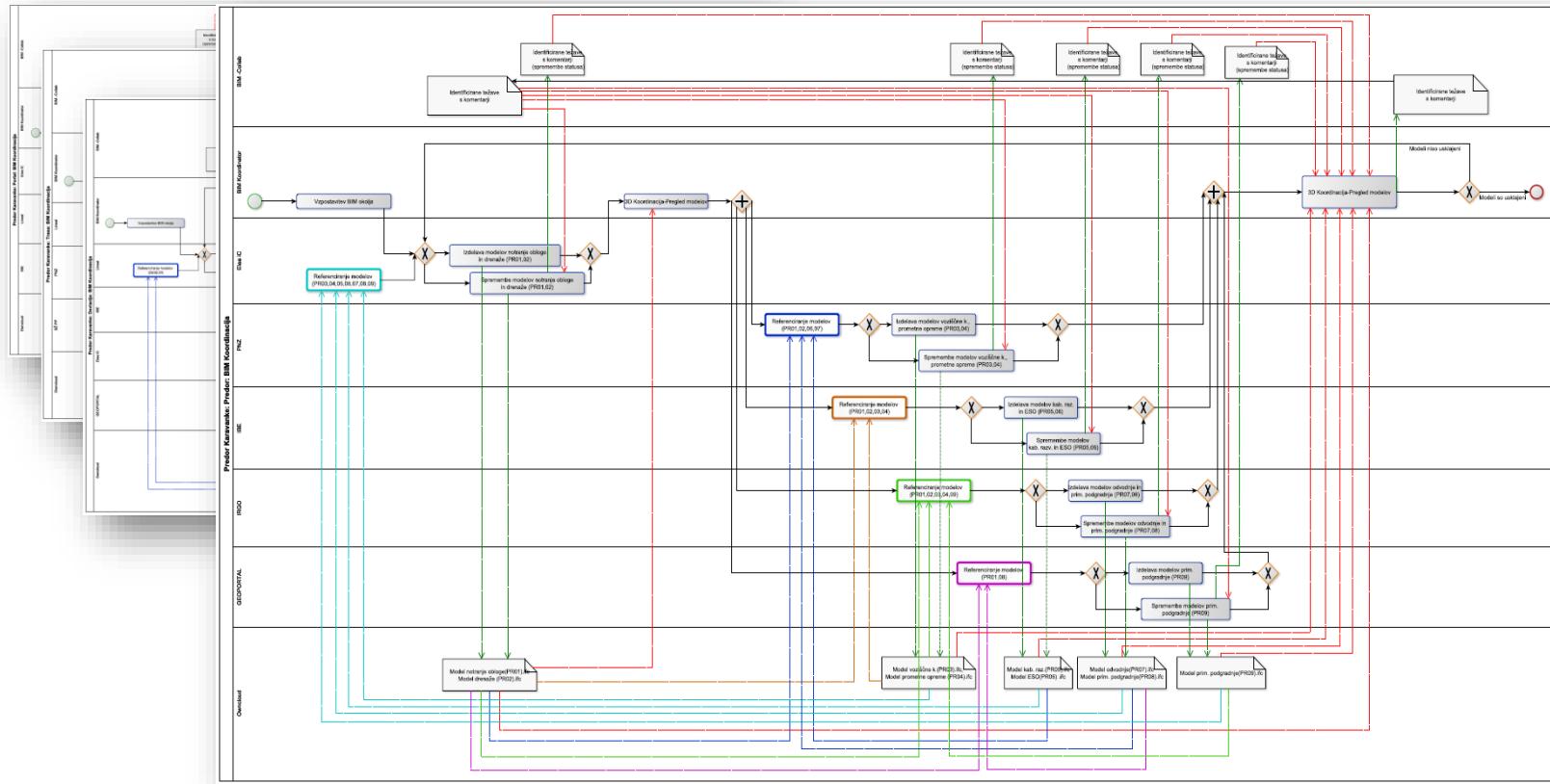
Behind the Scenes



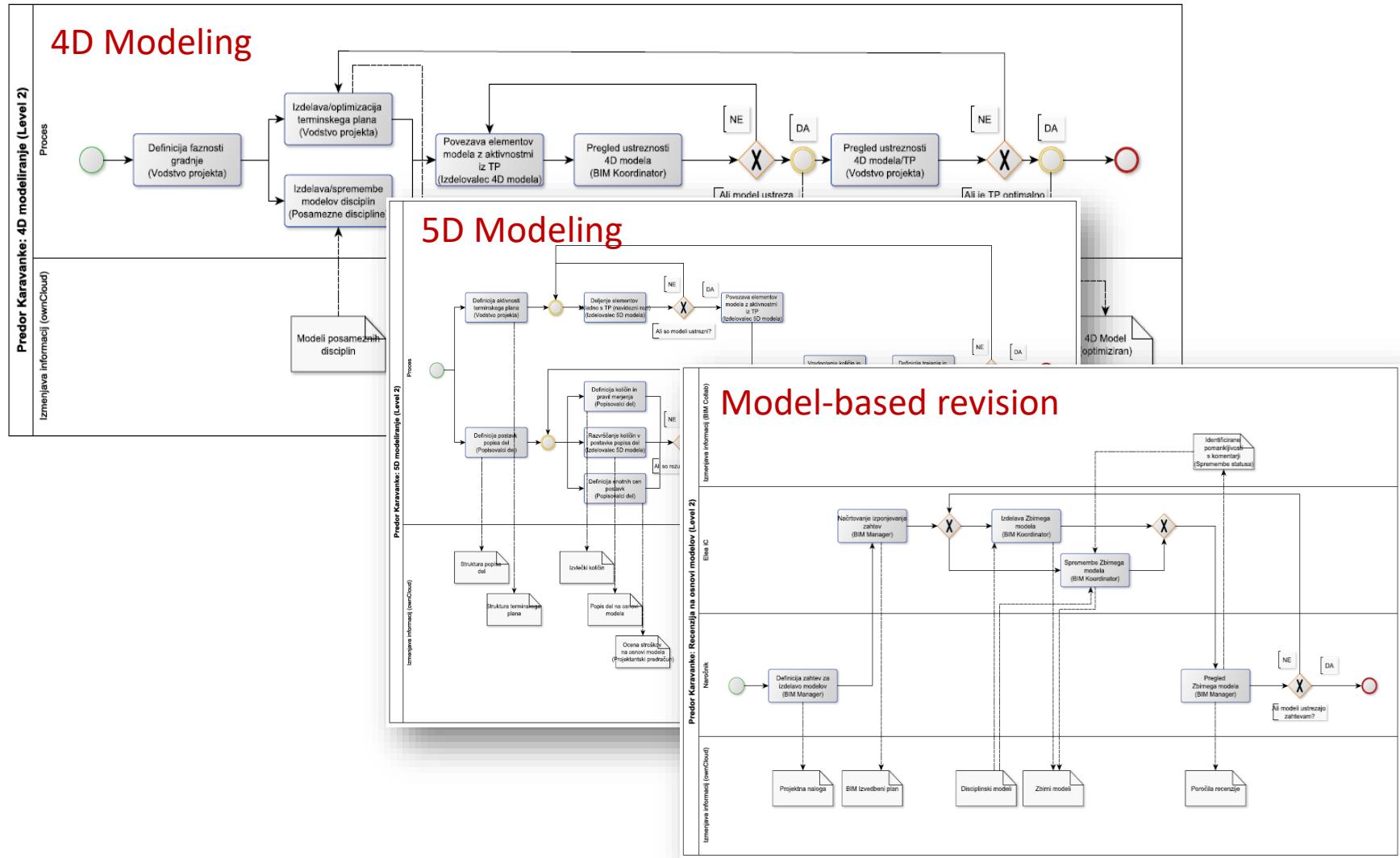
Definition of processes (BIM Overview process map)



Definition of processes (BIM Coordination)



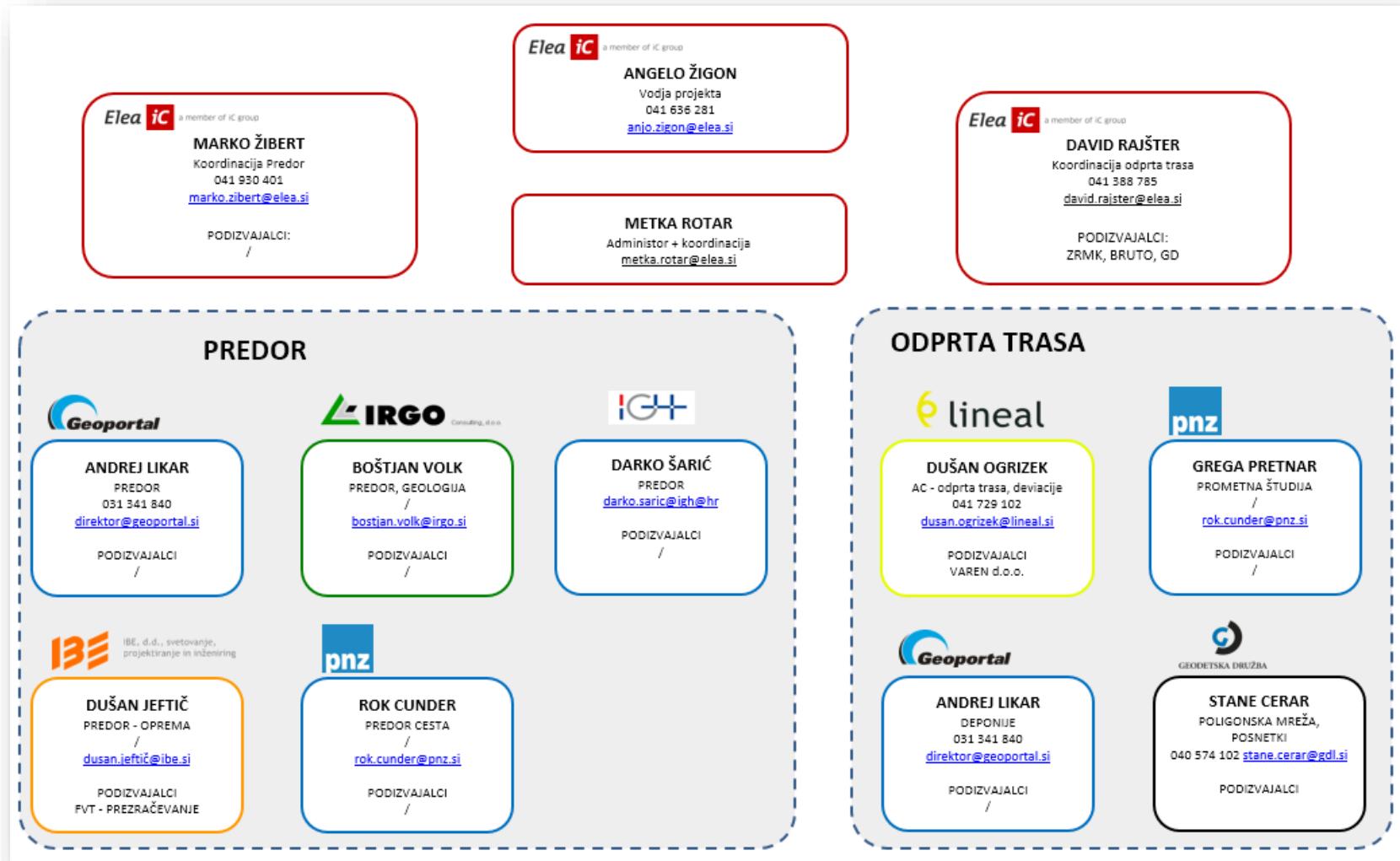
Definition of processes (Other detailed process maps)



Communication, Collaboration and Coordination



Project organization in the design stage



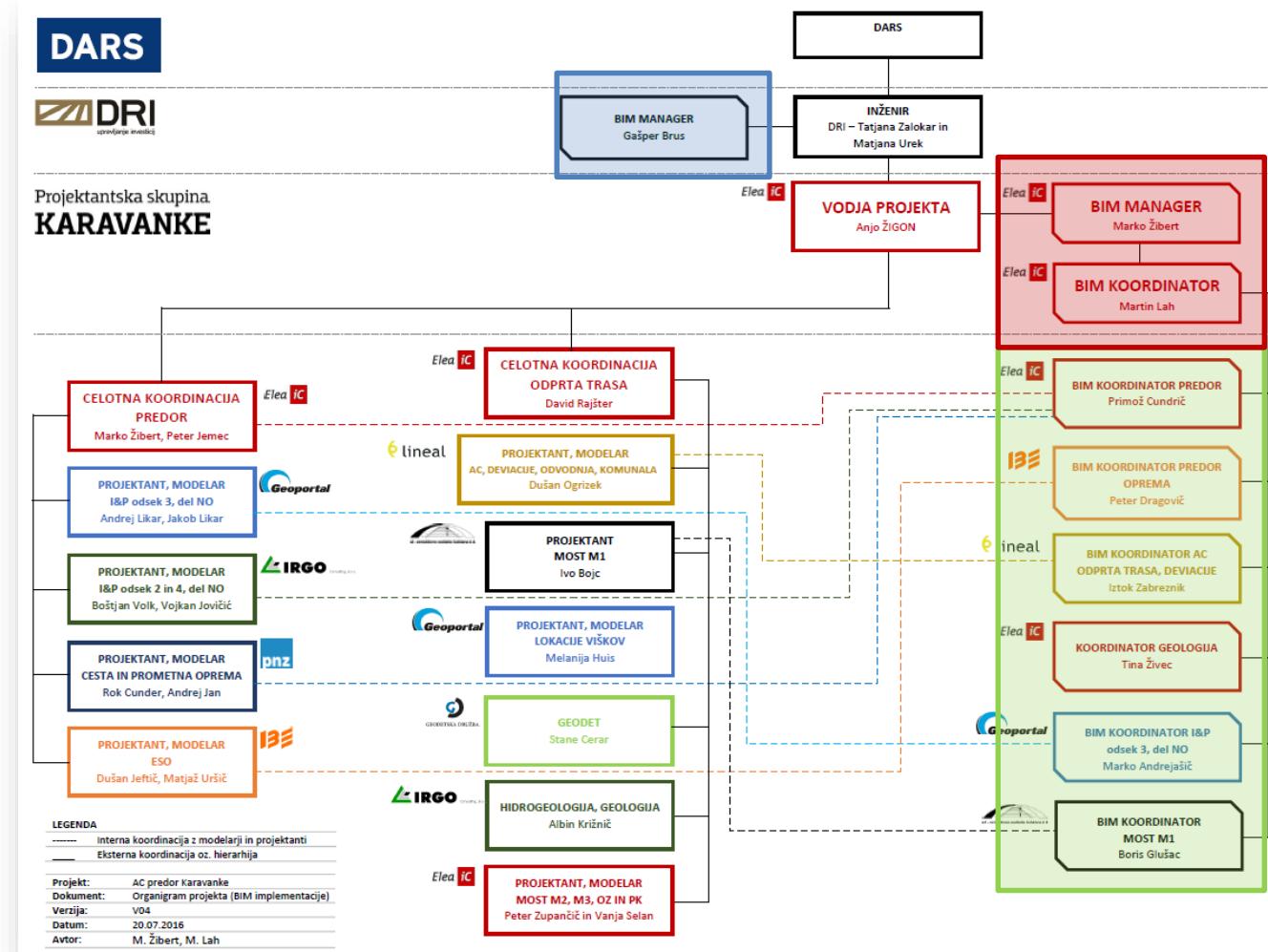
7 joint-venture partners | 15 companies | 60 engineers | > 120.000 hours

Project organization on BIM side

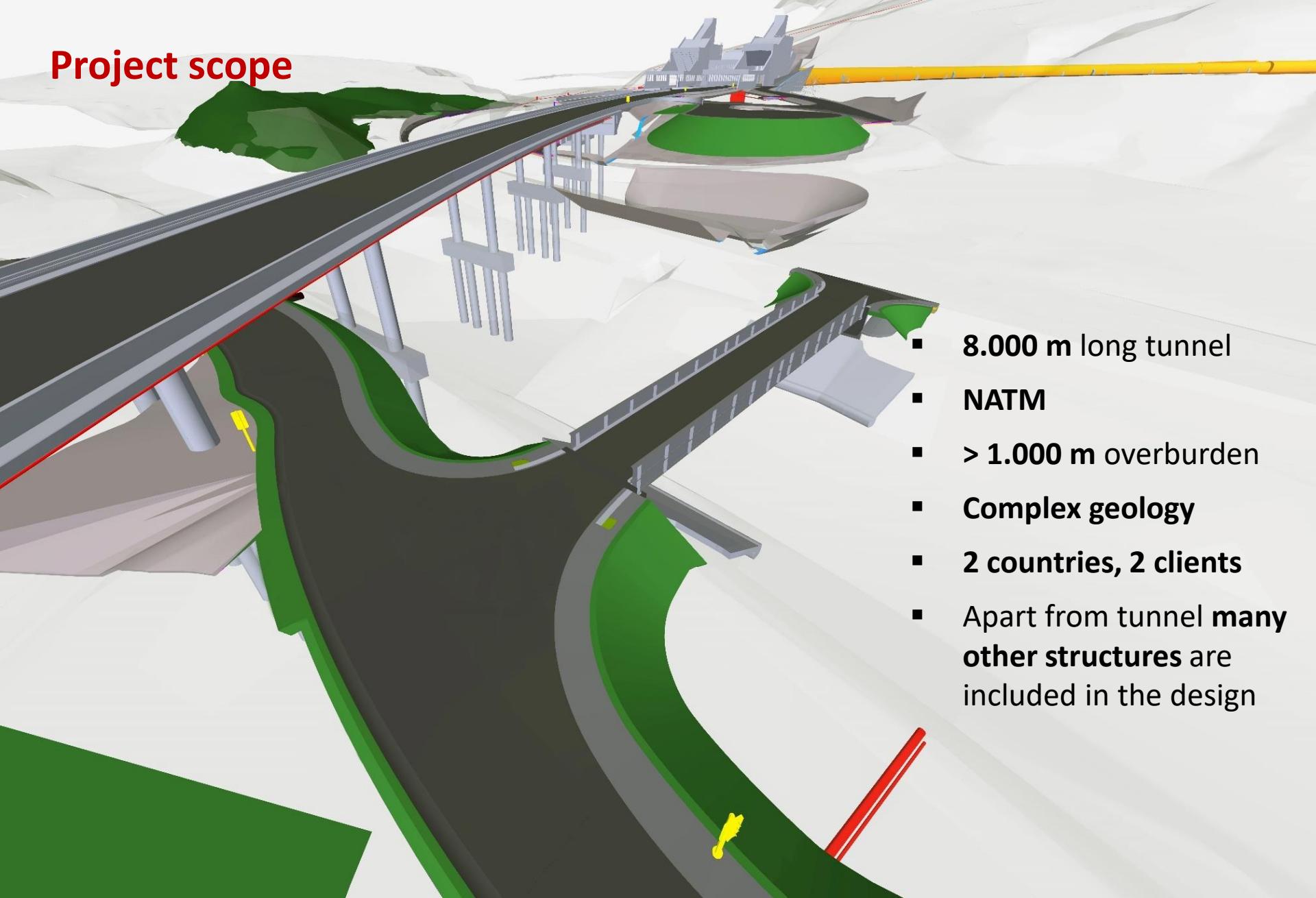
BIM Manager

BIM Overall coordination

BIM Discipline/
Trade coordination



Project scope



- **8.000 m long tunnel**
- **NATM**
- **> 1.000 m overburden**
- **Complex geology**
- **2 countries, 2 clients**
- Apart from tunnel **many other structures** are included in the design

Summary of BIM related activities

	2014	2016
Start of activities:	2014	2016
No. of involved companies:	9	3
No. of partial models:	160	29
3D BIM and Coordination:	✓	✗?
4D BIM:	✓	✗?
5D BIM:	✗?	✓
6D BIM:		
LoD:	300 - 400	300
LoL:	400	500

The Strategy | SLOVENIAN SIDE

KARAVANKE TUNNEL

TRADITIONAL APPROACH

Project assignment Design phase Execution Operation

↓ ↓ ↓ ↓ ↓

3D BIM
(Design team)

4D, 5D BIM
(Design team)

3D BIM
(Design team)

4D, 5D
BIM
(Contractor)

?

BIM COORDINATION

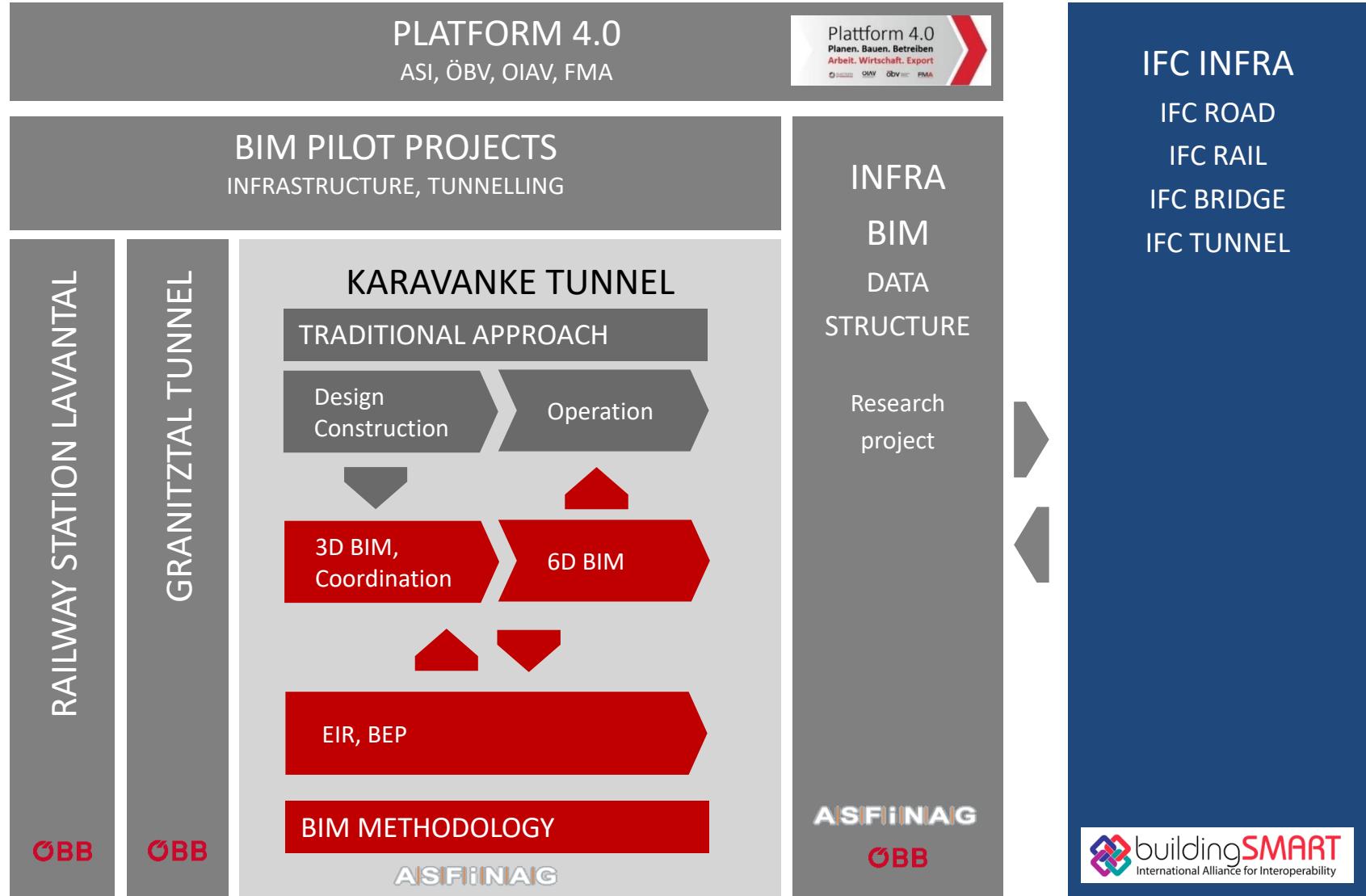
4D, 5D
BIM
(Supervision)

BIM STRATEGY, EIR

BIM EXECUTION PLAN (BEP)

BIM METHODOLOGY

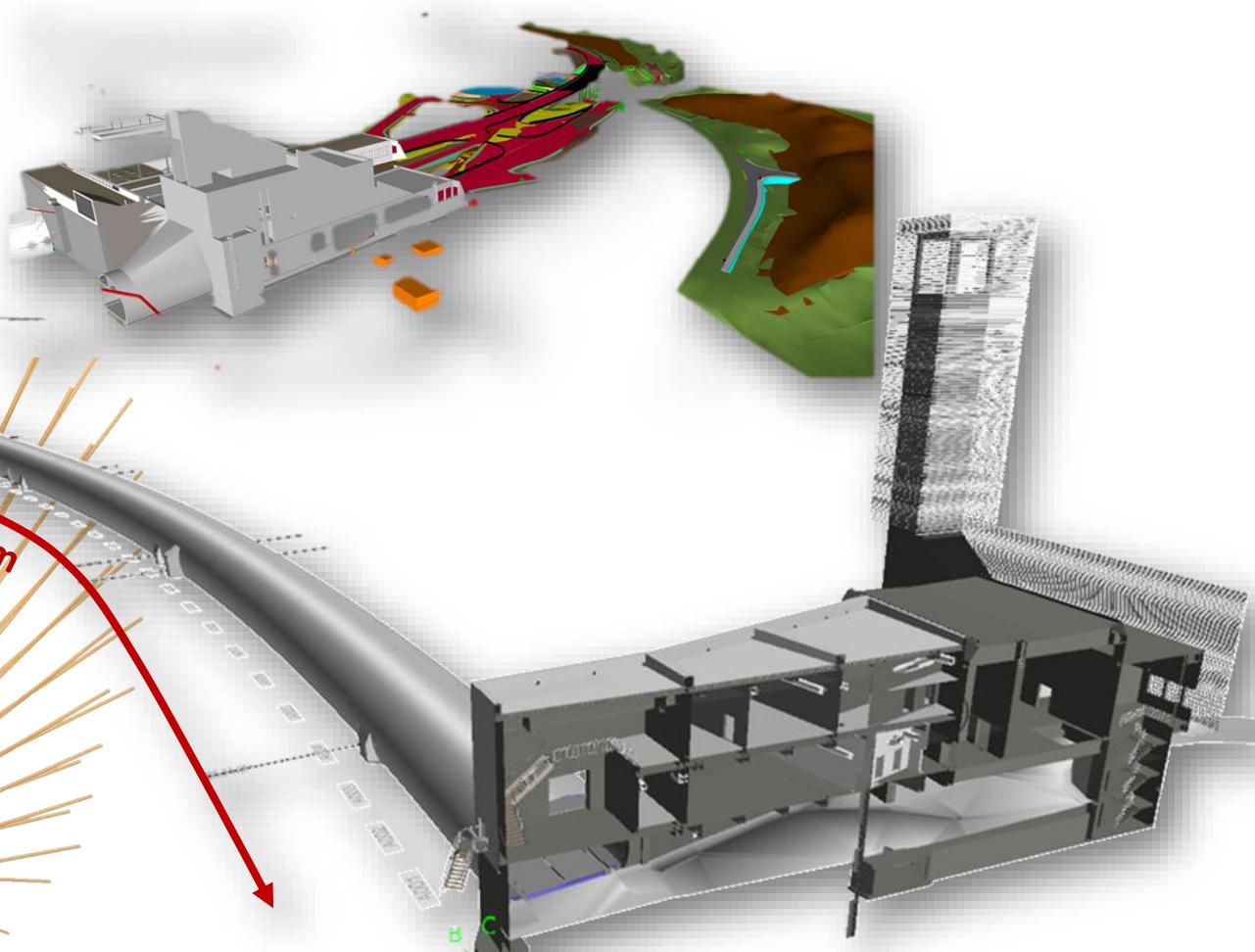
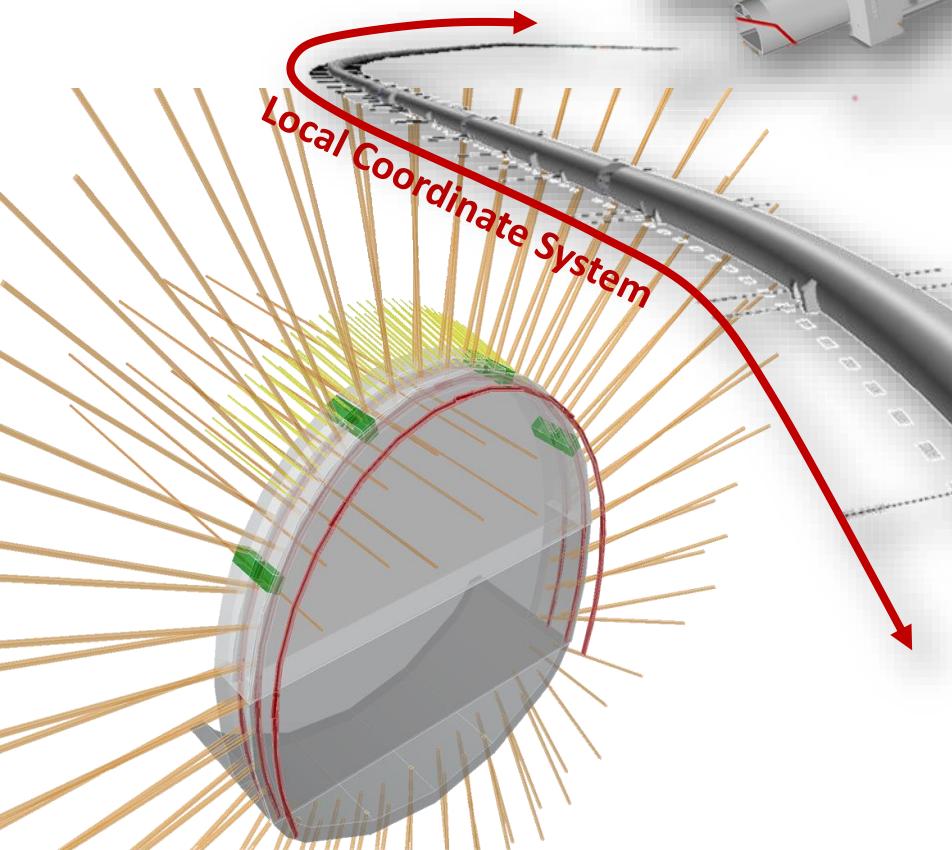
The Strategy | AUSTRIAN SIDE



Coordination – 5 Coordination models



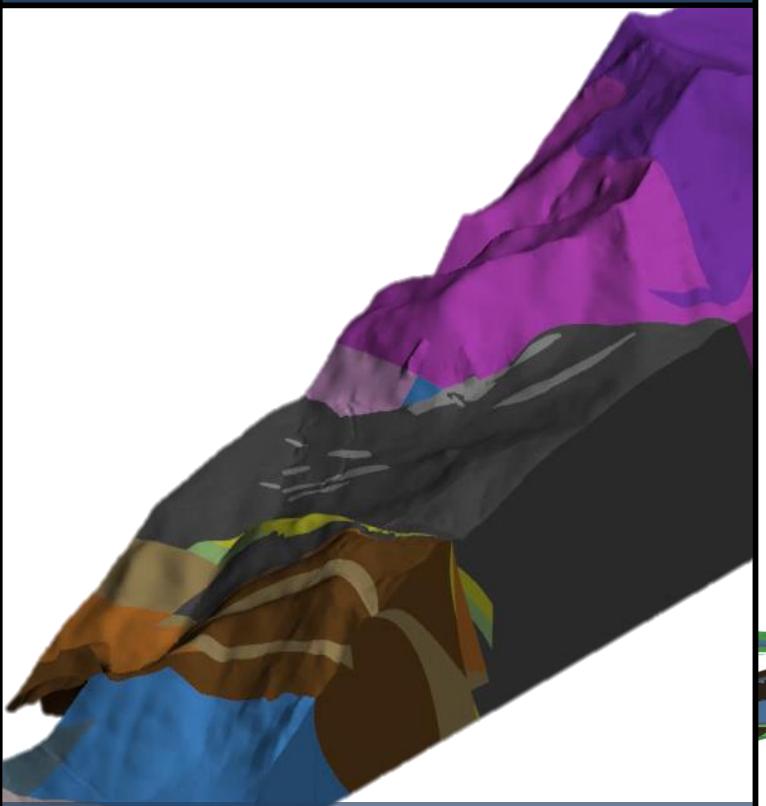
Slovenian National
Coordinate System



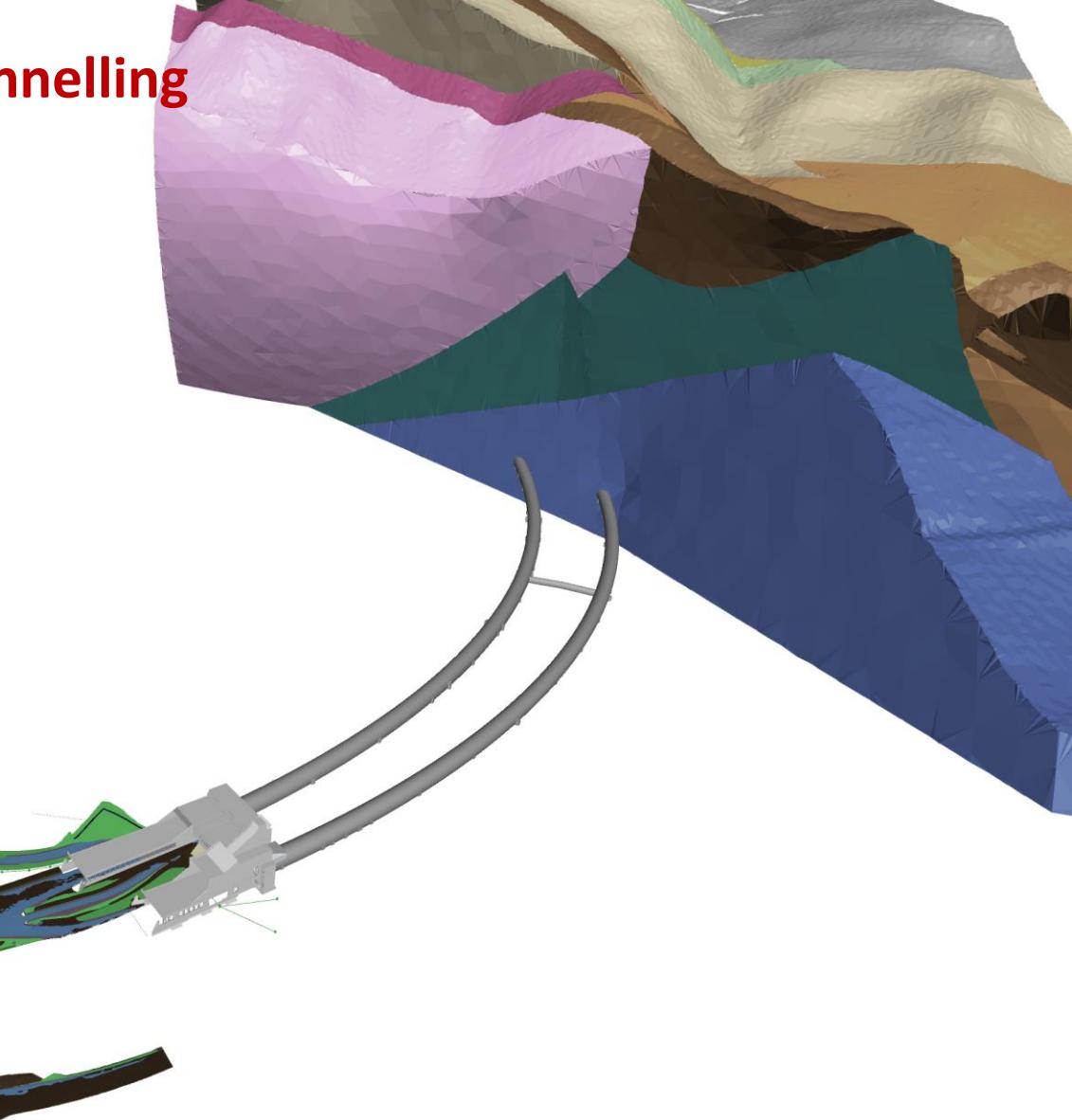
Austrian National
Coordinate System

Information modelling in tunnelling

GEOLOGY AND GEOTECHNICS

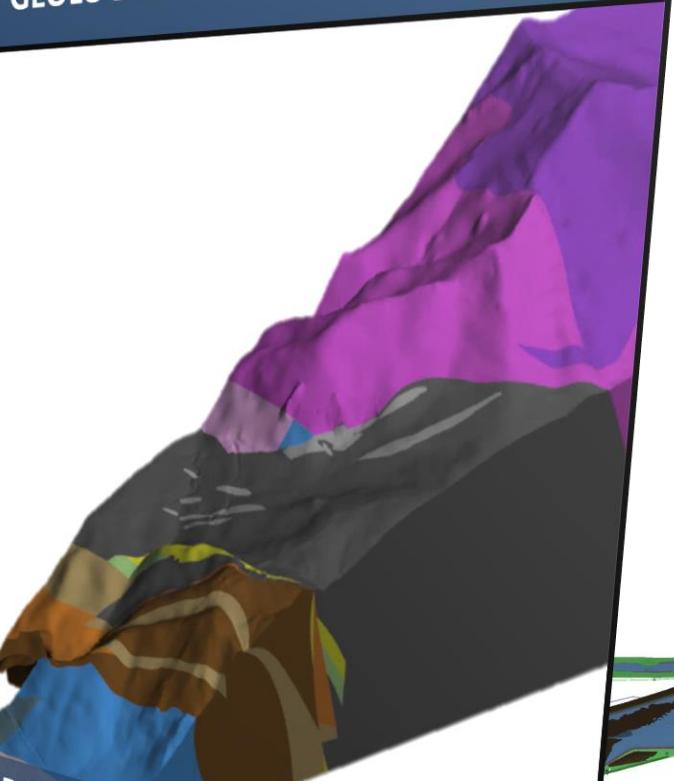


DRIVEN BY MINING EXPLORATION
LOGGING, MANAGING AND
INTERPRETING DATA

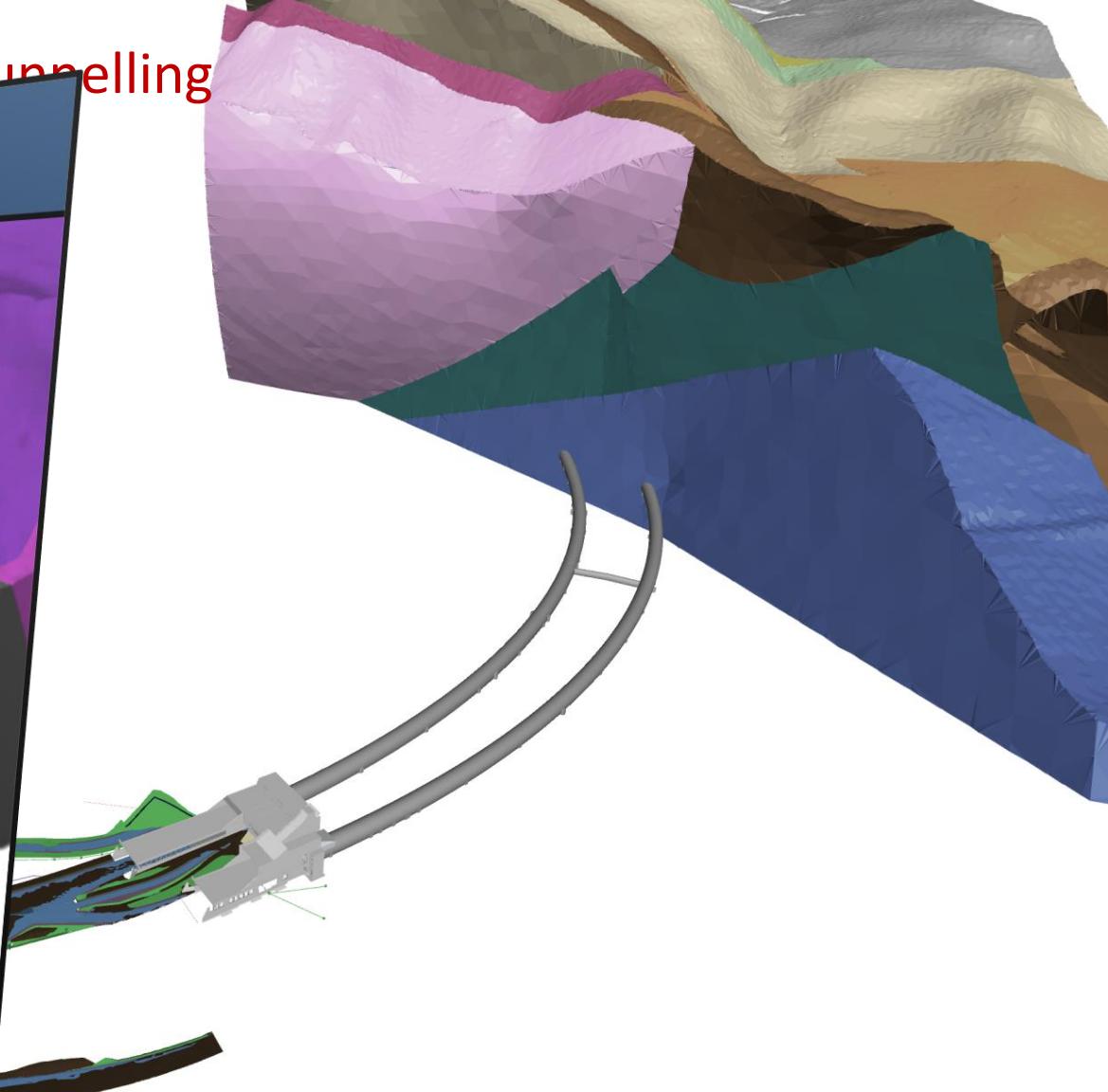


Information modelling in tunnelling

GEOLOGY AND GEOTECHNICS



DRIVEN BY MINING EXPLORATION
LOGGING, MANAGING AND
INTERPRETING DATA



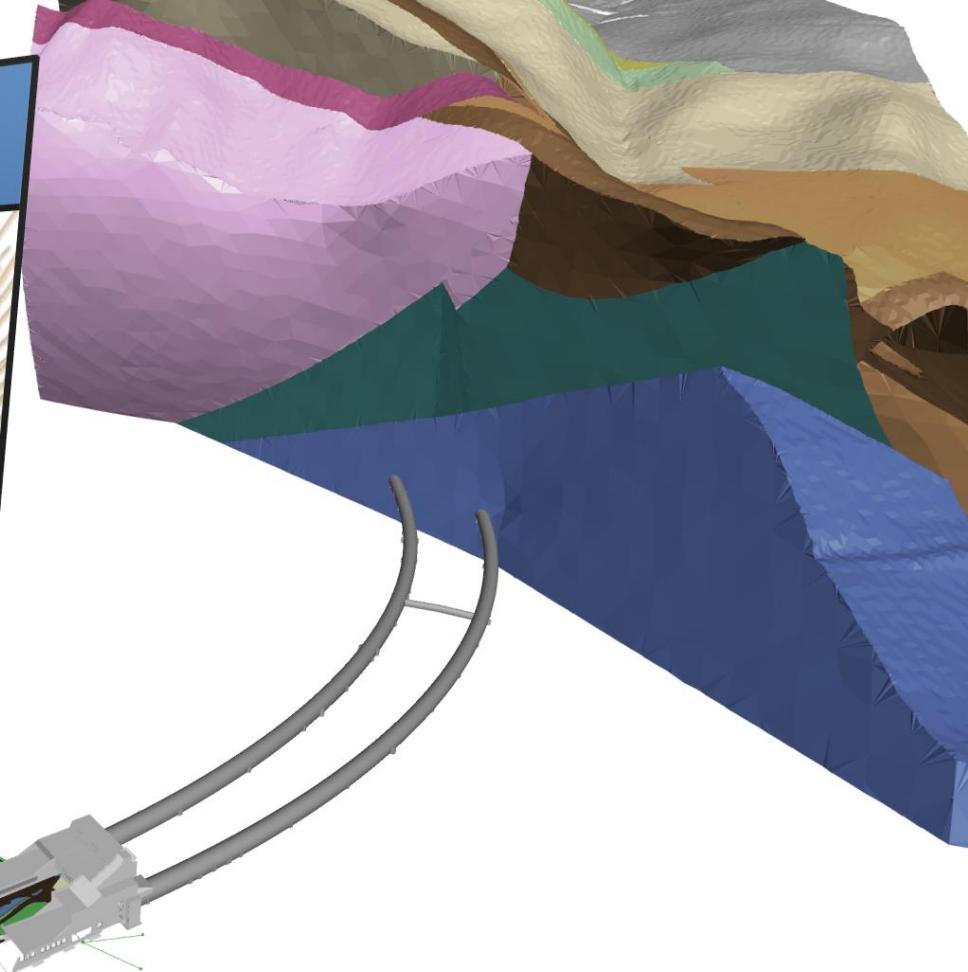
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Information modelling in tunnel II

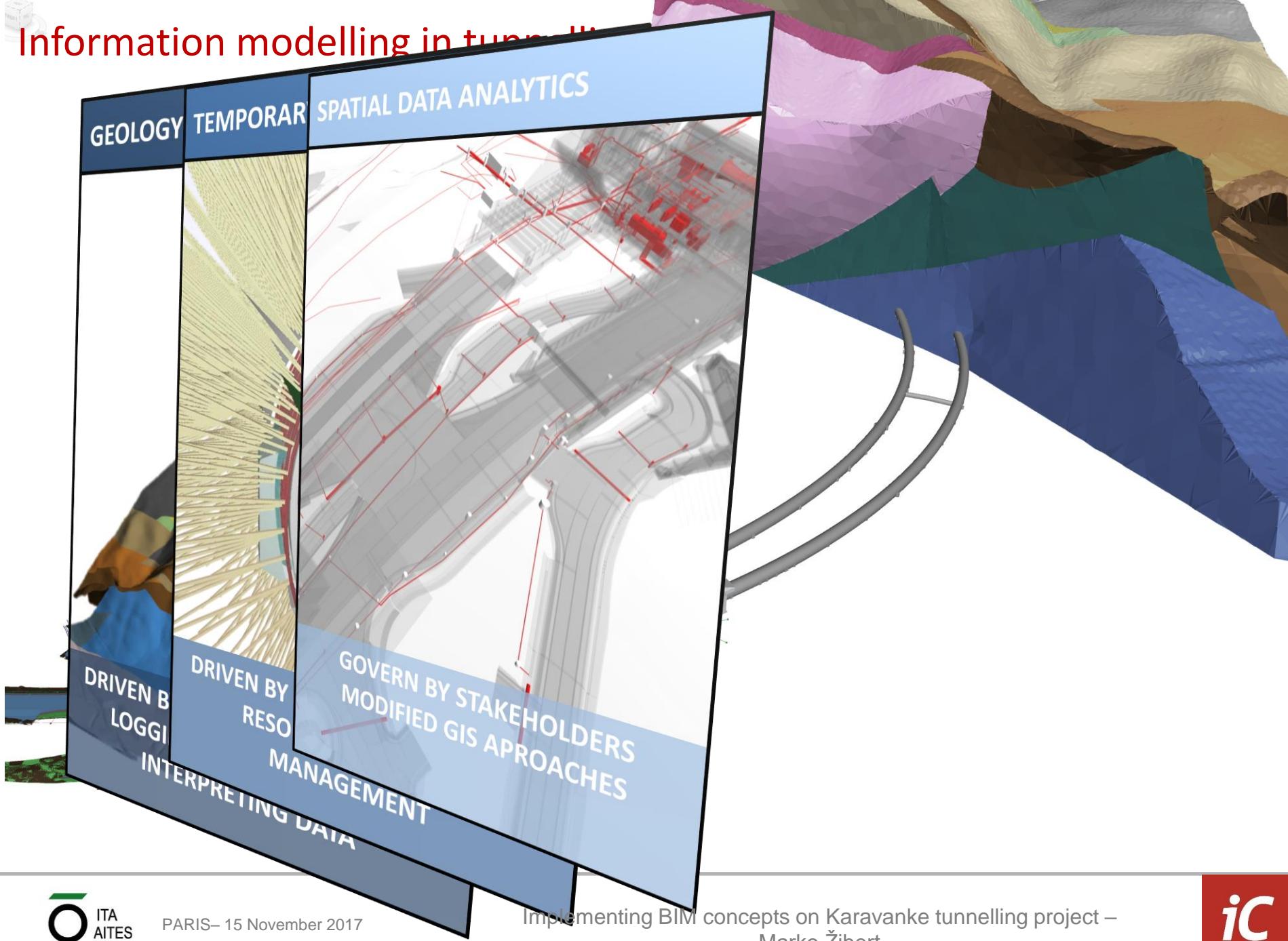
GEOLOGY TEMPORARY WORKS

DRIVEN BY
LOGGI

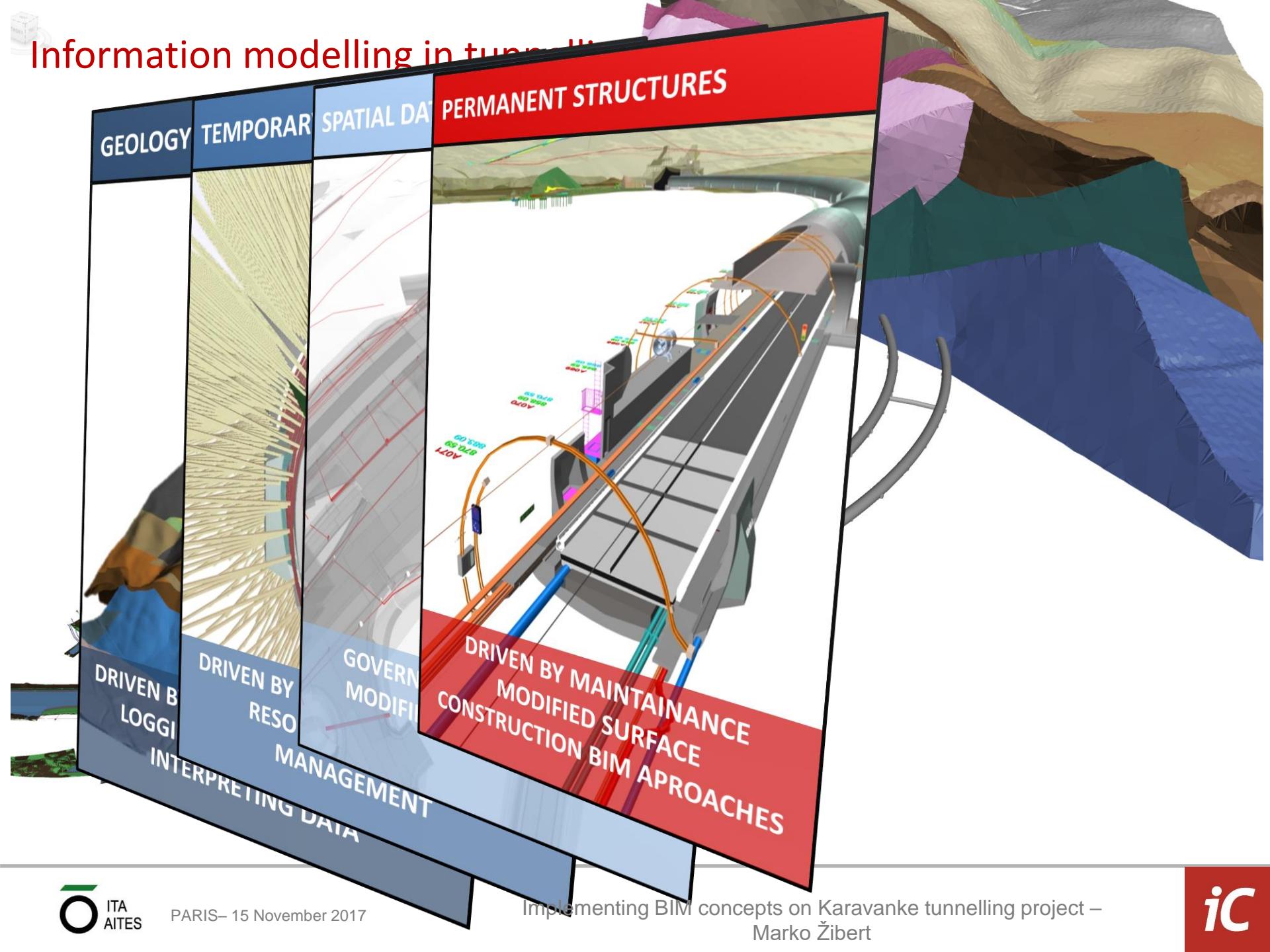
INTERPRETING DATA
DRIVEN BY MINE CONSTRUCTION
RESOURCE AND TIME
MANAGEMENT



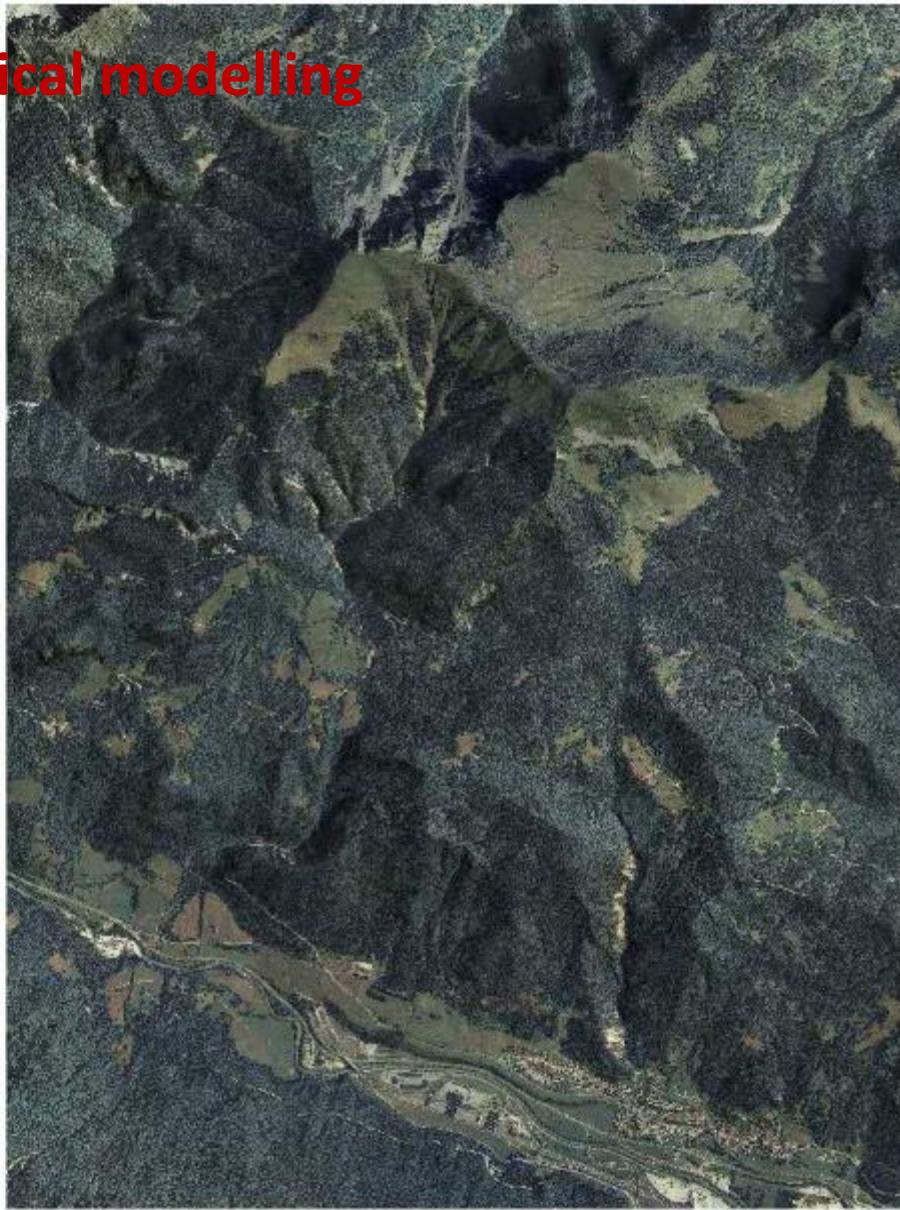
Information modelling in tunnel II



Information modelling in tunnel II

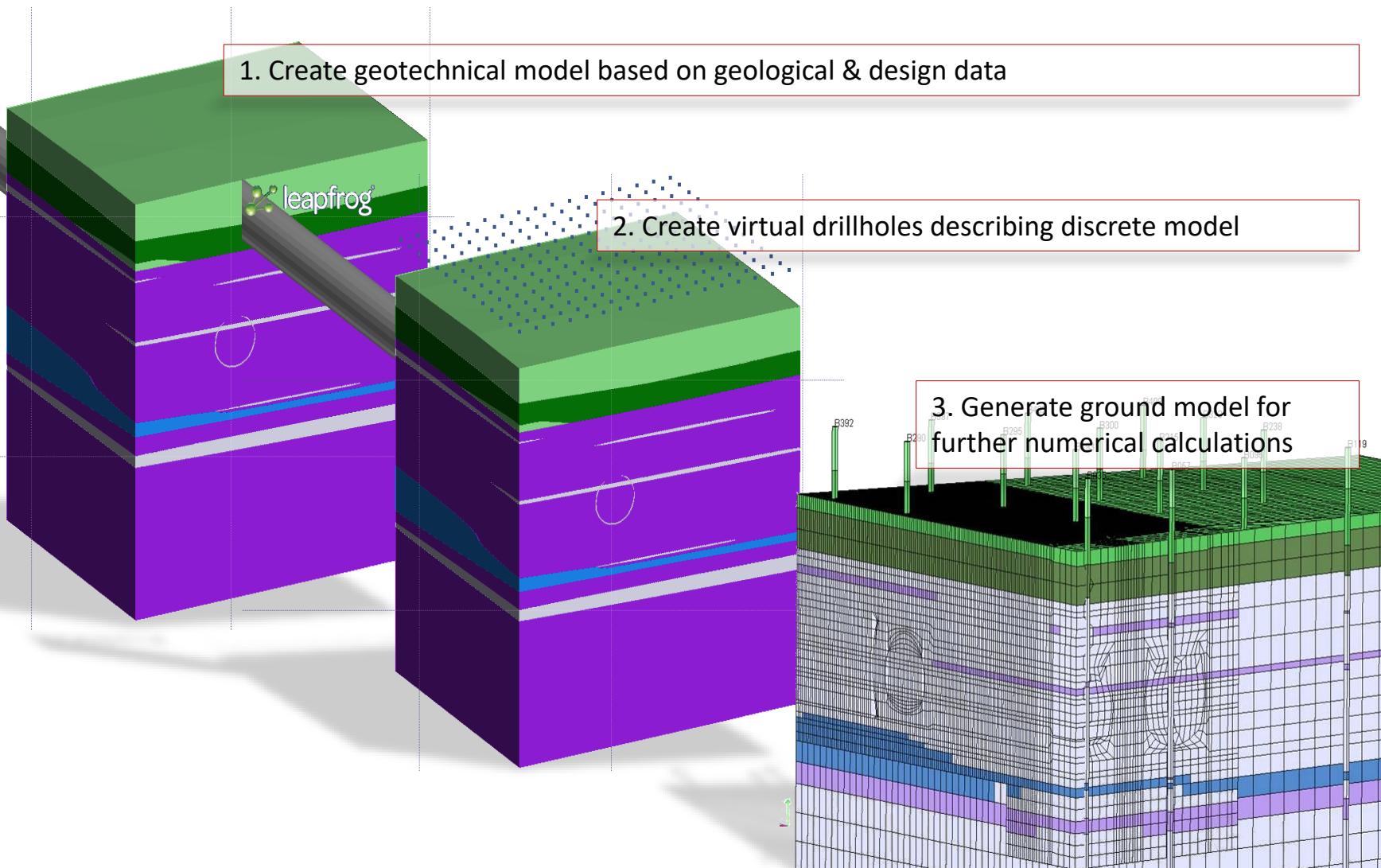


3D Geological modelling

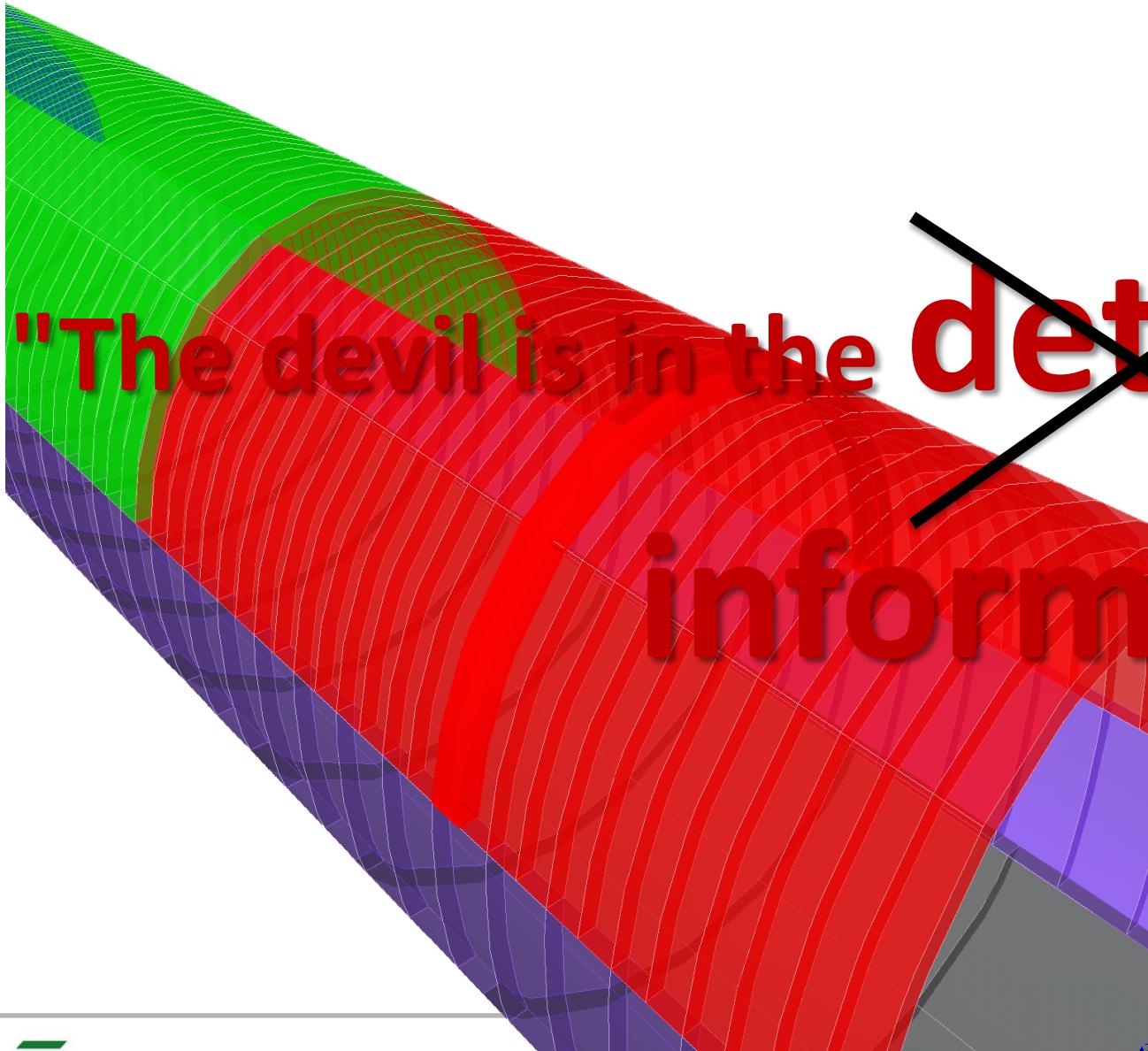




3D Geological modelling – using geological data as a basis for complex numerical calculations

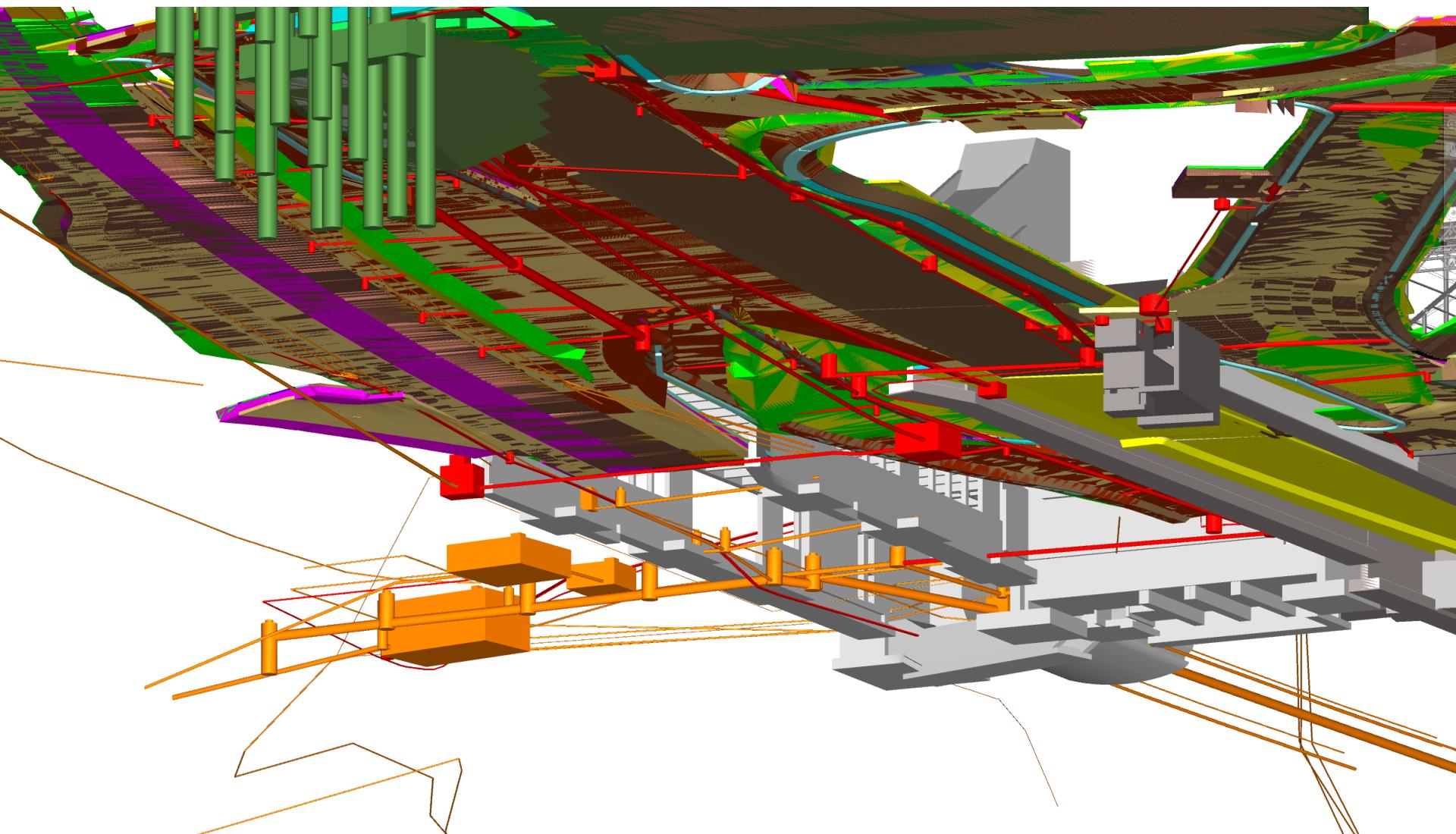


Modelling of temporary support structures

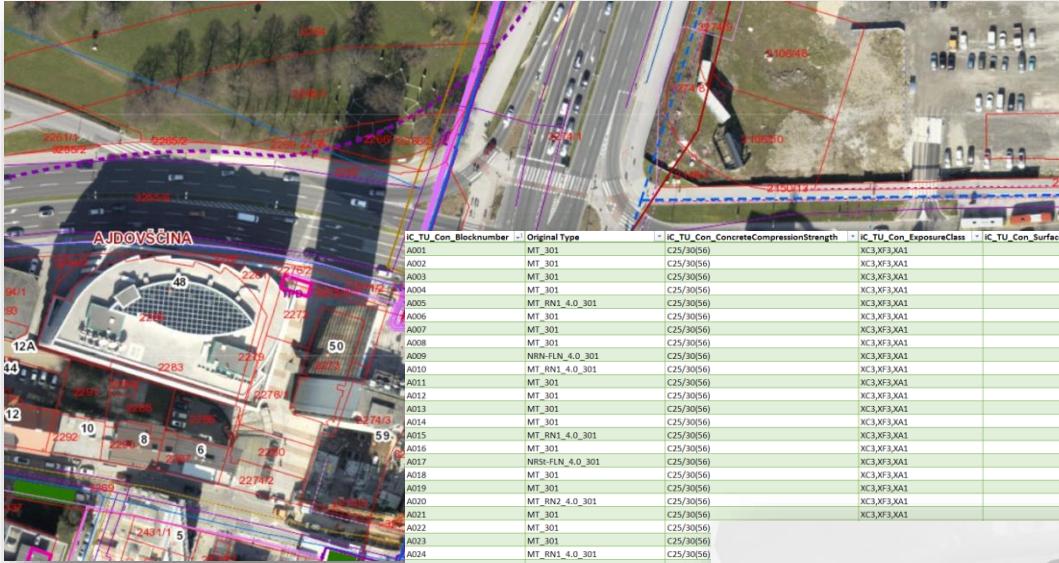


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Geometric Classification:	Solid
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Product Description:	
Product Object Type:	
Owning User:	@No Organization
Creation Date:	11.01.2017 14:59:28
Change Date:	
Last Update Date:	
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Enrol:	m3
Owner:	BT11
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Pay_item_Wire_mesh :	S 52 314
Pay_item_RB_1:	N 56 547
Pay_item_RBF:	N 56 548
Pay_item_SCF :	N 53 752
Pay_item_Spils:	N 56 671
Pay_item_Yielding_elems :	N 56 854
Pay_item_Steel_arches :	N 64 116
Pay_item_RB_1_N:	21
Pay_item_RBF_N:	1.112
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Spatial data analytics



Spatial data analytics

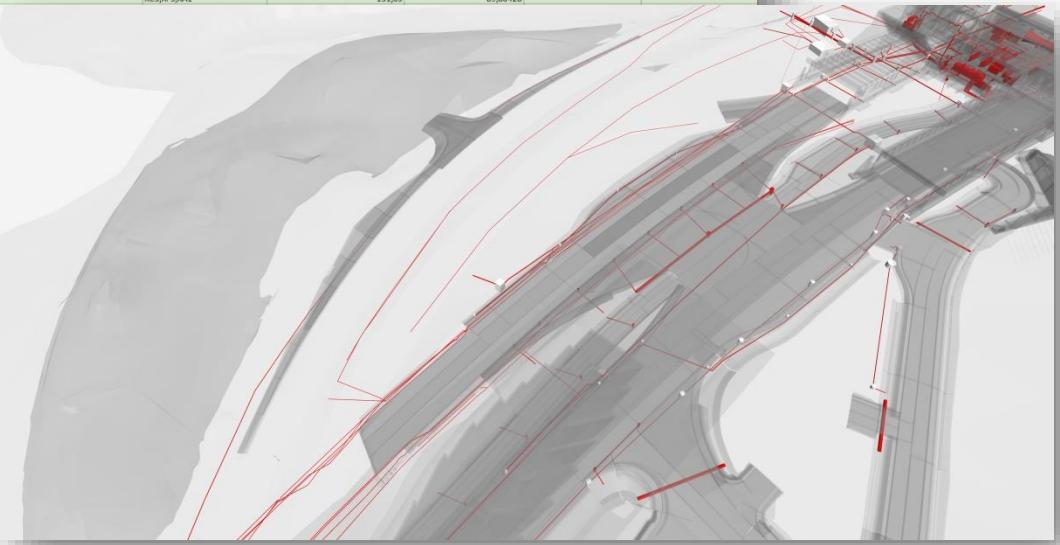


Open GIS database

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A003	MT_301	C25/30(56)	XC3,XF3,XA1	131,63	89,81552		
A004	MT_301	C25/30(56)	XC3,XF3,XA1	131,63	89,72022		
A005	MT_RN1_4_0_301	C25/30(56)	XC3,XF3,XA1	144,99	75,77298	6,61906	6,26918
A006	MT_301	C25/30(56)	XC3,XF3,XA1	131,63	89,65608		
A007	MT_301	C25/30(56)	XC3,XF3,XA1	131,63	89,81416		
A008	MT_301	C25/30(56)	XC3,XF3,XA1	131,64	89,72397		
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A013	MT_301	C25/30(56)	XC3,XF3,XA1	131,63	89,80123		
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XML/GML
conversion of
parameters

Basis for BIM
model of utilities



BIM – modelling of permanent works

Early stage modelling goals:

- Investigate different scenarios
- Costs and time analysis
- Communication with stakeholders

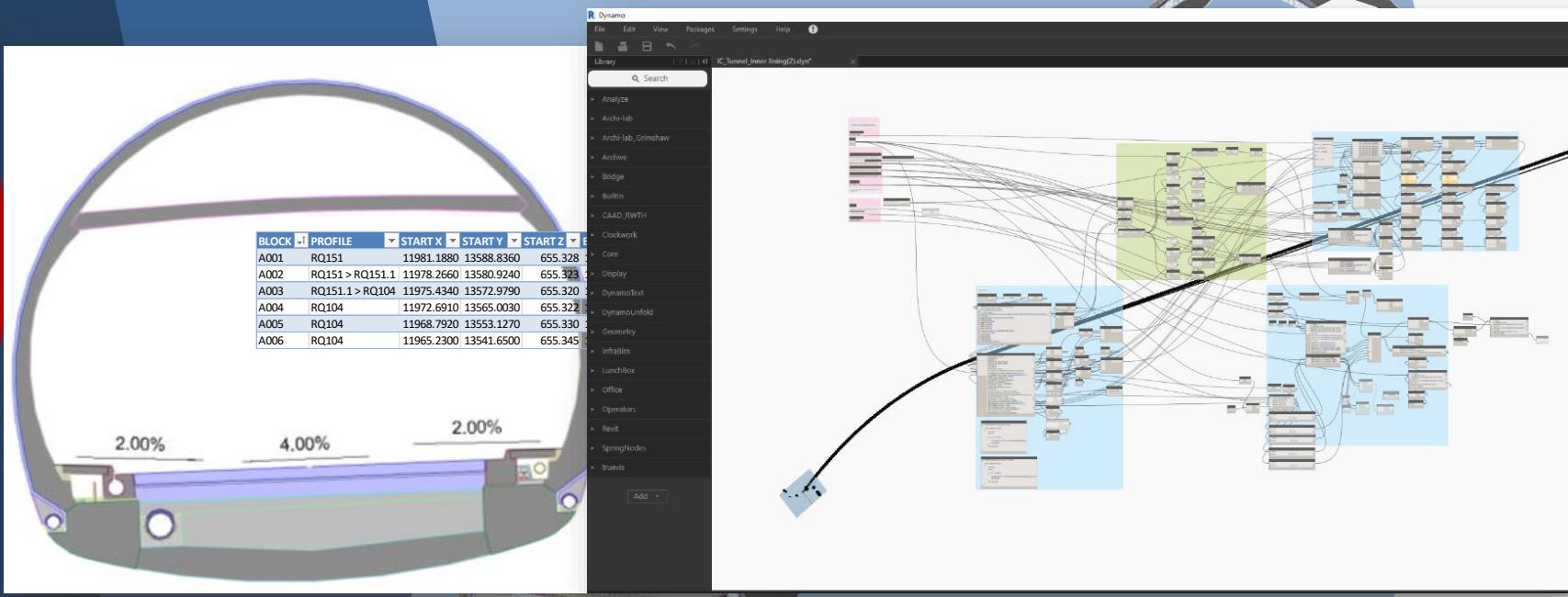
Detailed design modelling goals:

- Detailed geometry mimicking construction process
- Quality assurance by 3C
- Quantity take off analysis
- Time scheduling and budgeting

Early stage of model development

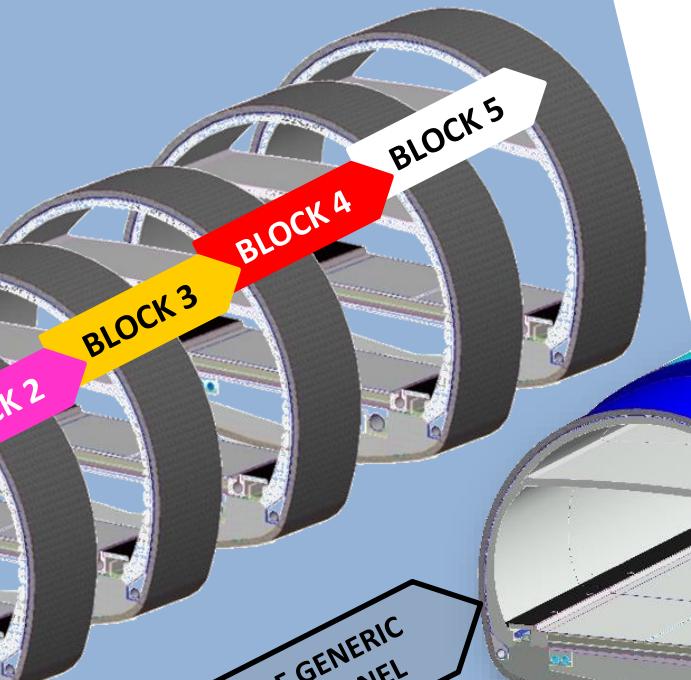
Create parametric families

Assembly: distribute parametric families over profiles



Early stage of model development

Define parametric families
for profiles



Distribute niches and other interventions according to the requirements-

PARKING BAY NICHES
GENERIC BLOCK

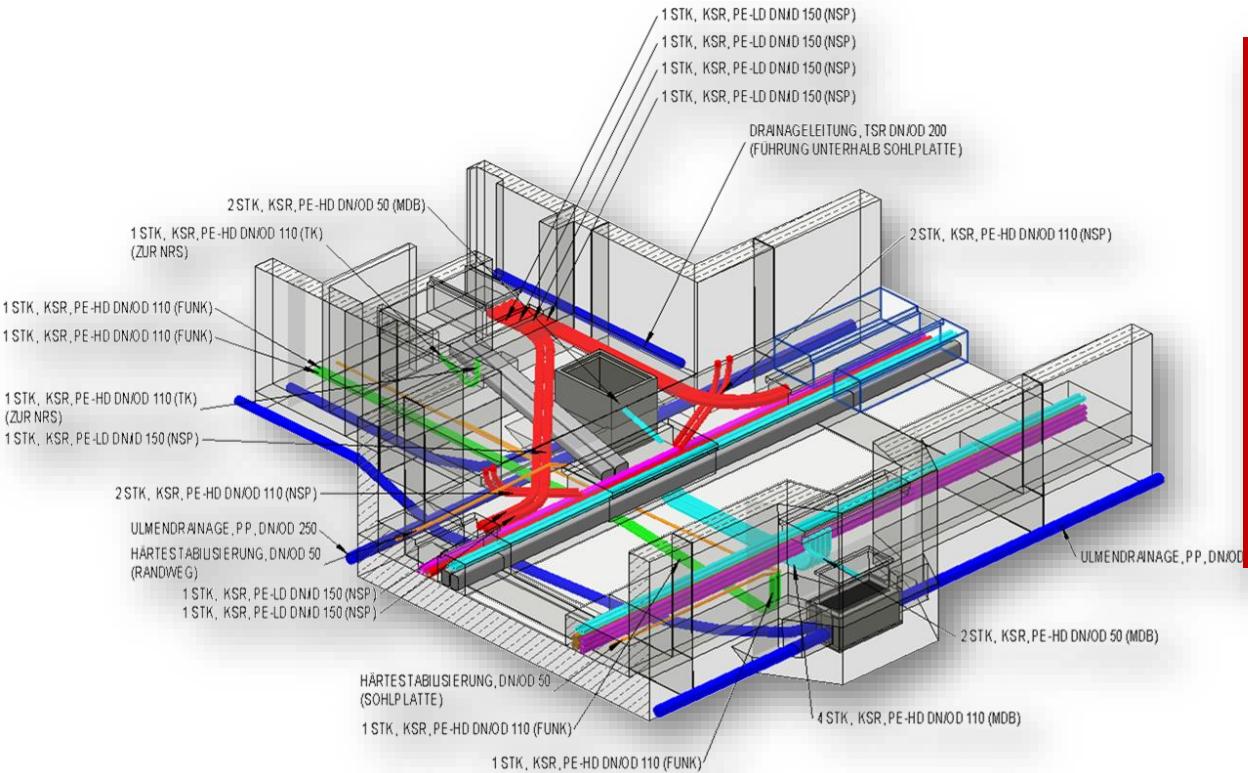
All elements are governed by series of queries each defining the required parameters

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Early stage - 4D (costs) and 5D (time) Modelling

Early stage - Communication with stakeholders

Detailed design stage - Model segregation



CONCRETE LINING

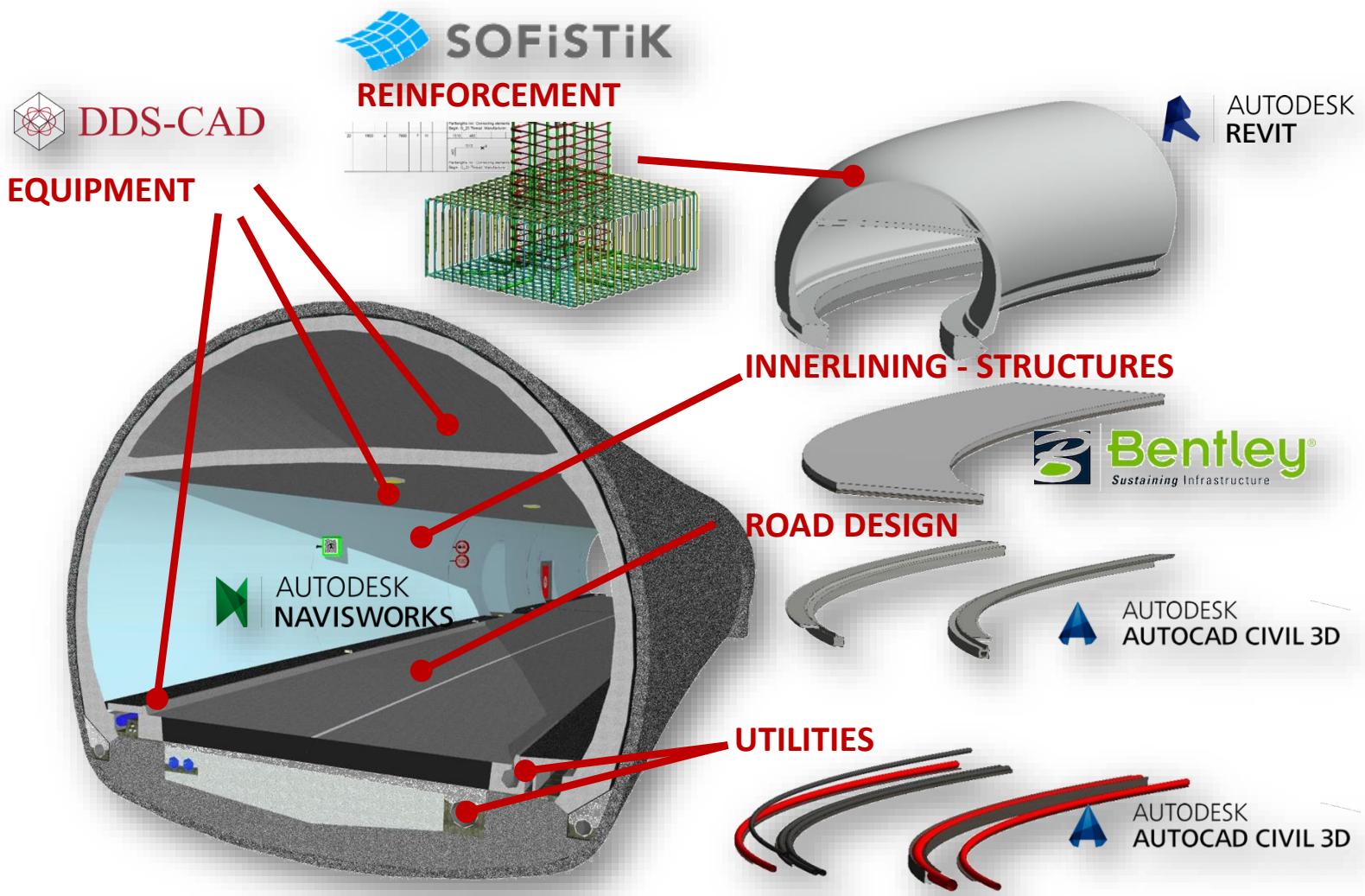
ROAD DESIGN

MECHANICAL

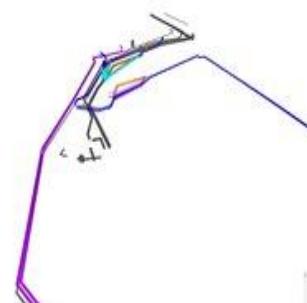
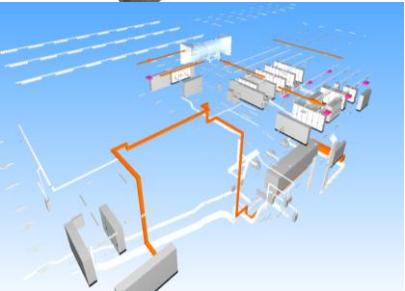
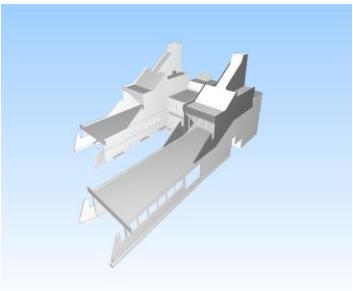
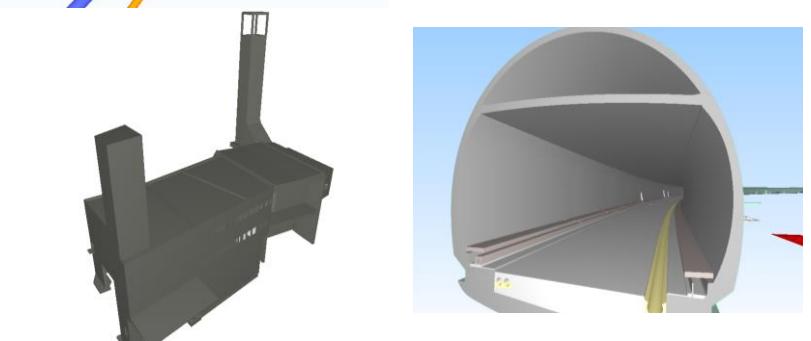
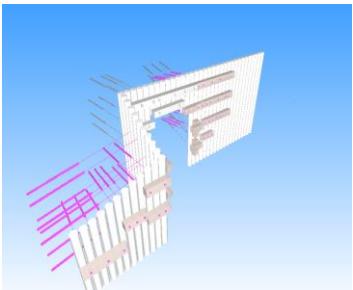
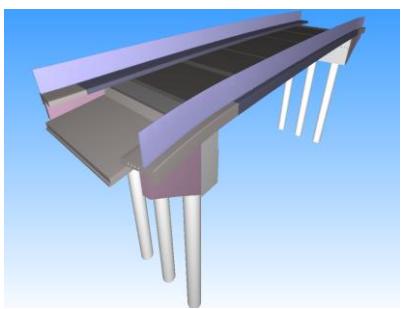
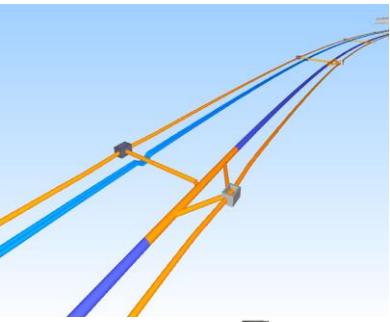
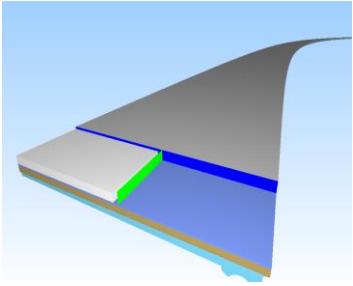
ELECTRICAL

DEWATERING

Detailed design stage - Model segregation



Detailed design stage - 190 Partial models



Model Delivery Schedule

Detailed design stage – Coordination workflows

Segregate generic model to discipline specific models

Create & Analyze detailed discipline specific models



Each team uses its own design specific tools

Compile federated model

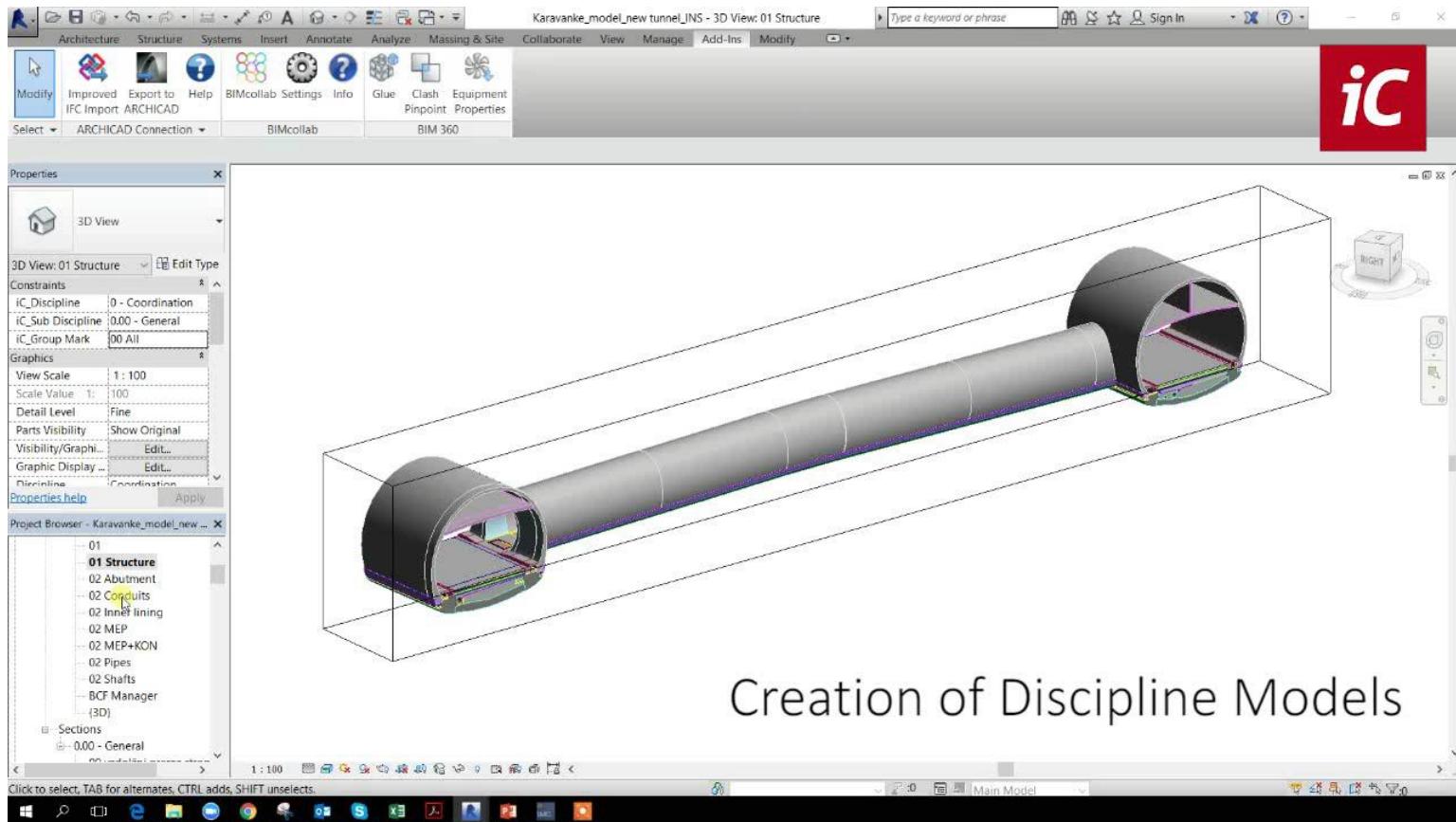


1 COMPILE PROJECT

6 UPDATE PROJECT

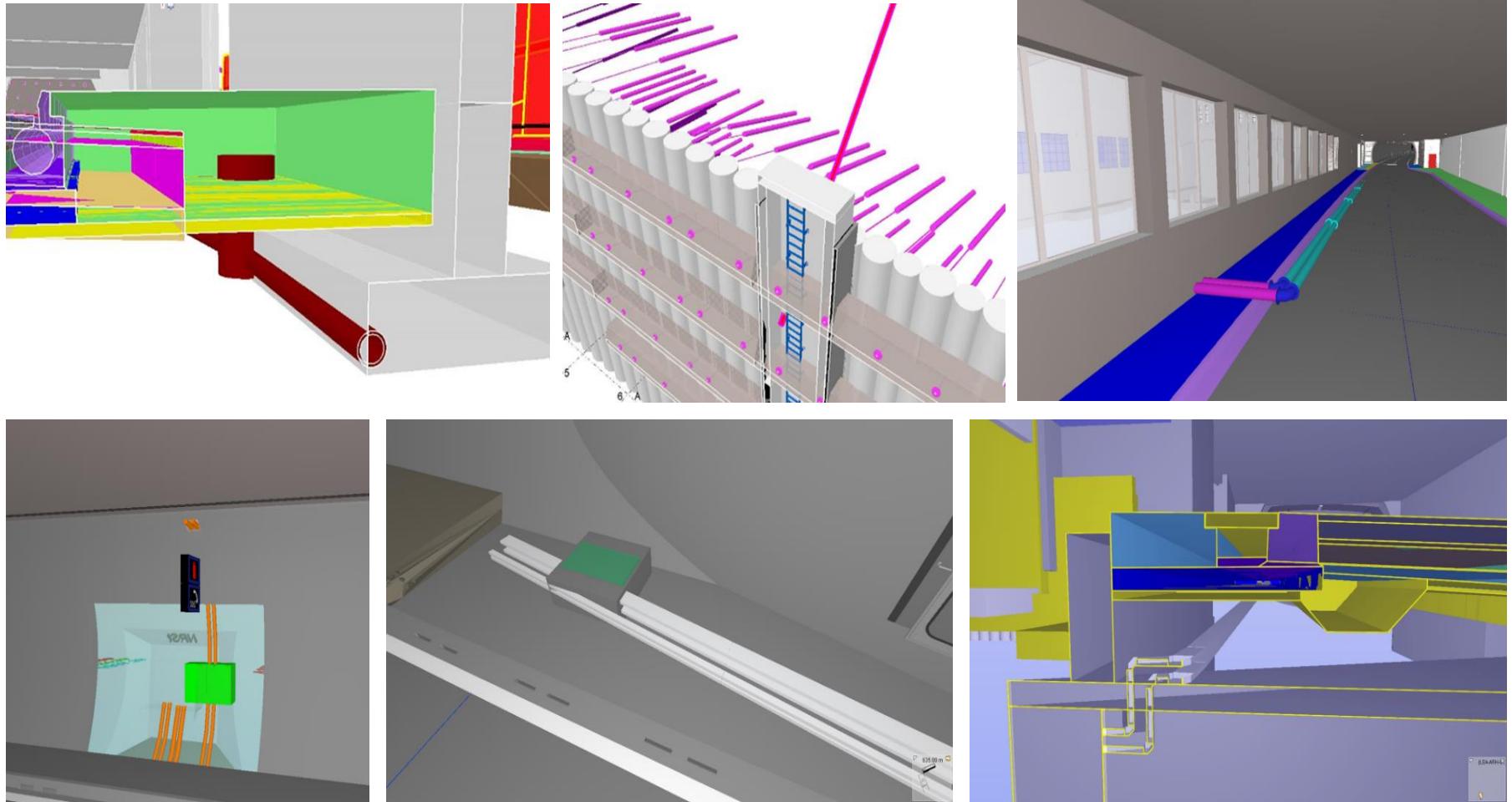
5

Detailed design stage – Efficient design coordination



Creation of Discipline Models

Detailed design stage – 1500 inconsistencies resolved in design stage



Detailed design stage – 4D and 5D Modelling

The screenshot shows the Element Planning software interface with multiple windows open:

- Top Bar:** Contains icons for Project Window, Project Catalogs, Variable Wizard, Update Links, Master Project, General, Update CPI Data, Objects, Entire Calculation, Update BoQs, BoQ, Filter, Edit, and Structure.
- Navigation Bar:** Model Check > Element Planning > Assignment > Quantities > BoQ Assignment.
- Structure Tree:** Shows a tree view with 'Objects' and '11 Default' items.
- 3D View:** A 3D wireframe model of a structure.
- CPI Attributes:** A table showing CPI attributes for objects, with one row selected: '1.2.6 Koli u vodnjaki'.
- Selection Sets:** A table showing selection sets, with one row selected: '1.3.1 Nosilne plasti'.
- Bottom Left Window:** Shows a list of QTO rules for 'Element Planning'.
- Bottom Right Window:** Shows a detailed list of items with their descriptions and quantities.

Text Overlay:

1. Creating „Selection sets“
2. QTO rules for each item in the BoQ → connecting „Selection sets“ to QTO rules

Detailed design stage – 4D and 5D Modelling

3. Scheduling by means of Gantt chart

The screenshot displays a complex construction management application interface. At the top, a navigation bar includes 'Activities', 'Performance Sheet', 'Performances', 'Resources', 'Activity Based Costs', and 'Analysis'. Below this is a 'Work Items Tree' pane showing a hierarchical structure of tasks like 'BoQ: BoQ - Most M2 čez Savo Dolinko - na cesti LC-152161 (načrt št.: 160015T/M2)' and its sub-tasks. To the right is a 'Properties' panel for a selected item, showing basic data (Code: 002.006, Description: Koli in vodnjaki), quantity/hours/costs/budget/revenue, and hours. A central 'Gantt Chart' shows tasks from March 2017 to April 2017, with specific tasks like 'Izdela uvrtnih kolov iz ojačenega cementnega betona' and 'Obsekanje uvrtnih kolov iz ojačenega cementnega betona' highlighted. Below the Gantt chart is a 'Costs' section showing a line graph of cumulative costs over time. To the right is a 3D 'Model' view showing cylindrical structures representing the project's spatial layout.

4. Checking simulations, reporting (S-curve, budgeting, etc.)

Detailed design stage – 4D and 5D Modelling

- SELECTION SETS – link to 3D models:

name4	set	name5	type	ctype
1.2.6 Koli in vodnjaki	Object_Res(Object(@Karavanke\Description == 'BC PF DRILL 120'))	1.2.6.0001	1	cpiObject

- ELEMENT PLANNING – QTO rule sets:

Code	Selection Set	Description	Quantity Query	Activation Condition	UoM	Quantity	RN
1.2.6.0001	1.2.6.0001	Izdelava uvrtnih kolov iz	QTO(Type:="Volume";UoM:="m ³ ")/QTO(Type:="BaseArea";UoM:="m ² ")		M1	60,000	1.2.6.0001

- QTO – (Quantity Take Off) geometric formulas:

RN	Outline Specification	FN	Computation	Result	UoM	ifcID [Value]
1.2.6.0001	Izdelava uvrtnih kolov iz	92	(10*25*(1/2*0.6*0.149))/(25*(1/2*0.6*0.149))=	10,000	M1	0QEOkpgrTFVuH2Kqum5oWJ

- BOQ –comparison of model based QTO and traditional (contractual) BOQs:

RN	Outline Specification	Model based Quantity	Quantity – official BOQ	UoM	Unit Rate	Total Amount	VAT	Opomba postavke	Normaliv	Comment Client
1.2.6.0001	Izdelava uvrtnih kolov iz	60,000	60,000	M1	390,00	23.400,00	22,00	* kompletna	S 27115	

OPEN BIM™?

Detailed design stage – 4D and 5D Modelling

Elea 

Mastering engineering challenges

PREDOR KARAVANKE

5D SIMULACIA

FAZA PGD

DARS 



PARIS– 15 November 2017

Implementing BIM concepts on Karavanke tunnelling project –
Marko Žibert

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