ITA TUNNELLING AWARDS 2017

TECHNICAL PROJECT INNOVATION - OF THE YEAR -

Implementing BIM concepts on Karavanke tunnelling project

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

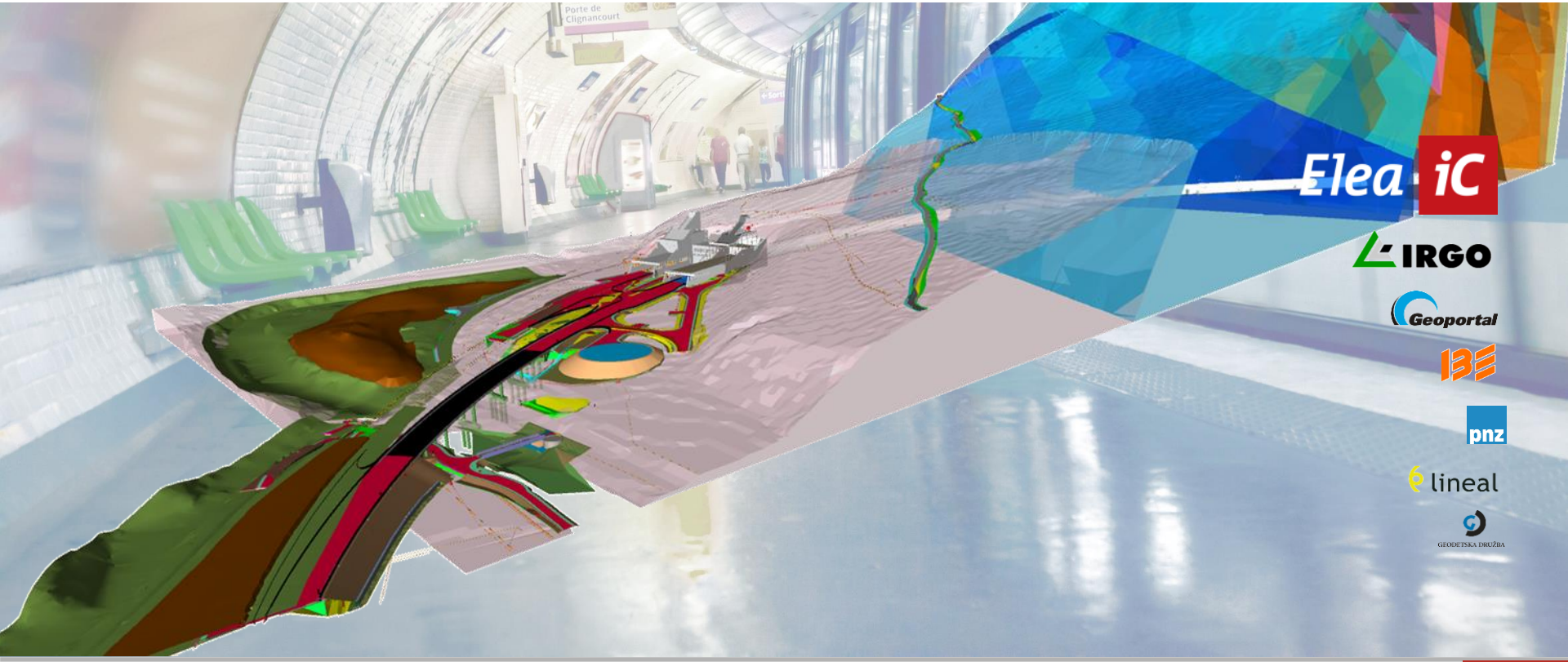
ITA TUNNELLING AWARDS 2017

TECHNICAL PROJECT INNOVATION - OF THE YEAR -

Stakeholders

PGK - Planungsgemeinschaft Karawankentunnel

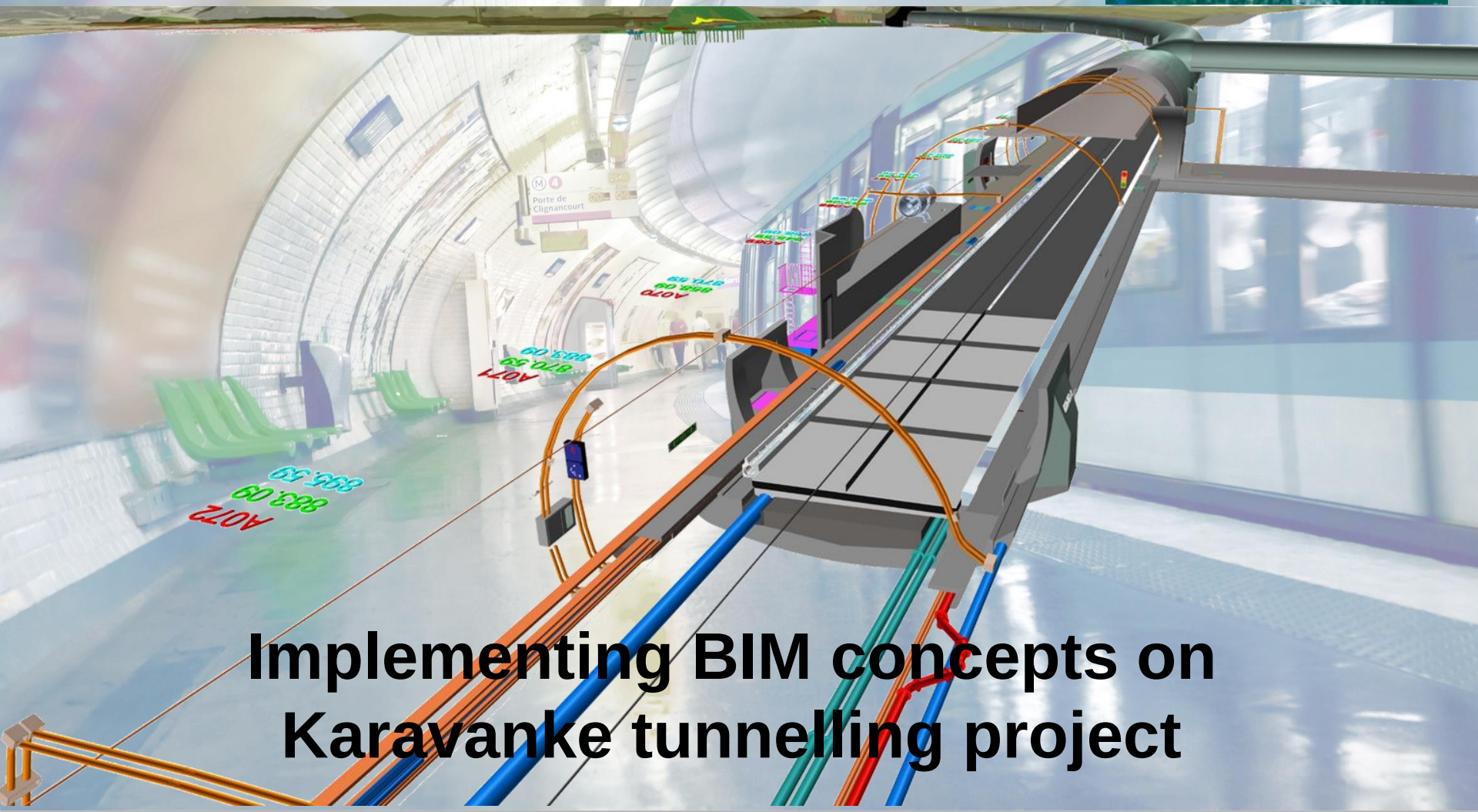
ASFINAG laabmayr IGT GEOTECHNIK UND TUNNELBAU iC consulenten DARS DRI Projektantska skupina KARAVANKE



Elea iC IRGO Geoportal IBE pnz lineal GEODETSKA DRUŽBA

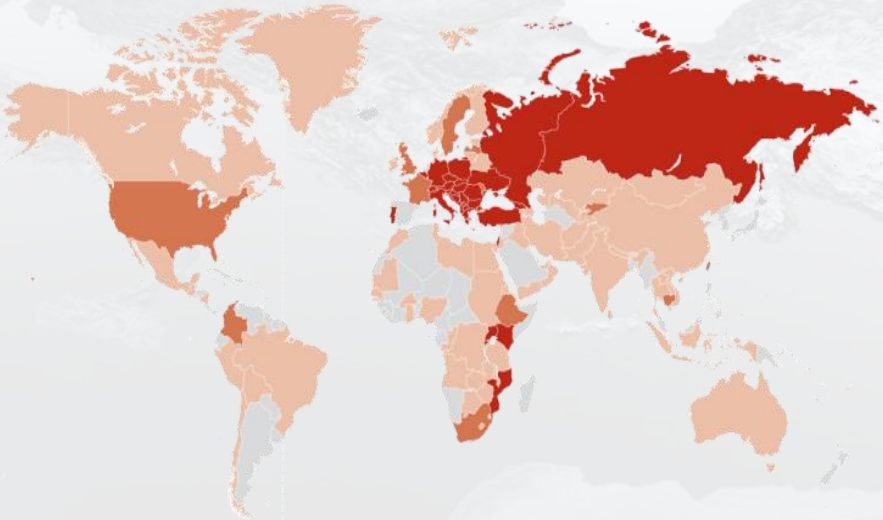
ITA TUNNELLING AWARDS 2017

TECHNICAL PROJECT INNOVATION - OF THE YEAR -

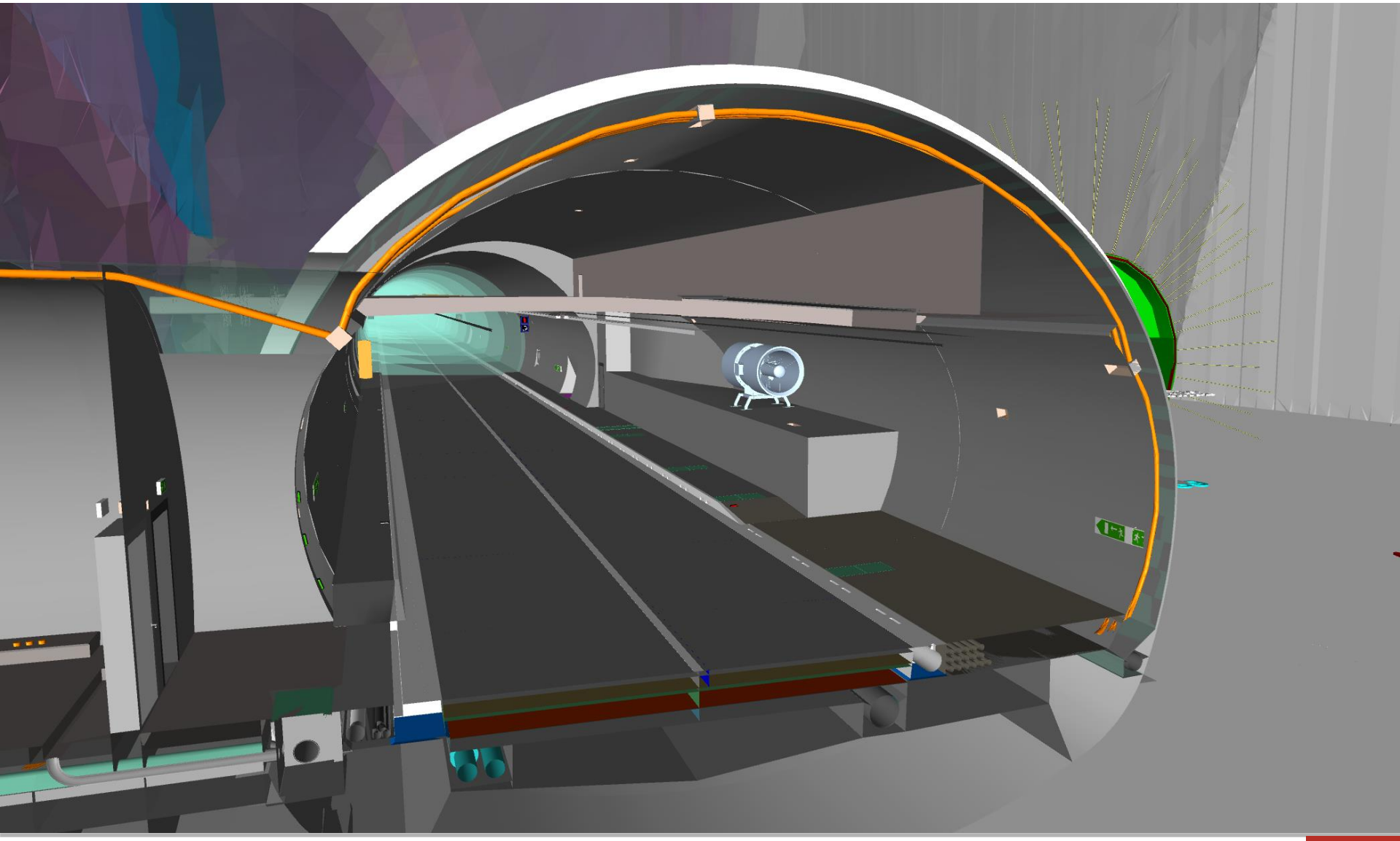


Implementing BIM concepts on Karavanke tunnelling project

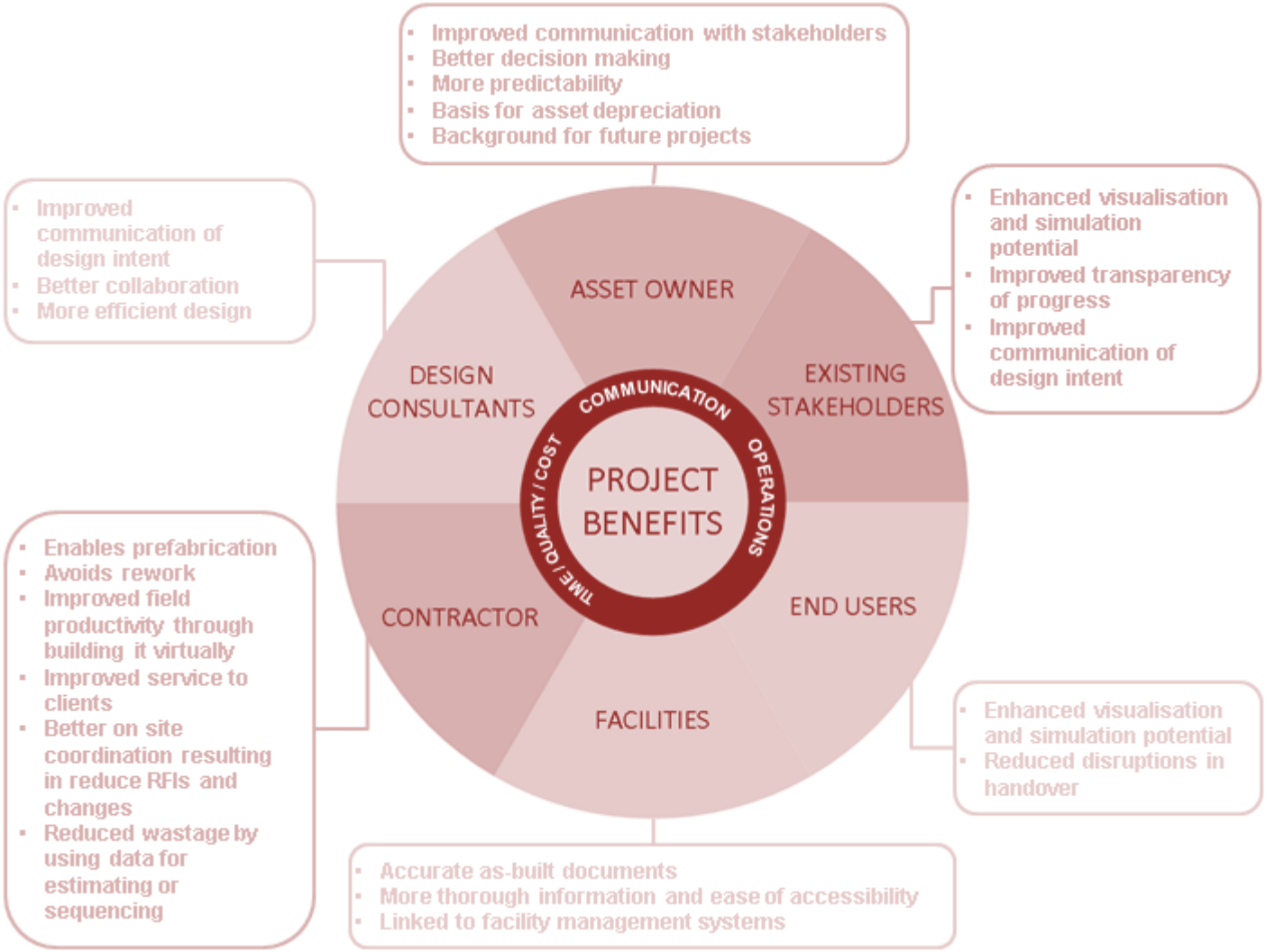
With our global know-how and competencies on site as well as **more than 450 colleagues** and our experience **in 100 countries** we provide solutions for projects worldwide.



Why using BIM? Are there any benefits?

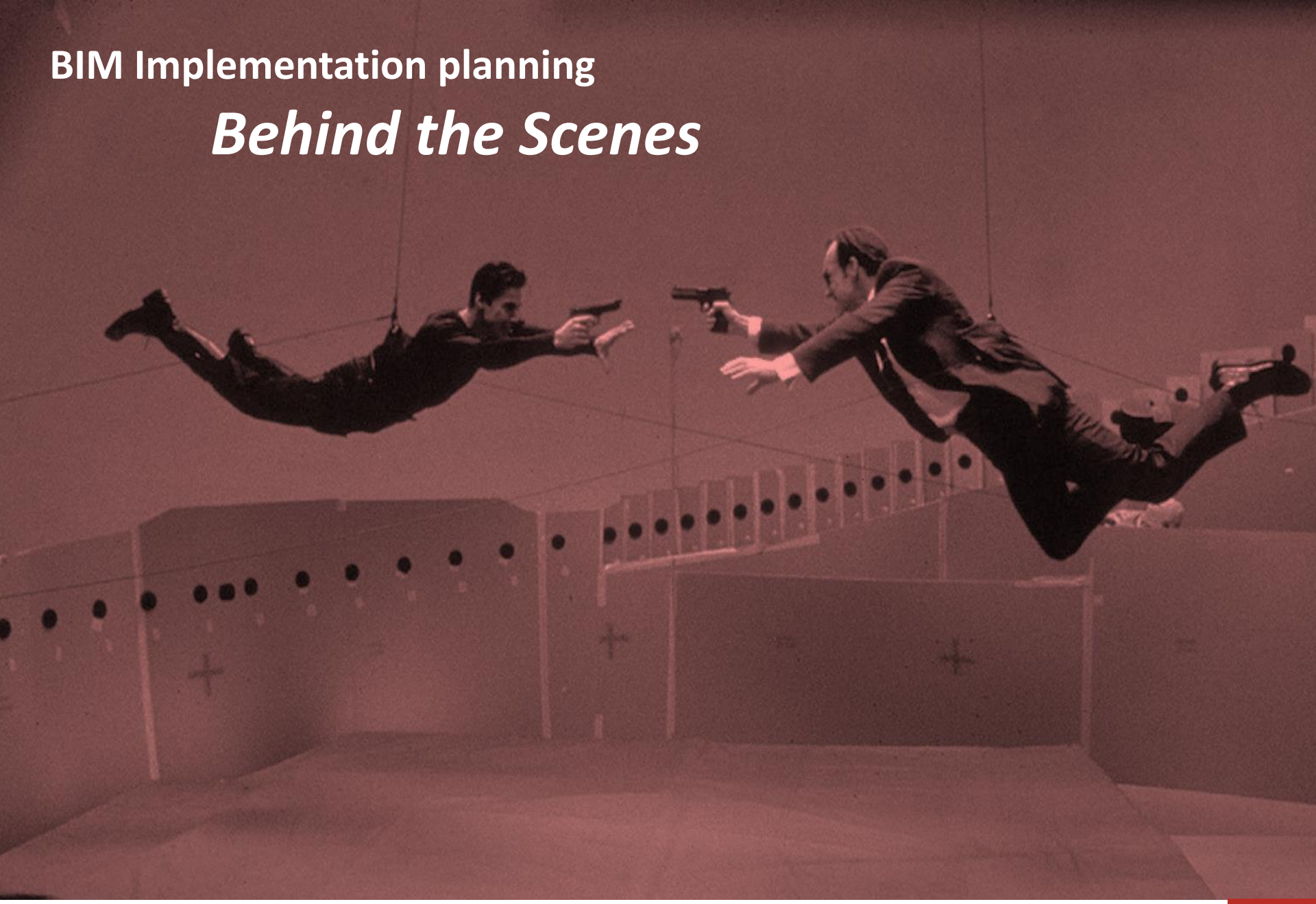


Why using BIM? Are there any benefits?

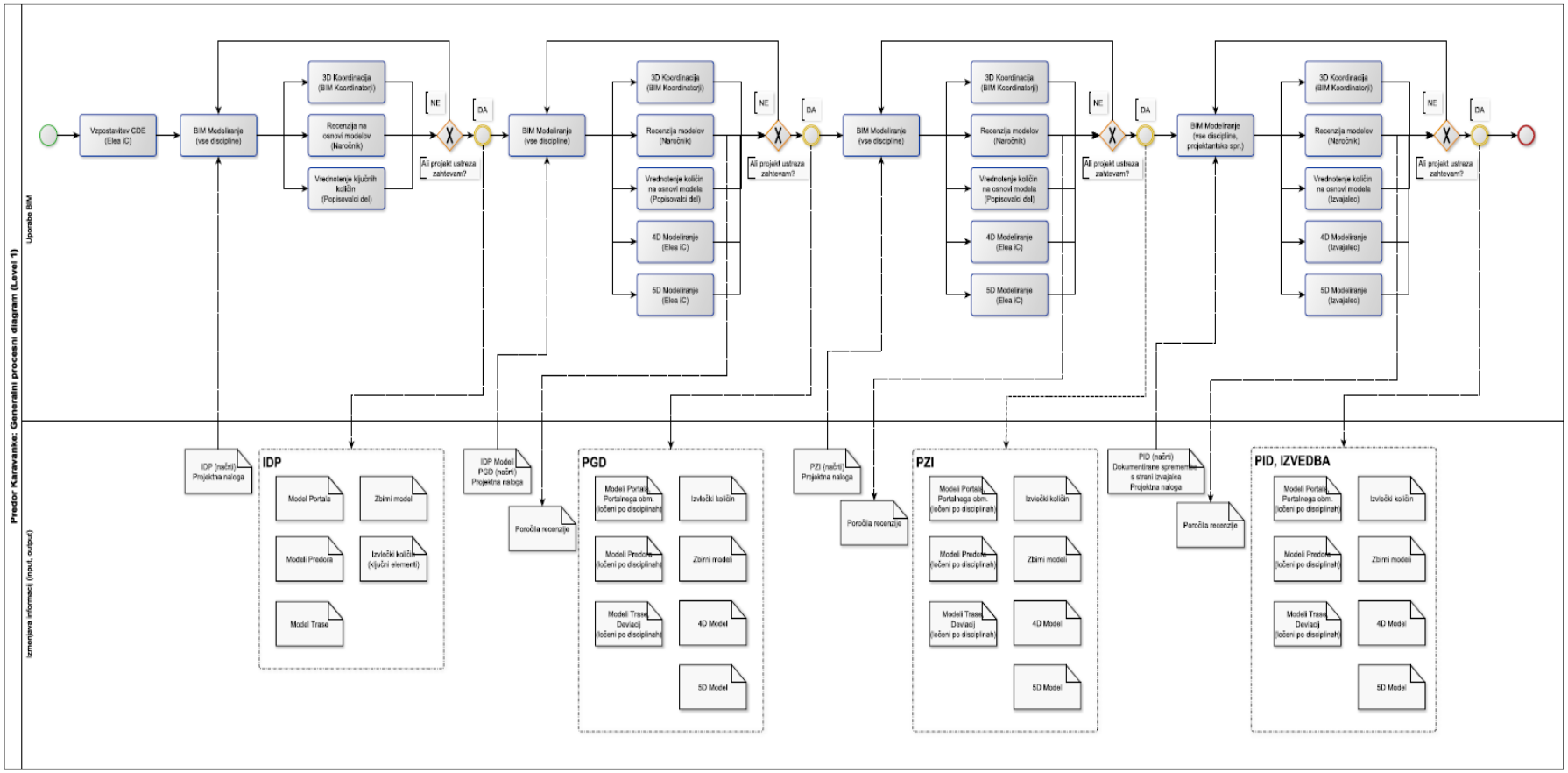


BIM Implementation planning

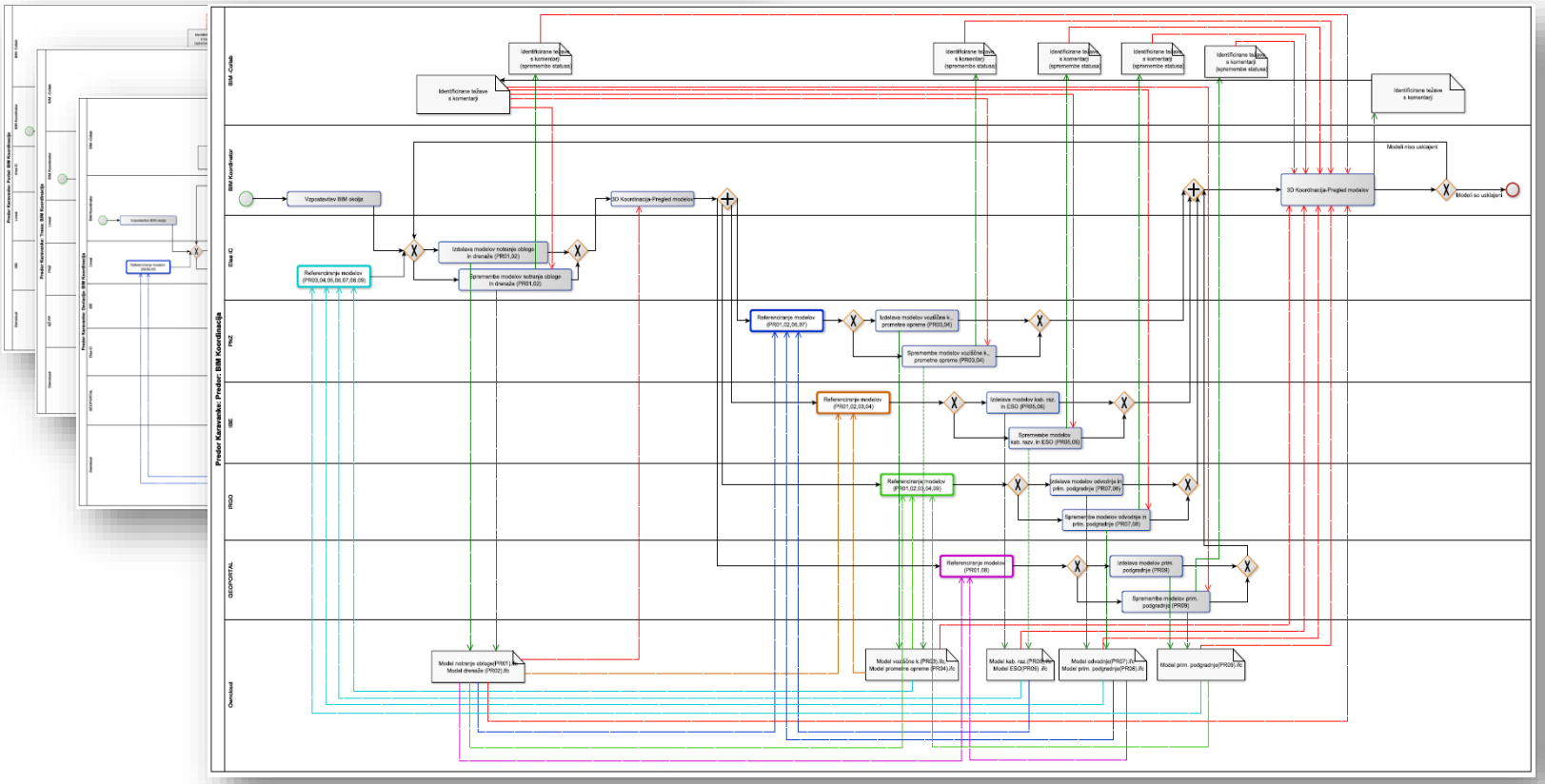
Behind the Scenes



Definition of processes (BIM Overview process map)



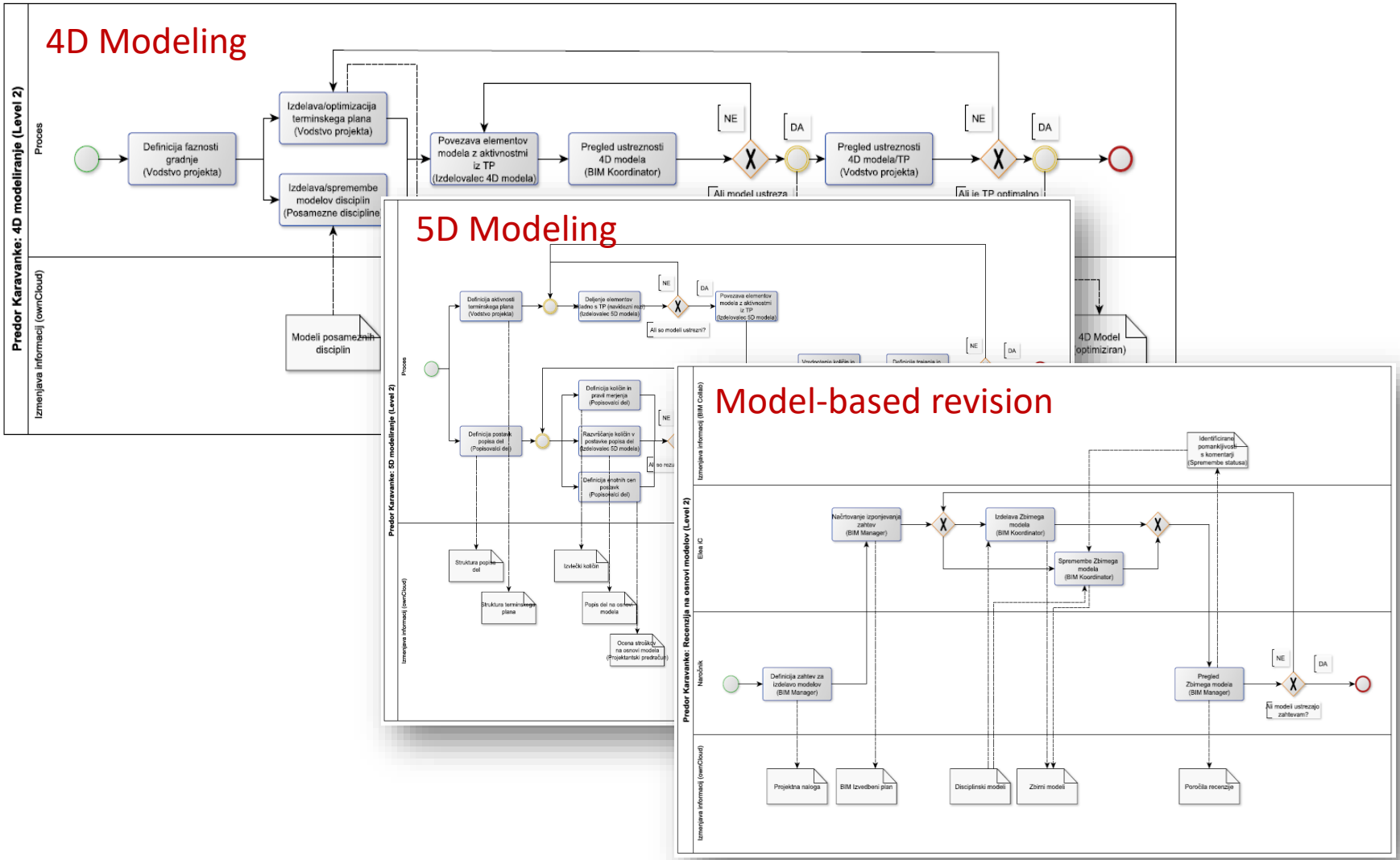
Definition of processes (BIM Coordination)



BIM Collaboration Format

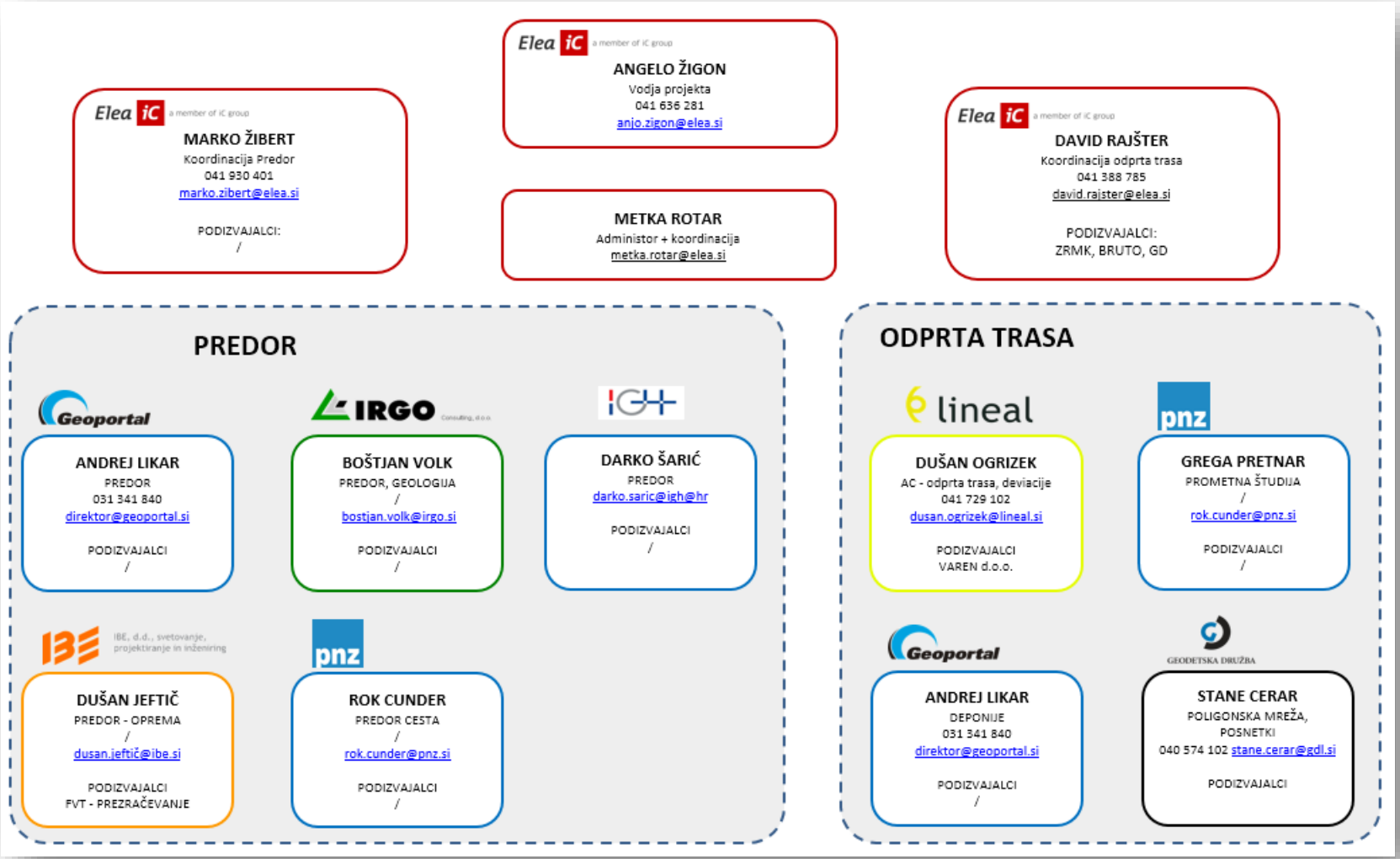
IFC2x3 CV2.0

Definition of processes (Other detailed process maps)



Communication, Collaboration and Coordination

Project organization in the design stage



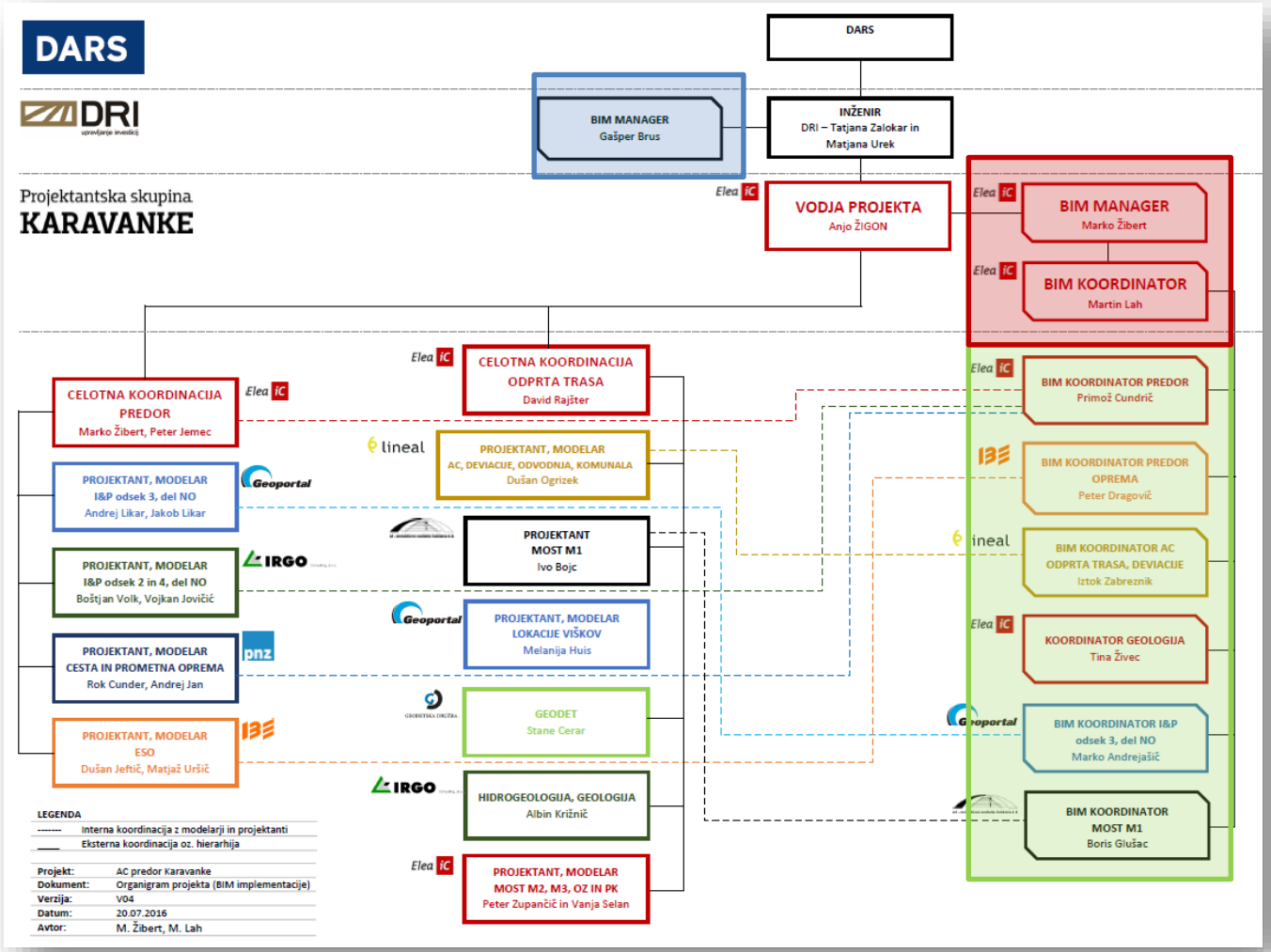
7 joint-venture partners | 15 companies | 60 engineers | > 120.000 hours

Project organization on BIM side

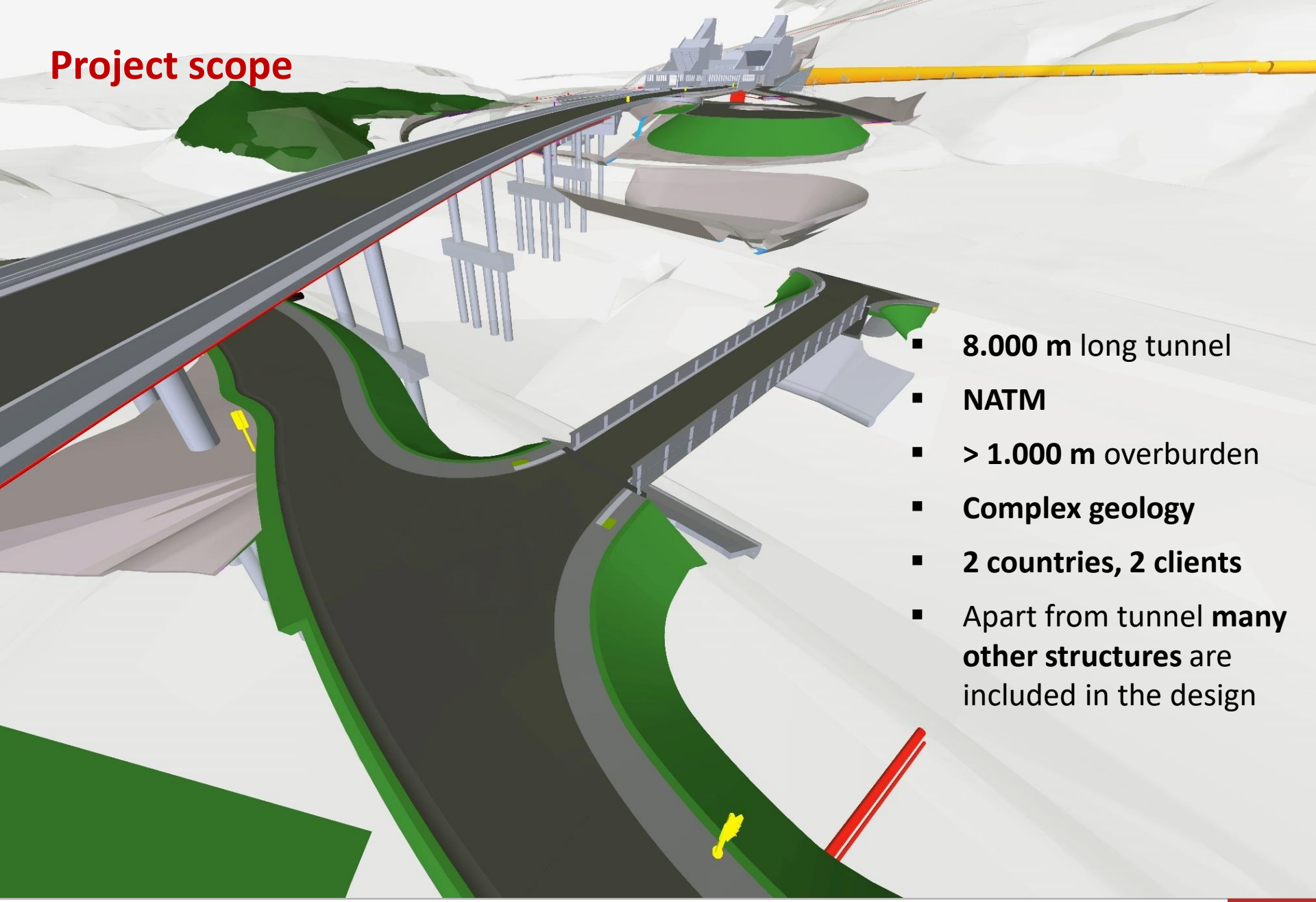
BIM Manager

BIM Overall coordination

BIM Discipline/ Trade coordination

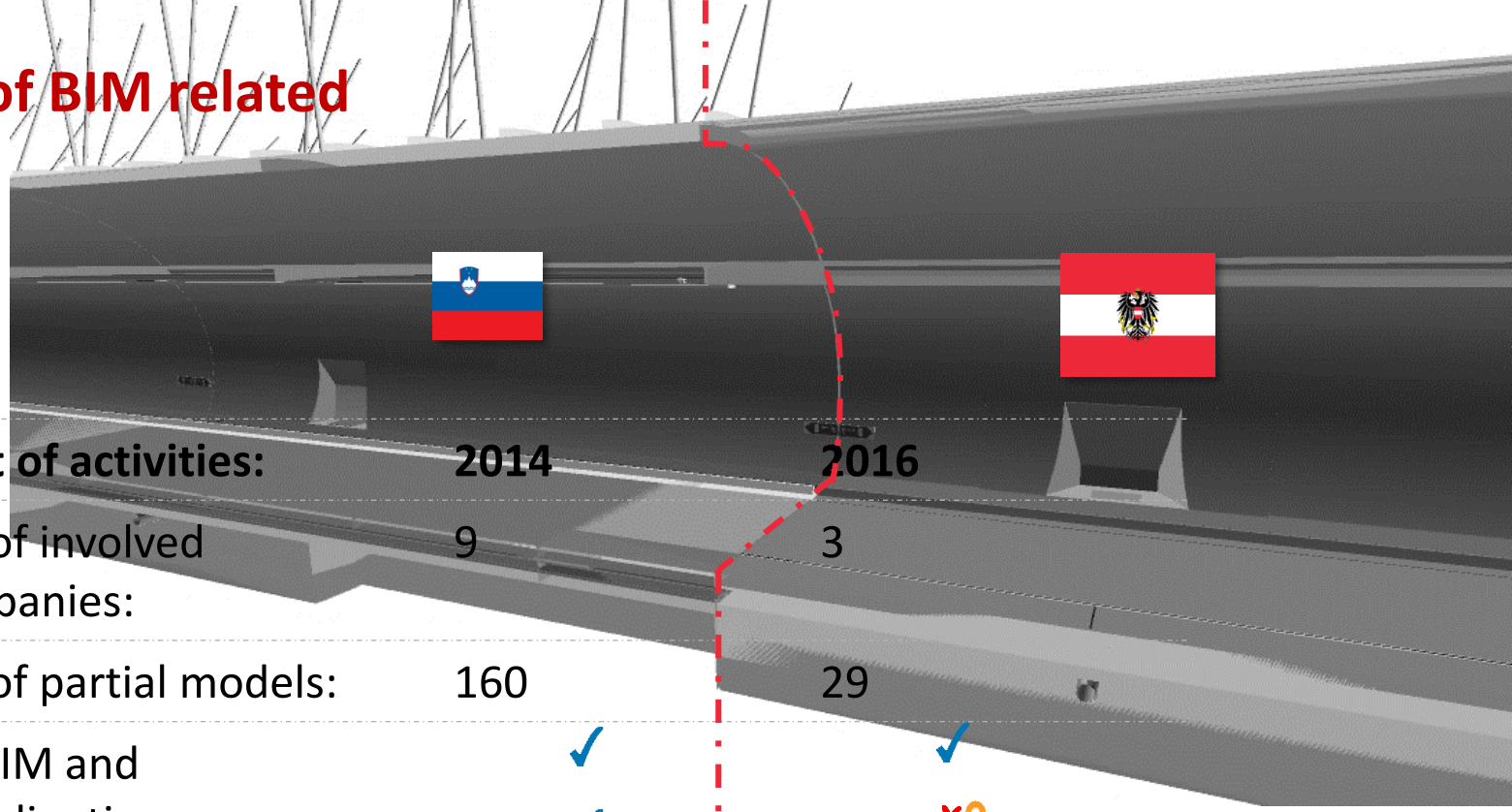


Project scope



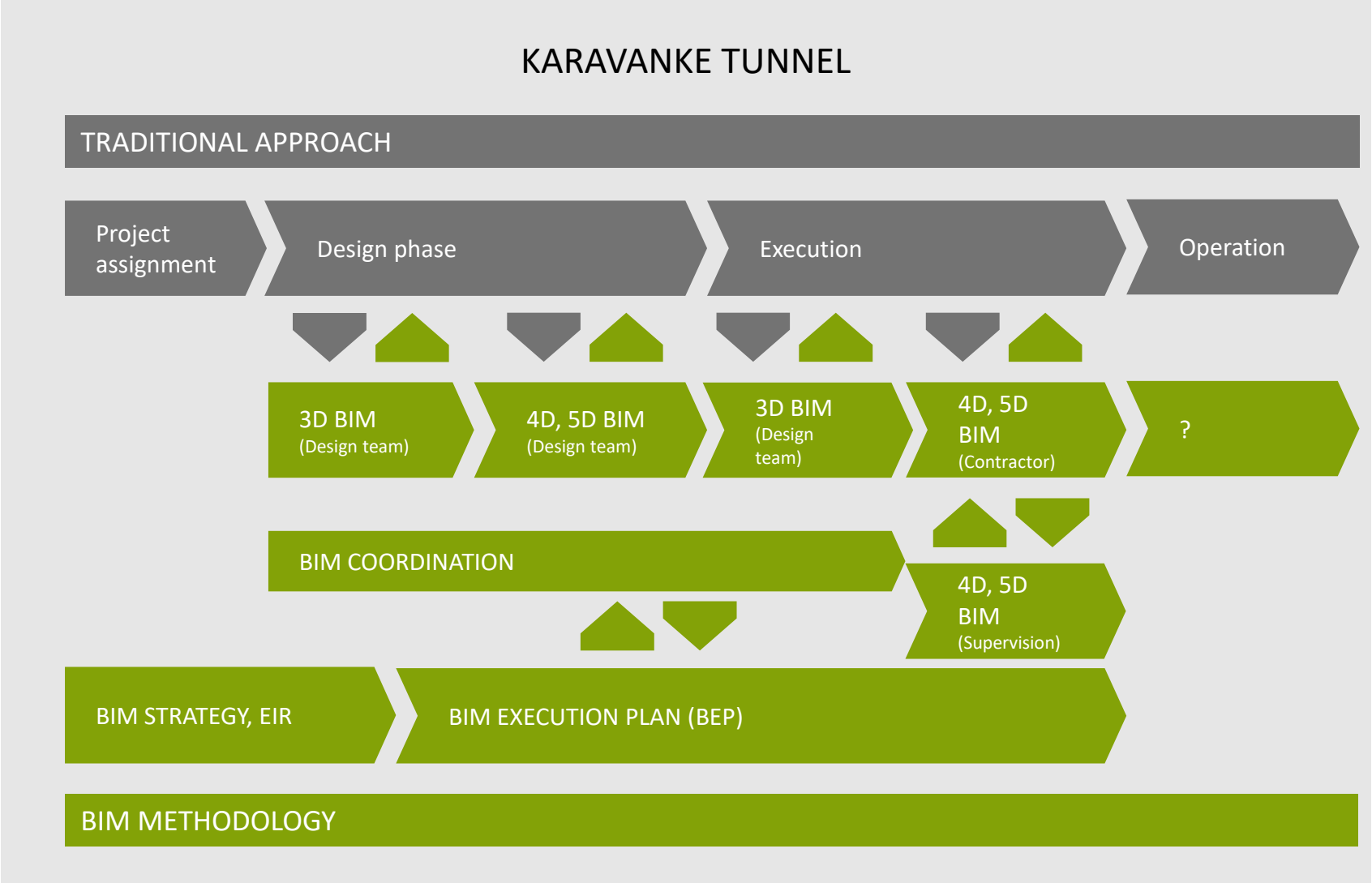
- **8.000 m** long tunnel
- **NATM**
- **> 1.000 m** overburden
- **Complex geology**
- **2 countries, 2 clients**
- Apart from tunnel **many other structures** are included in the design

Summary of BIM related activities

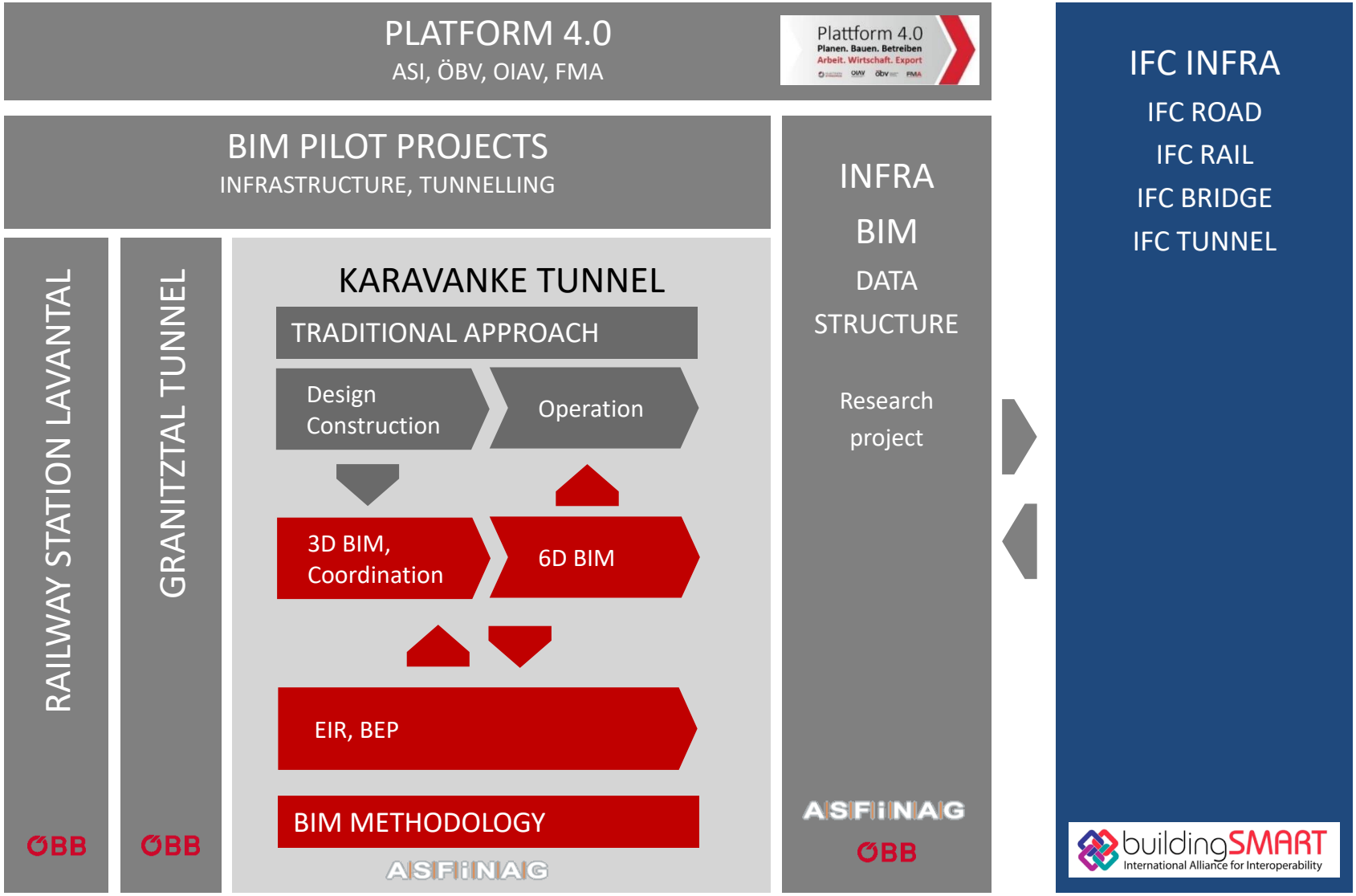


Start of activities:	2014	2016
No. of involved companies:	9	3
No. of partial models:	160	29
3D BIM and Coordination:	✓ ✓	✓ ✗?
4D BIM:	✓	✗?
5D BIM:	✗?	✓
6D BIM:		
LoD:	300 - 400	300
LoI:	400	500

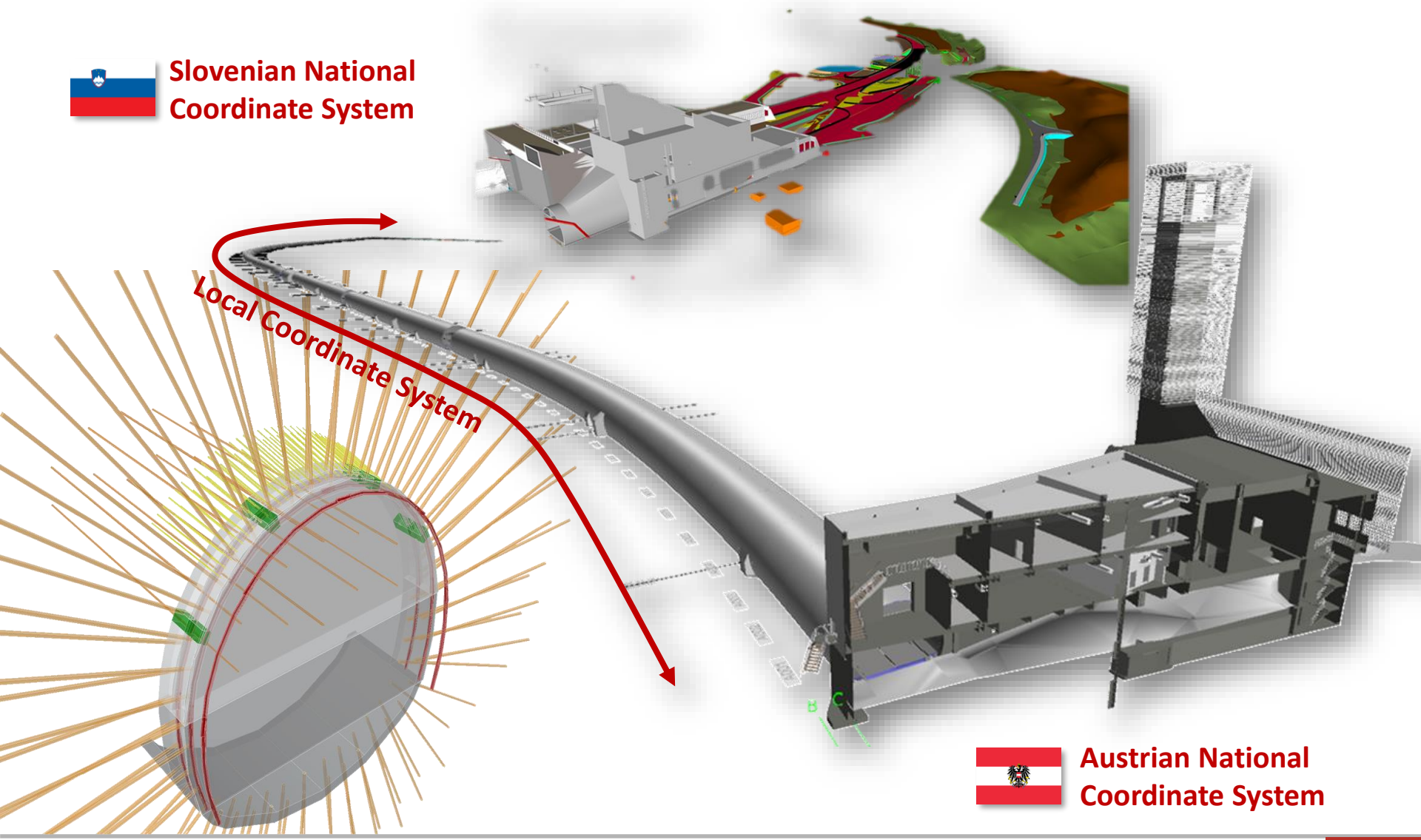
The Strategy | SLOVENIAN SIDE



The Strategy | AUSTRIAN SIDE

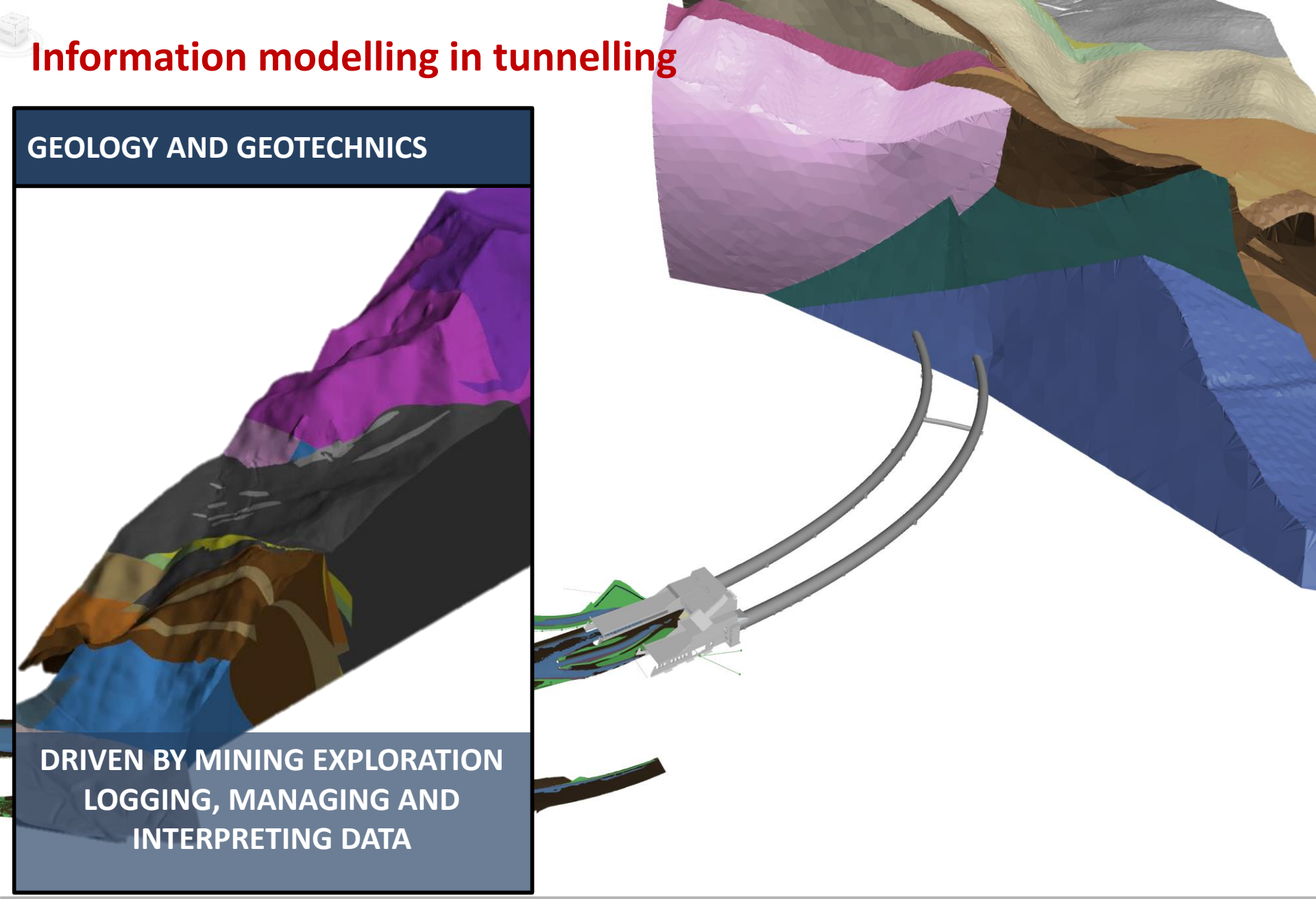


Coordination – 5 Coordination models



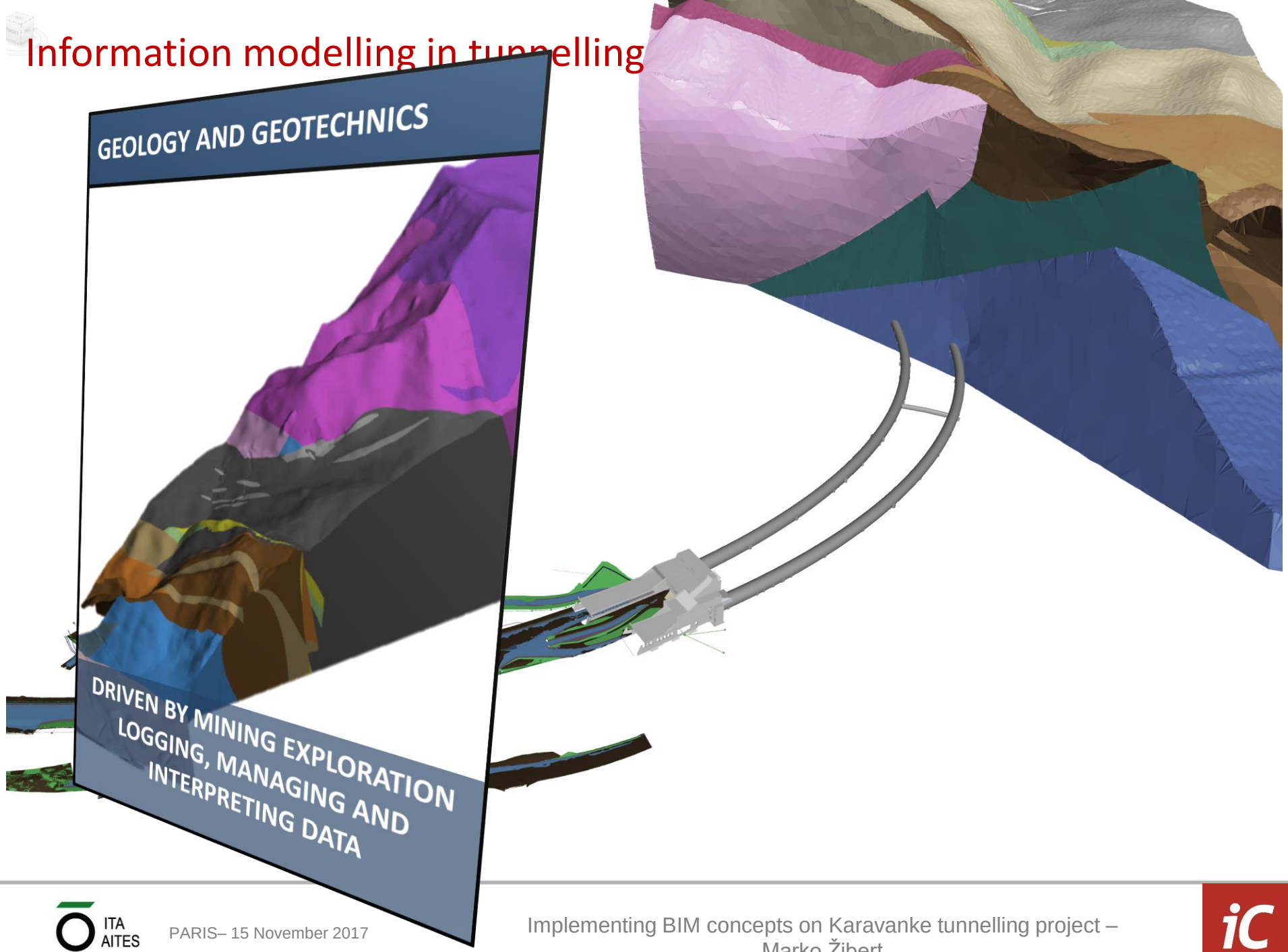
Information modelling in tunnelling

GEOLOGY AND GEOTECHNICS

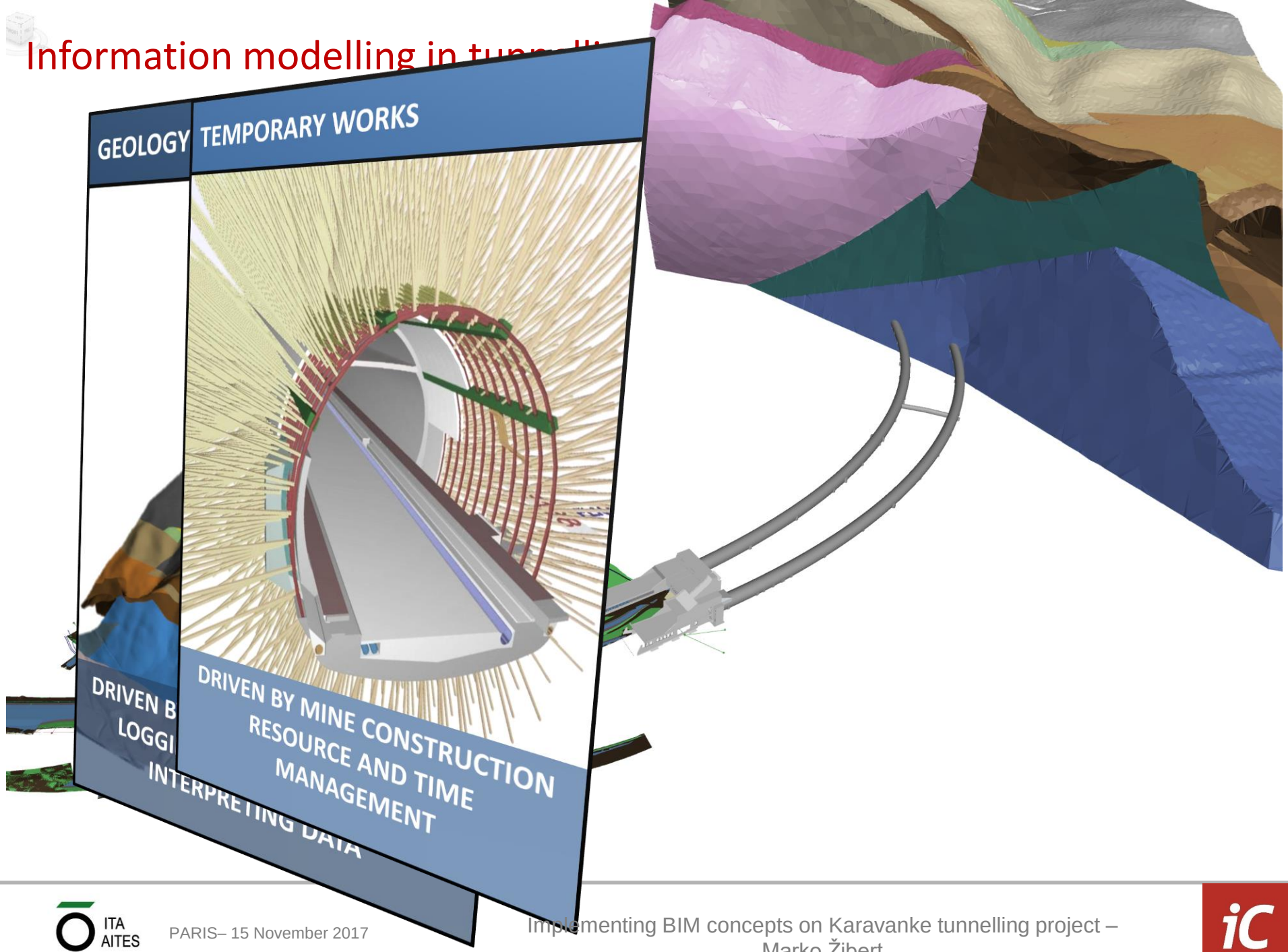


DRIVEN BY MINING EXPLORATION LOGGING, MANAGING AND INTERPRETING DATA

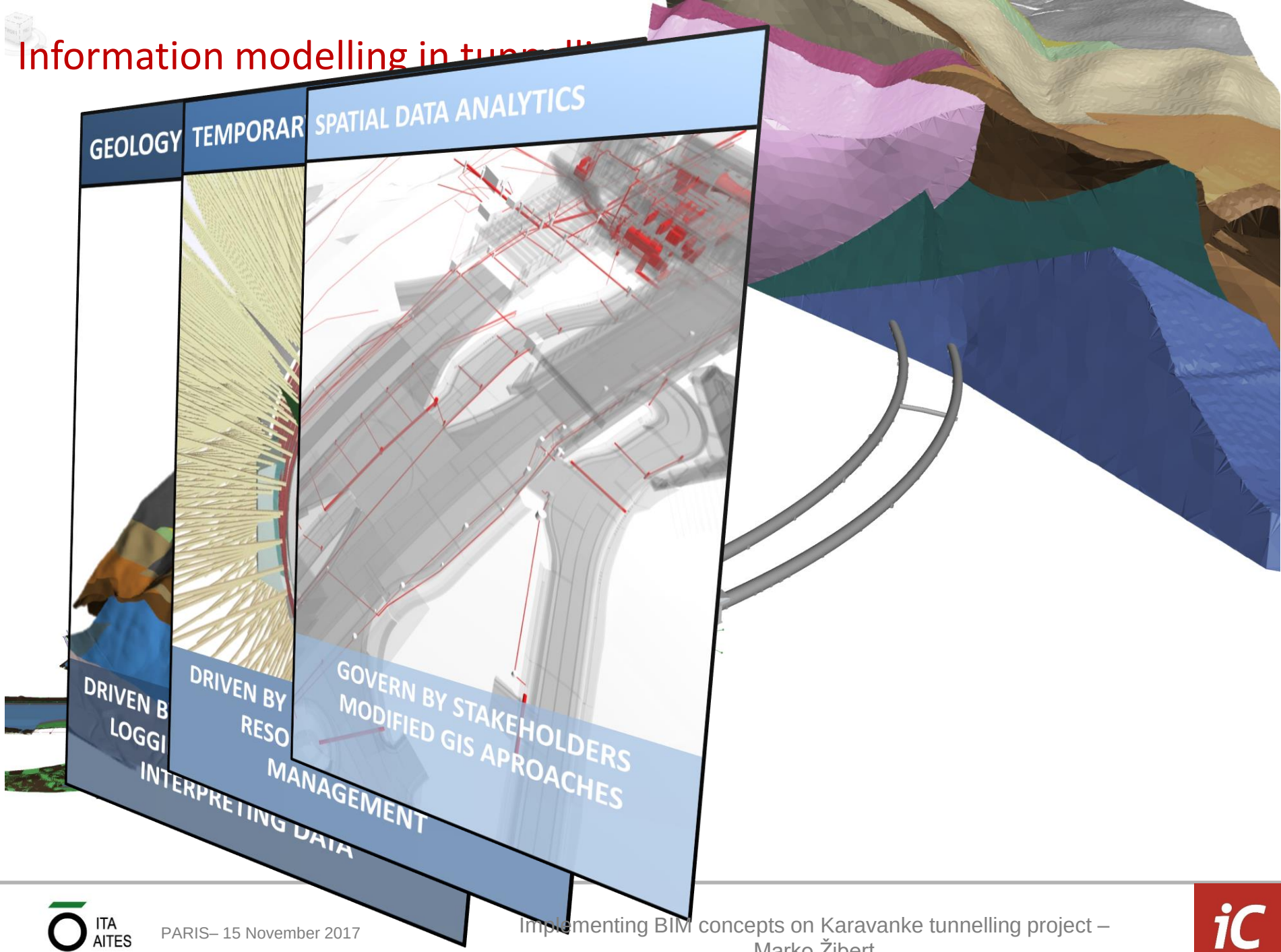
Information modelling in tunnelling



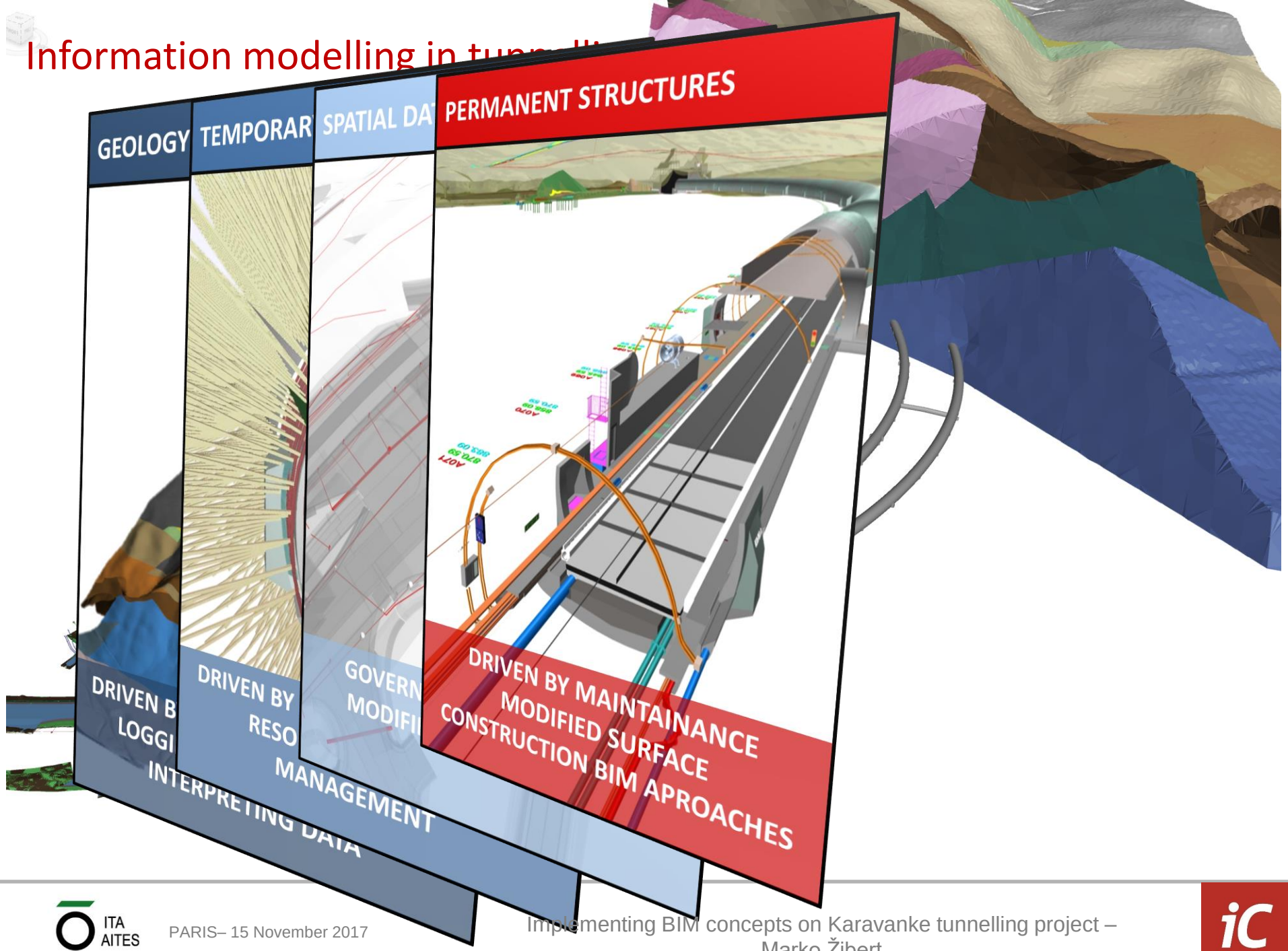
Information modelling in tunnelli



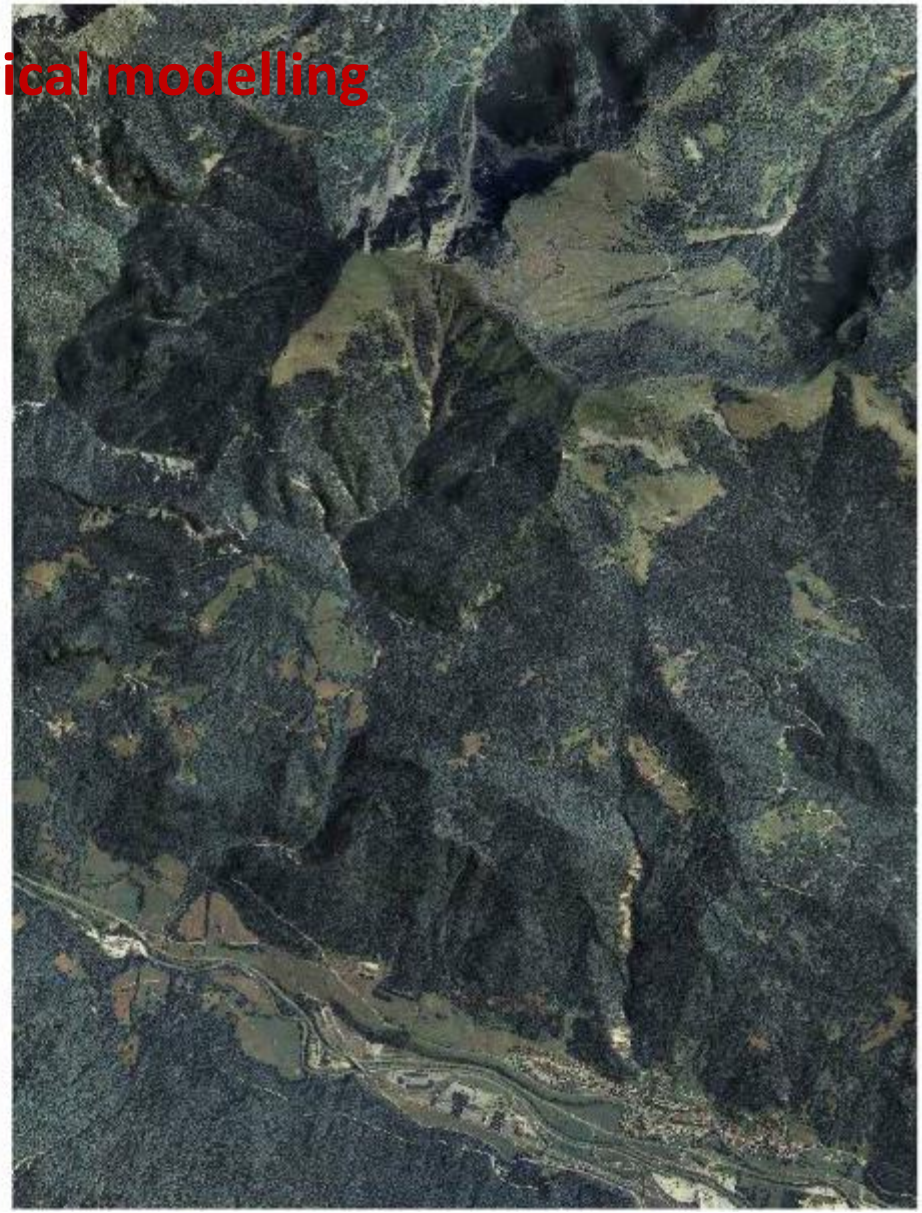
Information modelling in tunn



Information modelling in tunn

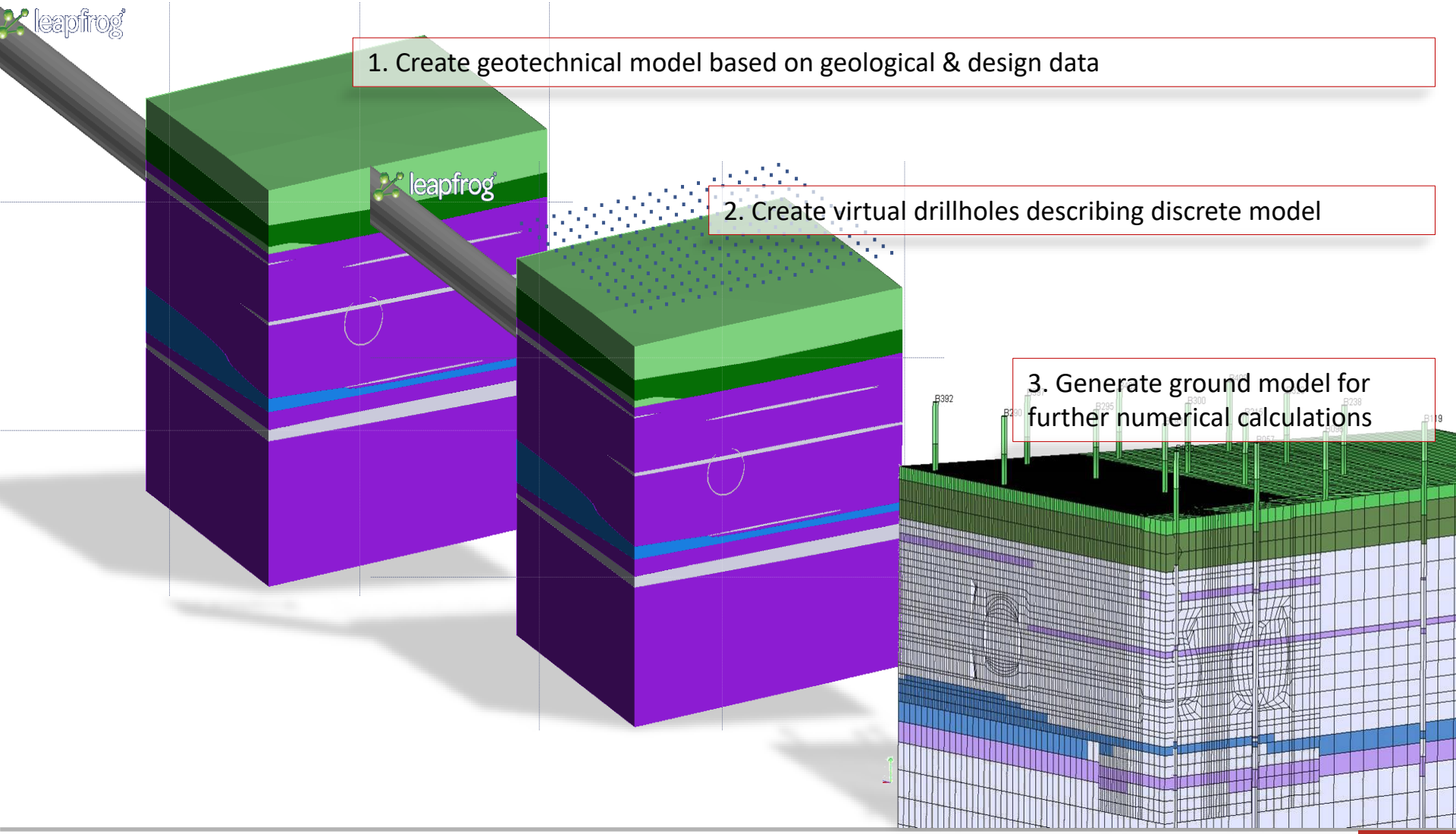


3D Geological modelling

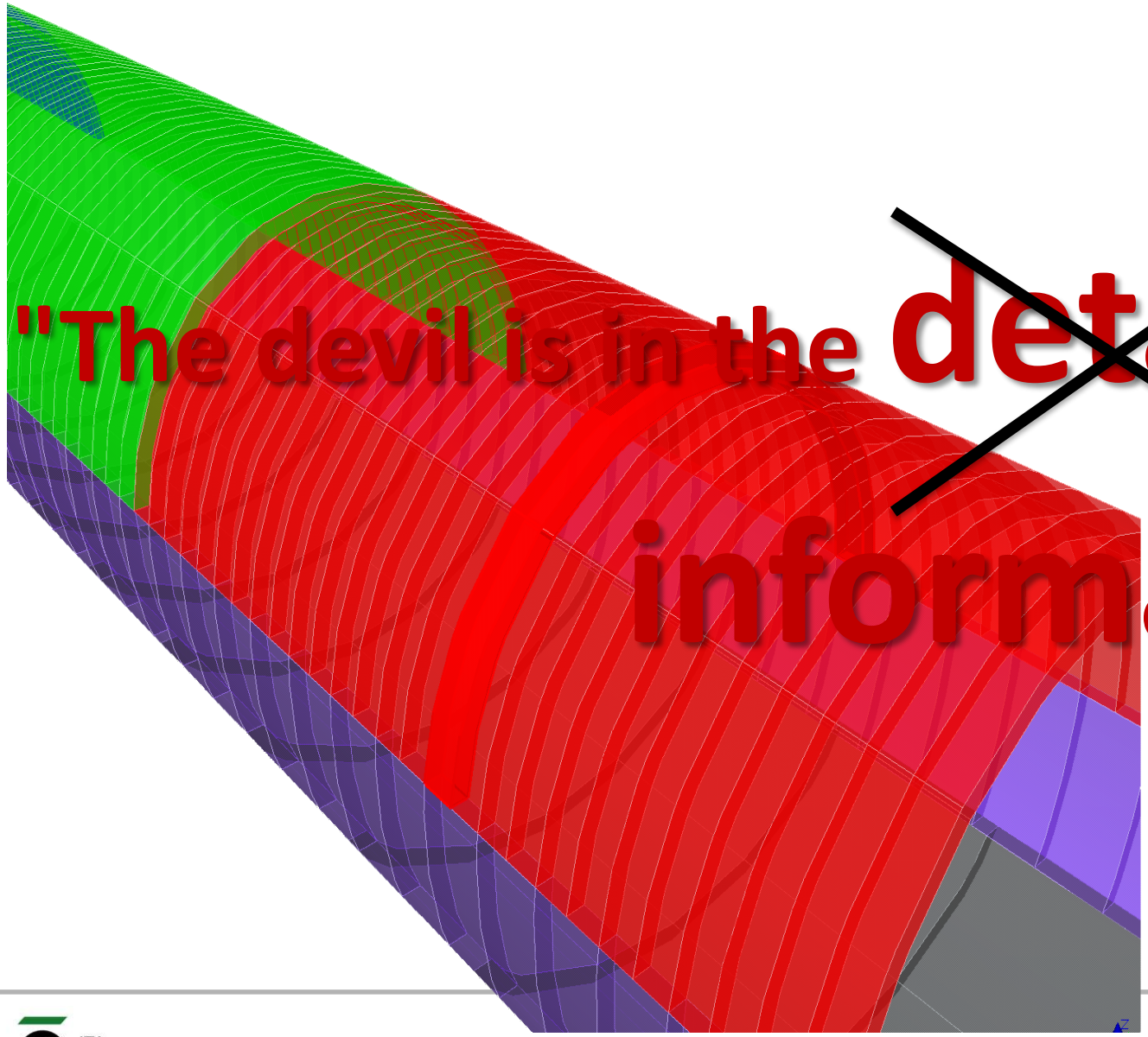


leapfrog®
FAST, DYNAMIC GEOLOGICAL MODELLING

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



Modelling of temporary support structures



"The devil is in the ~~detail~~ information"

Color :	
ReferenceObject	
GUID:	1k3tYSYwPAsvRe7LgoR_hV
File Format:	Ifc
Common Type:	BuildingElementProxy
Geometric Classification:	Solid
Volume:	5.7 m3
Ifc2X3Product	
Product Name:	TH_BT11
Product Description:	
Product Object Ty	
Owning Us	@No Organization
te:	01. 2017 14:59:28
ange n:	Added
ate:	Undefined
	Allplan (Allplan v2017.0)
IfcMate	
Material:	C 25/30 J2
Material Color:	#D5D5D5
Allplan Attributes	
Ident. št. elementa_ALLright:	0101RaE0000013714
Enota:	m3
	BT11
Materia	/30 J2
	429f- 0fe52e
Pay_item_SC :	N 53 718
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_elemens :	N 56 854
Pay_item_Steel_arches :	N 64 116
Pay_item_RB_1_N:	21
Pay_item_RBF_N:	1.112
Pay_item_SC_m2:	14.408
Pay_item_SCF_m2:	58.736
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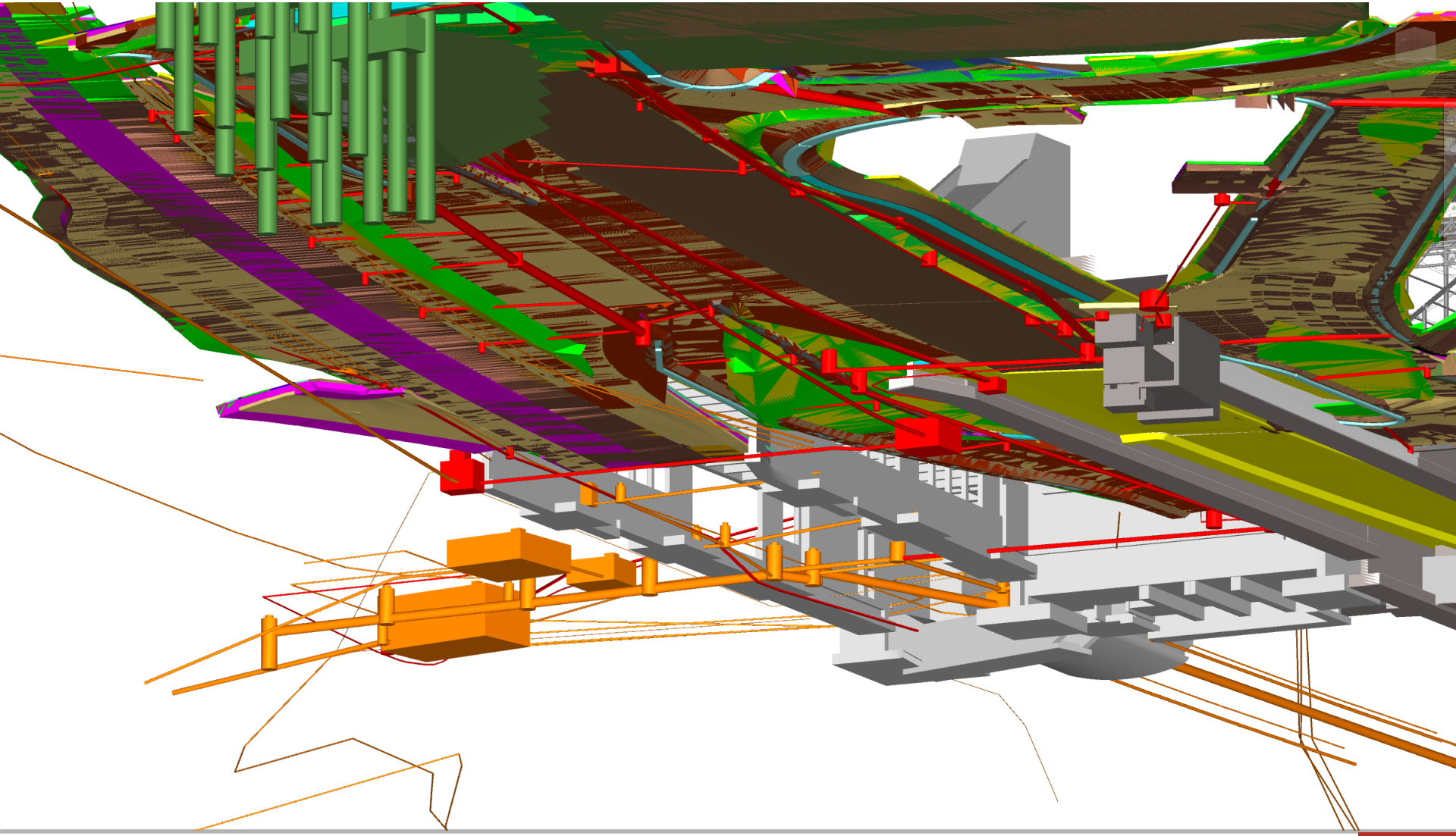
Pay_item_Yielding_elements_N:	4
Suport type:	K 8/33,25

Spatial data analytics



Spatial data analytics

Open GIS database

iC_TU_Con_Blocknumber	Original Type	iC_TU_Con_ConcreteCompressionStrength	iC_TU_Con_ExposureClass	iC_TU_Con_SurfaceAreaPaint	iC_TU_Con_Volume_MT	iC_TU_Con_Volume_N1	iC_TU_Con_Volume_N2
A001	MT_301	C25/30(56)	XC3,XF3,XA1	126,93	86,48385		
A002	MT_301	C25/30(56)	XC3,XF3,XA1	131,63	89,65608		
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	131,62	89,65318		
A007	MT_301	C25/30(56)	XC3,XF3,XA1	131,63	89,81418		
A008	MT_301	C25/30(56)	XC3,XF3,XA1	131,64	89,72397		
A009	NRN-FLN_4.0_301	C25/30(56)	XC3,XF3,XA1	168,58	74,80433	10,55313	9,46895
A010	MT_RN1_4.0_301	C25/30(56)	XC3,XF3,XA1	144,98	75,64185	6,61906	6,25478
A011	MT_301	C25/30(56)	XC3,XF3,XA1	131,63	89,81564		
A012	MT_301	C25/30(56)	XC3,XF3,XA1	131,63	89,6681		
A013	MT_301	C25/30(56)	XC3,XF3,XA1	131,63	89,80123		
A014	MT_301	C25/30(56)	XC3,XF3,XA1	131,63	89,72318		
A015	MT_RN1_4.0_301	C25/30(56)	XC3,XF3,XA1	144,99	75,78456	6,61906	6,26918
A016	MT_301	C25/30(56)	XC3,XF3,XA1	131,63	89,81579		
A017	NRSI-FLN_4.0_301	C25/30(56)	XC3,XF3,XA1	141,06	72,51215	10,55412	9,40429
A018	MT_301	C25/30(56)	XC3,XF3,XA1	131,63	89,62018		
A019	MT_301	C25/30(56)	XC3,XF3,XA1	131,63	89,8175		
A020	MT_RN2_4.0_301	C25/30(56)	XC3,XF3,XA1	148,31	74,03069	7,8723	6,62225
A021	MT_301	C25/30(56)	XC3,XF3,XA1	131,63	89,80428		
A022	MT_301	C25/30(56)					
A023	MT_301	C25/30(56)					
A024	MT_RN1_4.0_301	C25/30(56)					
A025	NRN-FLN_4.0_301	C25/30(56)					
A026	MT_301	C25/30(56)					
A027	MT_301	C25/30(56)					
A028	MT_301	C25/30(56)					
A029	MT_RN1_4.0_301	C25/30(56)					
A030	MT_301	C25/30(56)					
A031	MT_301	C25/30(56)					
A032	GQ26_1.PH_301-310.1	C25/30(56)					
A033	NRSI-FLN_4.0_301	C25/30(56)					
A034	MT_RN1_4.0_301	C25/30(56)					
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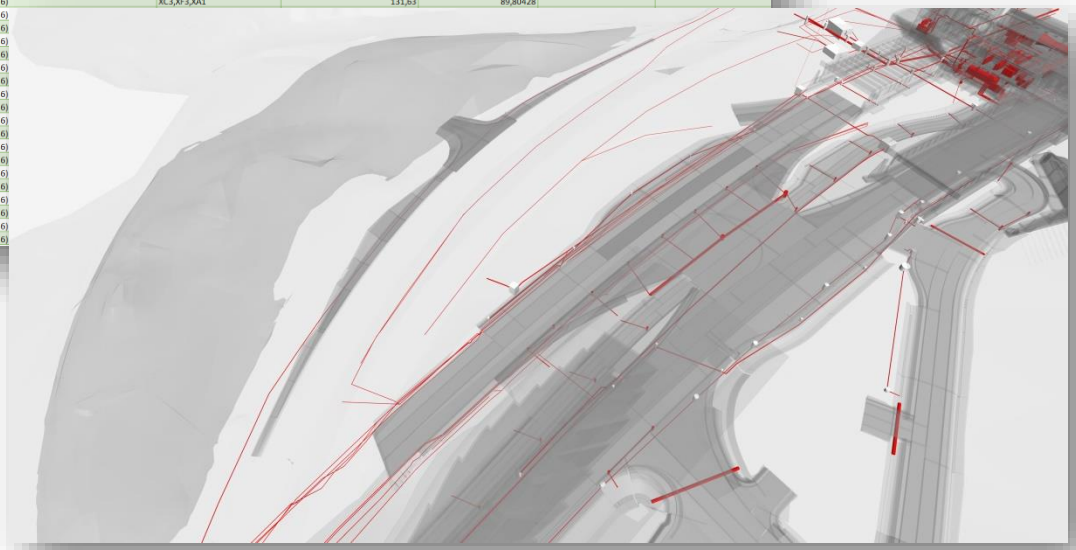
A037	MT_301	C25/30(56)					
A038	MT_301	C25/30(56)					
A039	MT_RN2_4.0_301	C25/30(56)					

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

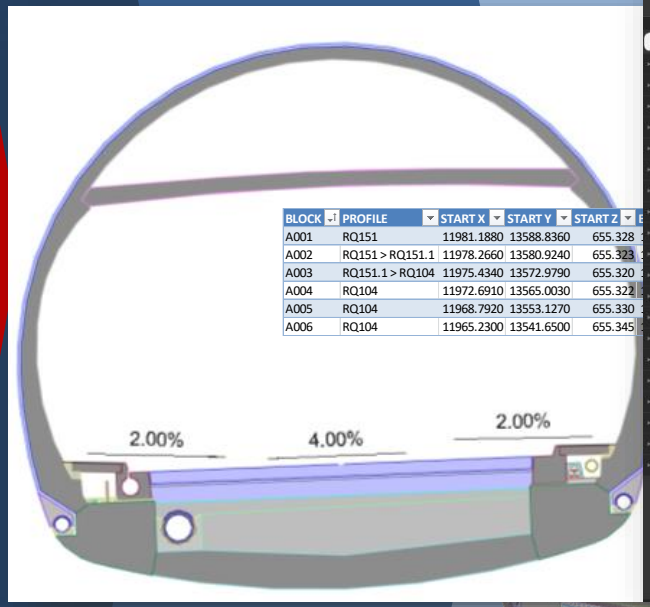
Detailed design modelling goals:

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

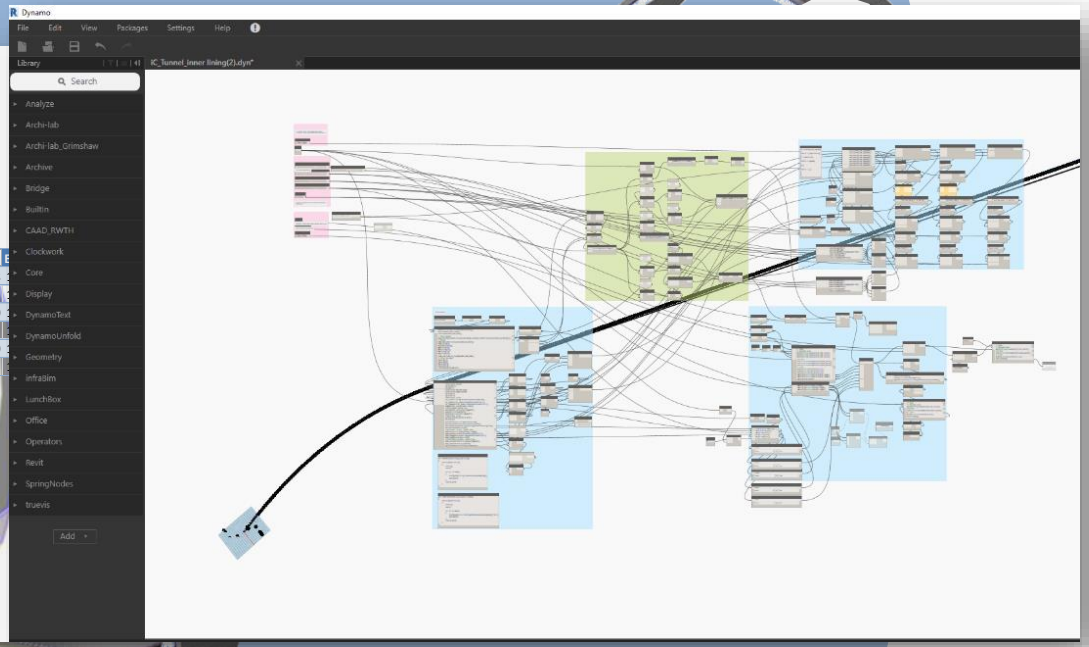
Early stage of model development

Create parametric families

Assembly: distribute parametric families over profiles



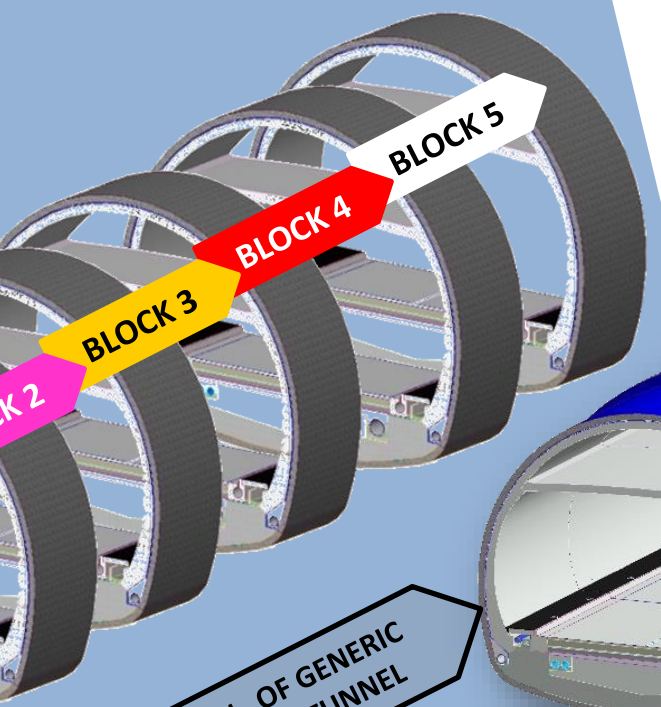
BLOCK	PROFILE	START X	START Y	START Z
A001	RQ151	11981.1880	13588.8360	655.328
A002	RQ151 > RQ151.1	11978.2660	13580.9240	655.323
A003	RQ151.1 > RQ104	11975.4340	13572.9790	655.320
A004	RQ104	11972.6910	13565.0030	655.322
A005	RQ104	11968.7920	13553.1270	655.330
A006	RQ104	11965.2300	13541.6500	655.345

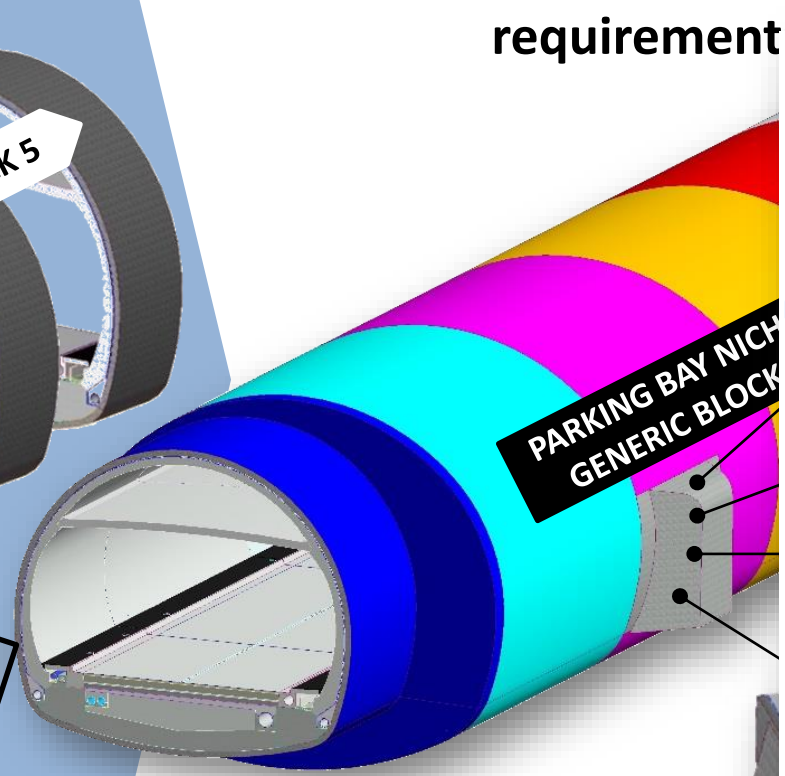


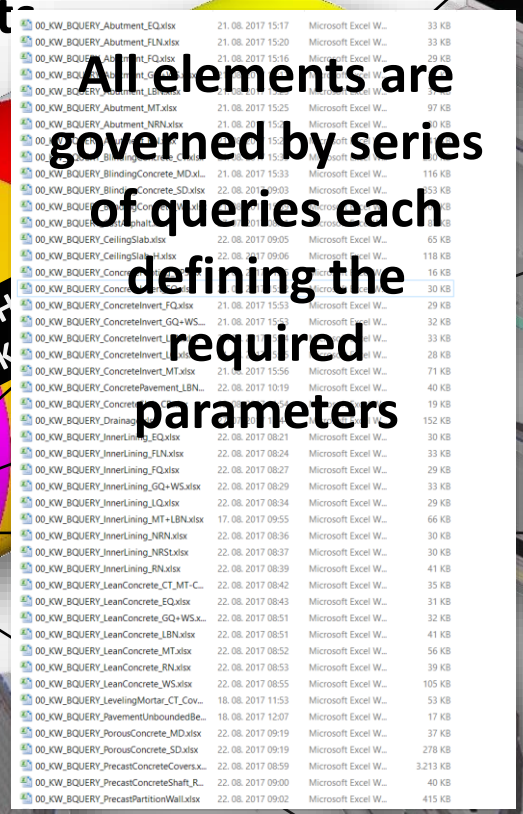
Early stage of model development

ute parametric families
r profiles

Distribute niches and other interventions according to the requirements



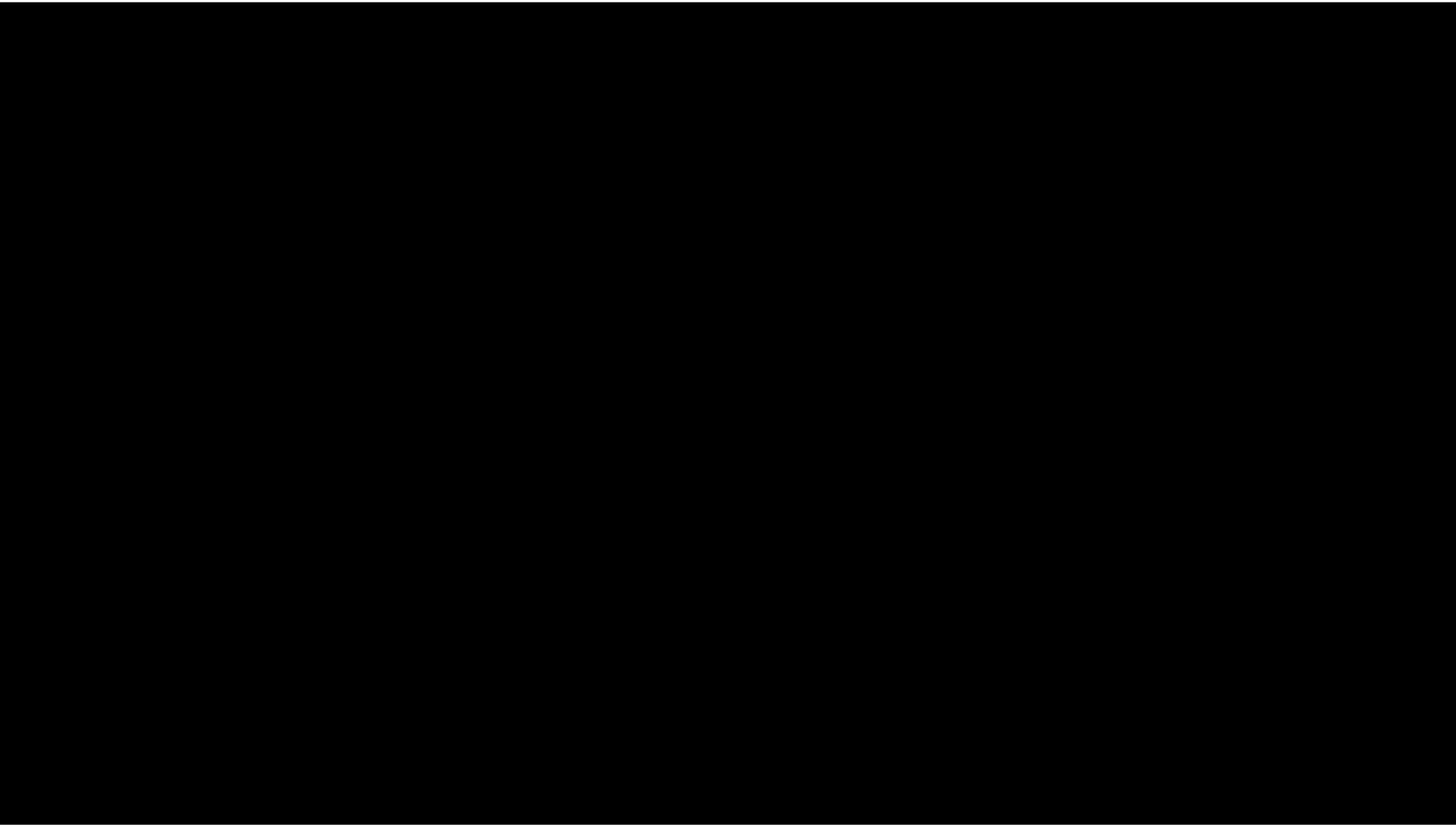




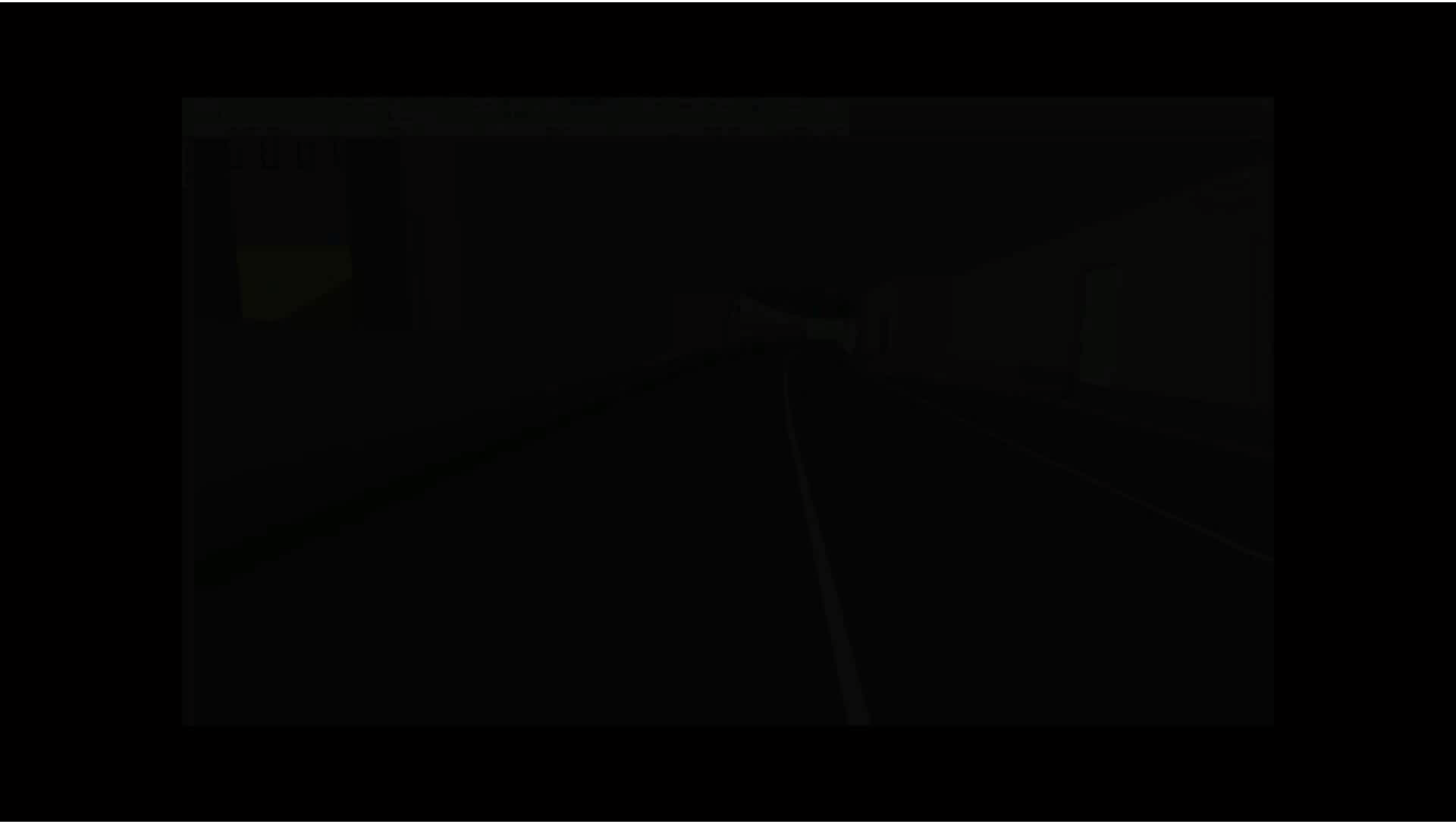
All elements are governed by series of queries each defining the required parameters

ATIC COMPOSITION OF GENERIC
KS ALONG THE RUNNING TUNNEL

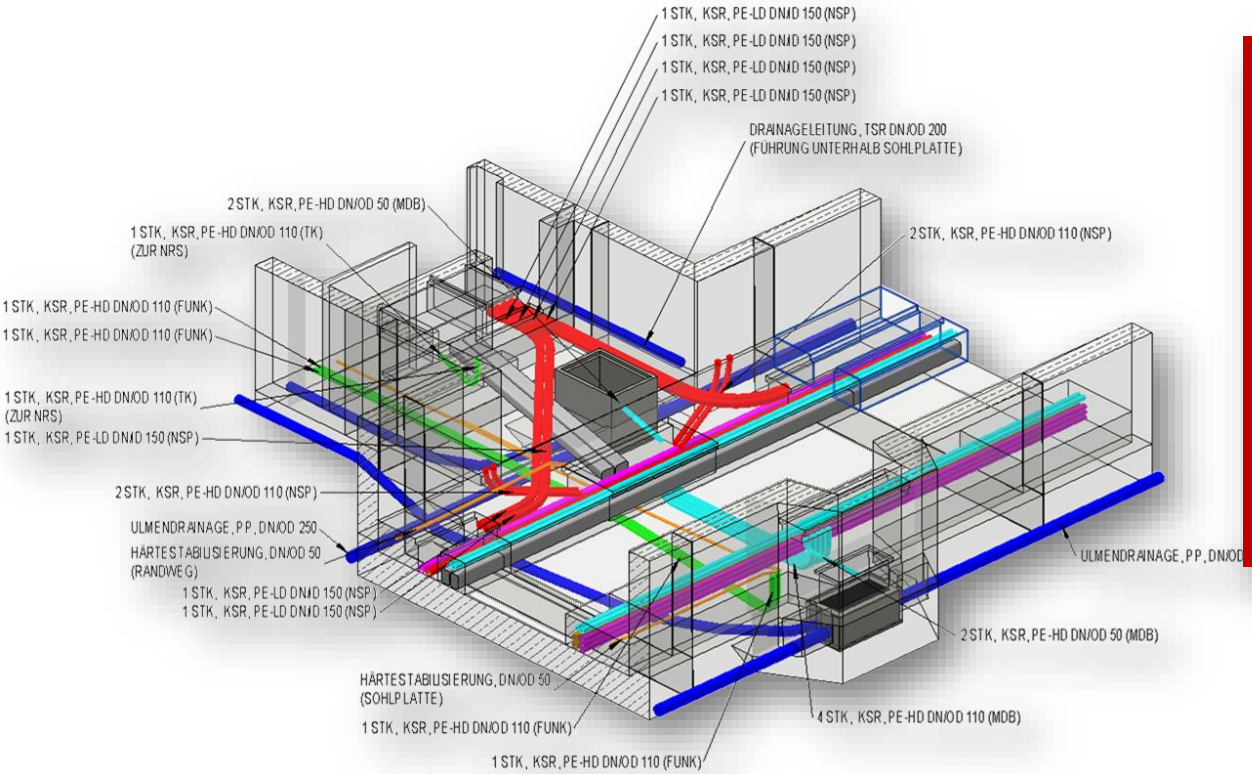
Early stage - 4D (costs) and 5D (time) Modelling



Early stage - Communication with stakeholders



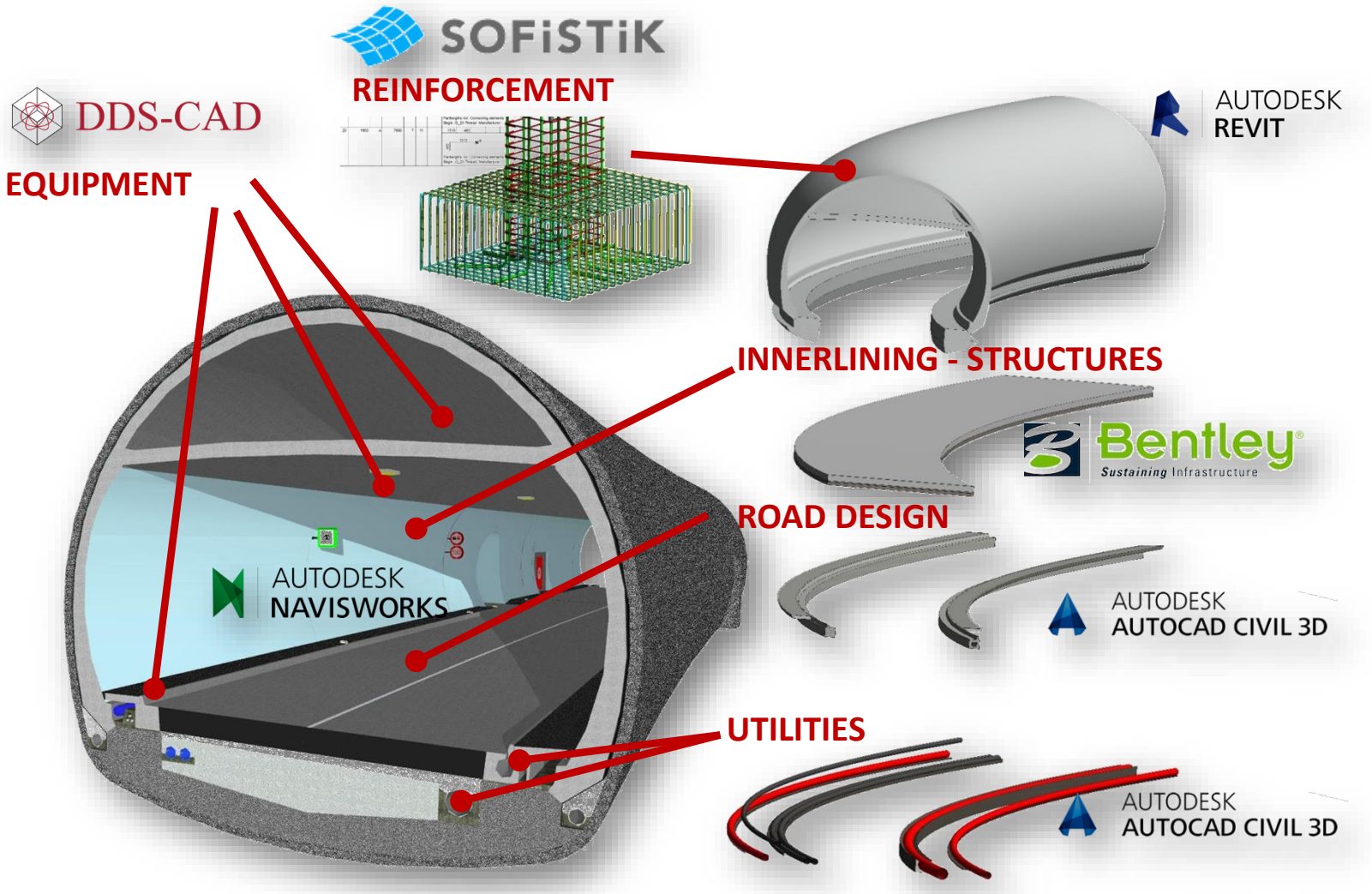
Detailed design stage - Model segregation



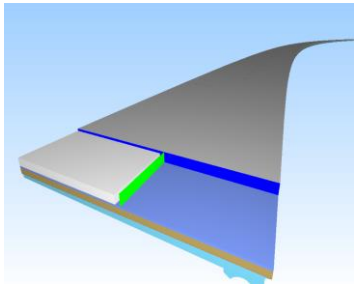
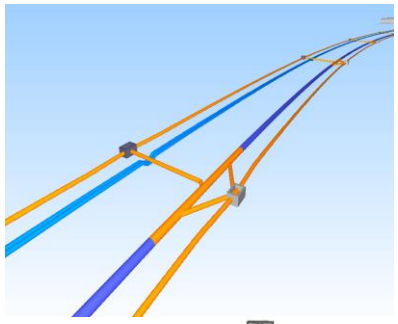
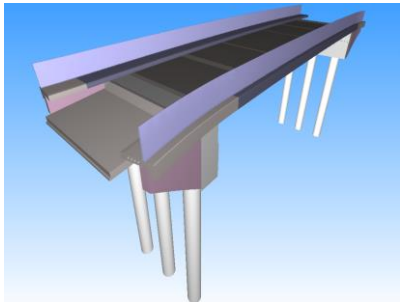
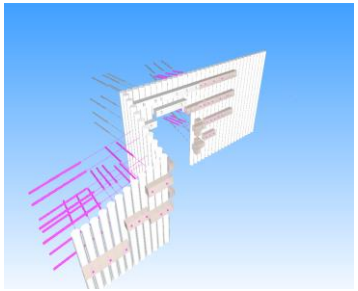
CONCRETE LINING

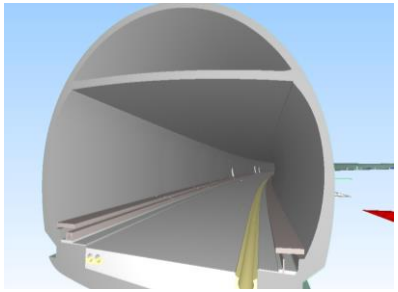
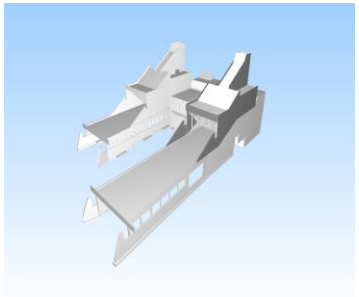
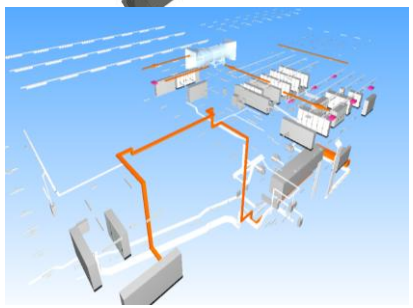
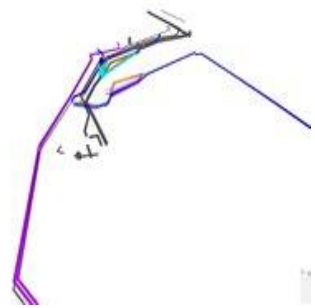
- ROAD DESIGN
- MECHANICAL
- ELECTRICAL
- DEWATERING

Detailed design stage - Model segregation

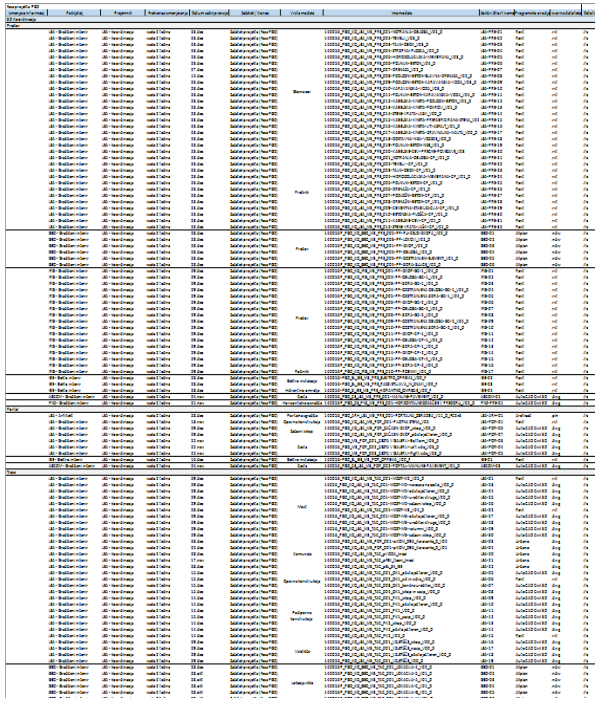


Detailed design stage - 190 Partial models

Model Delivery Schedule



Detailed design stage – Coordination workflows

Segregate generic model to discipline specific models

IFC2x3 CV2.0

Create & Analyze detailed discipline specific models

Each team uses its own design specific tools

Compile federated model

IFC2x3 CV2.0

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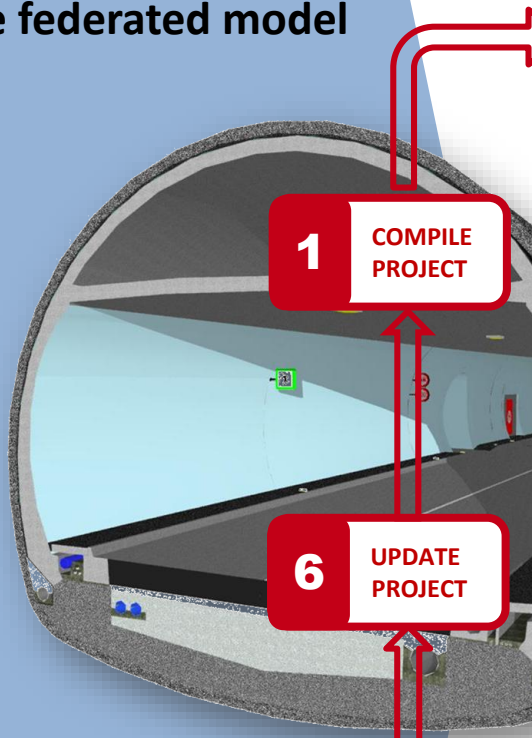
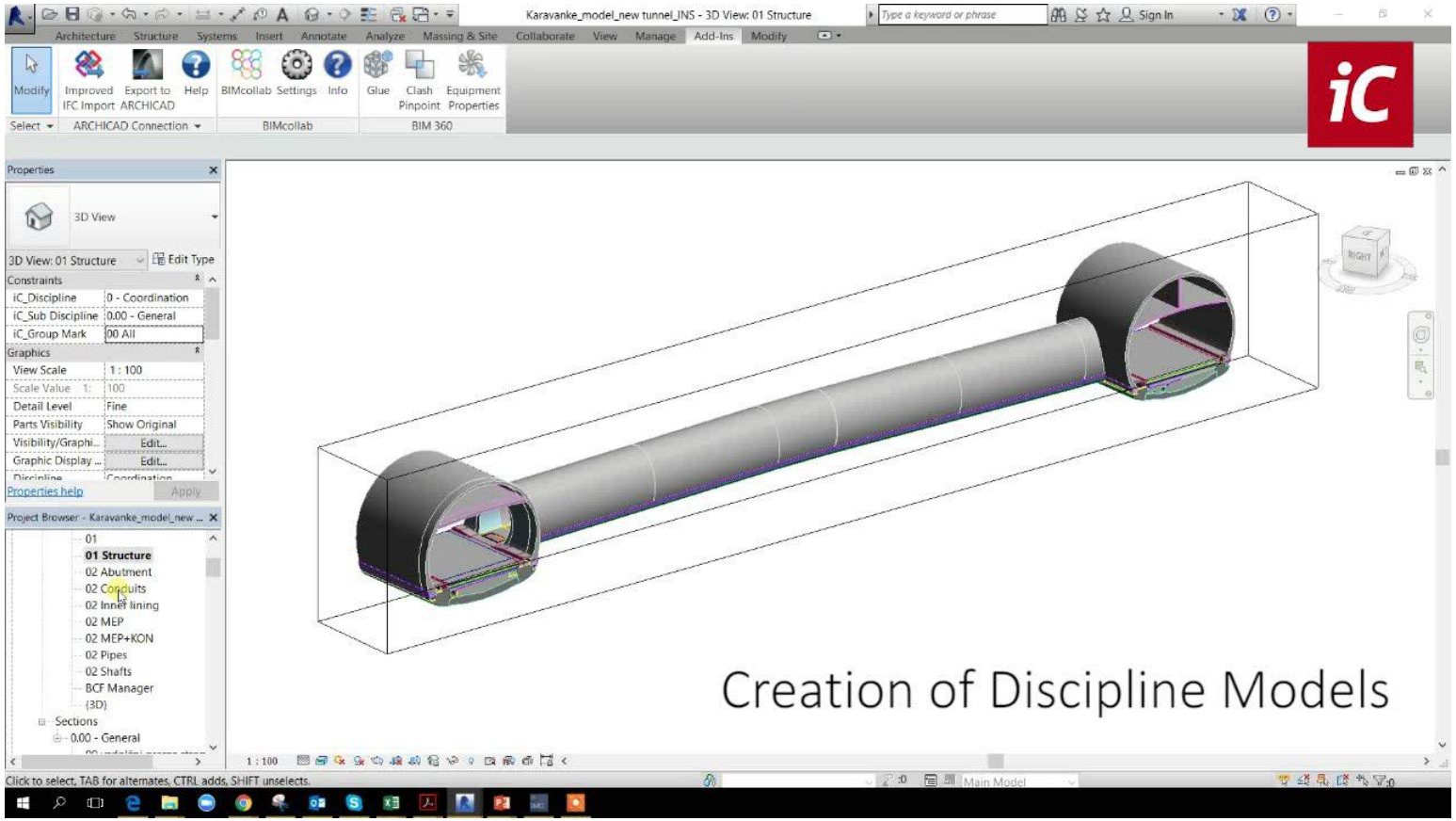


1 COMPILE PROJECT

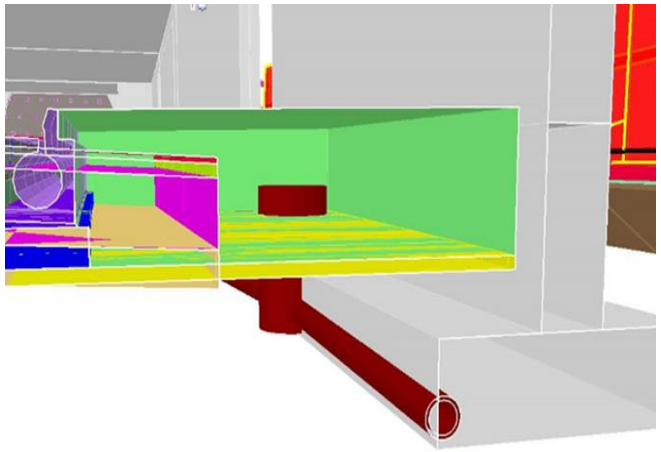
6 UPDATE PROJECT

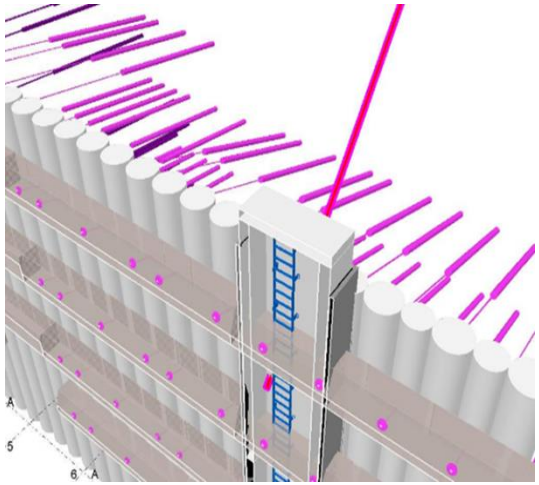
5

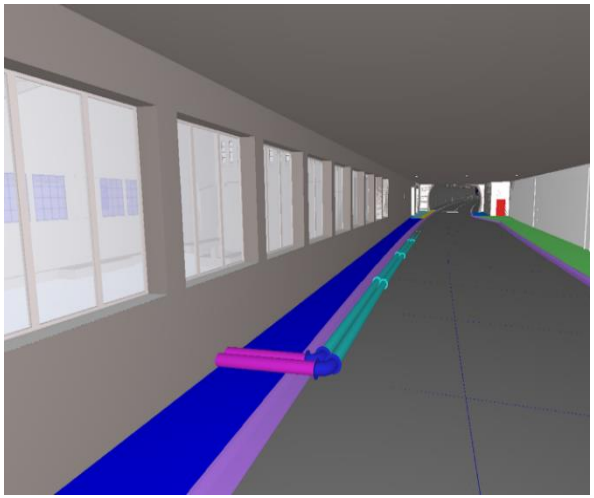
Detailed design stage – Efficient design coordination

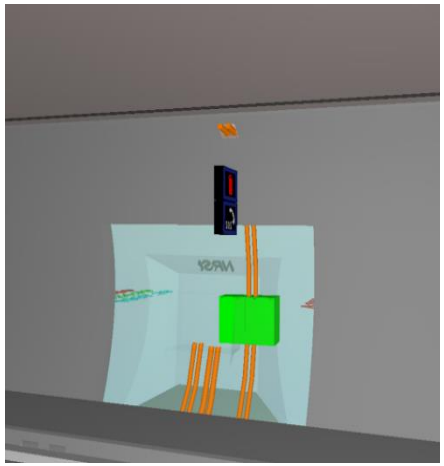


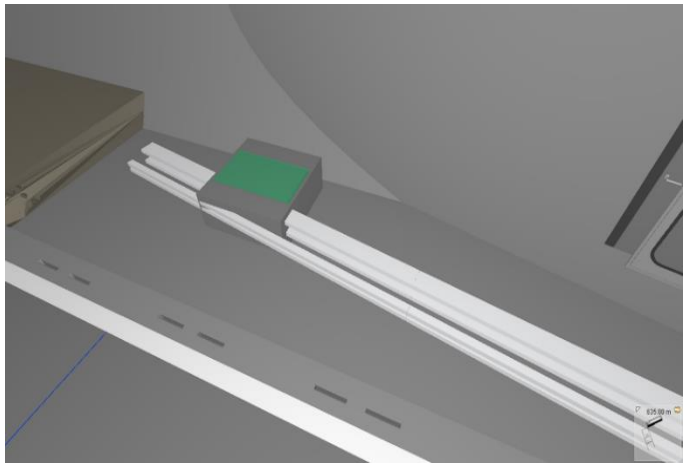
Detailed design stage – 1500 inconsistencies resolved in design stage

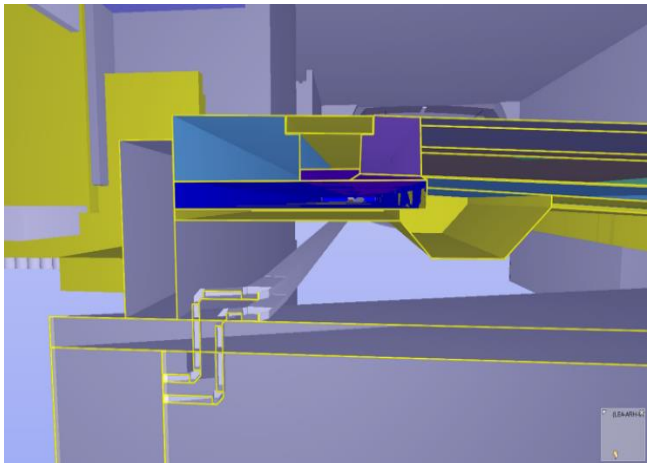




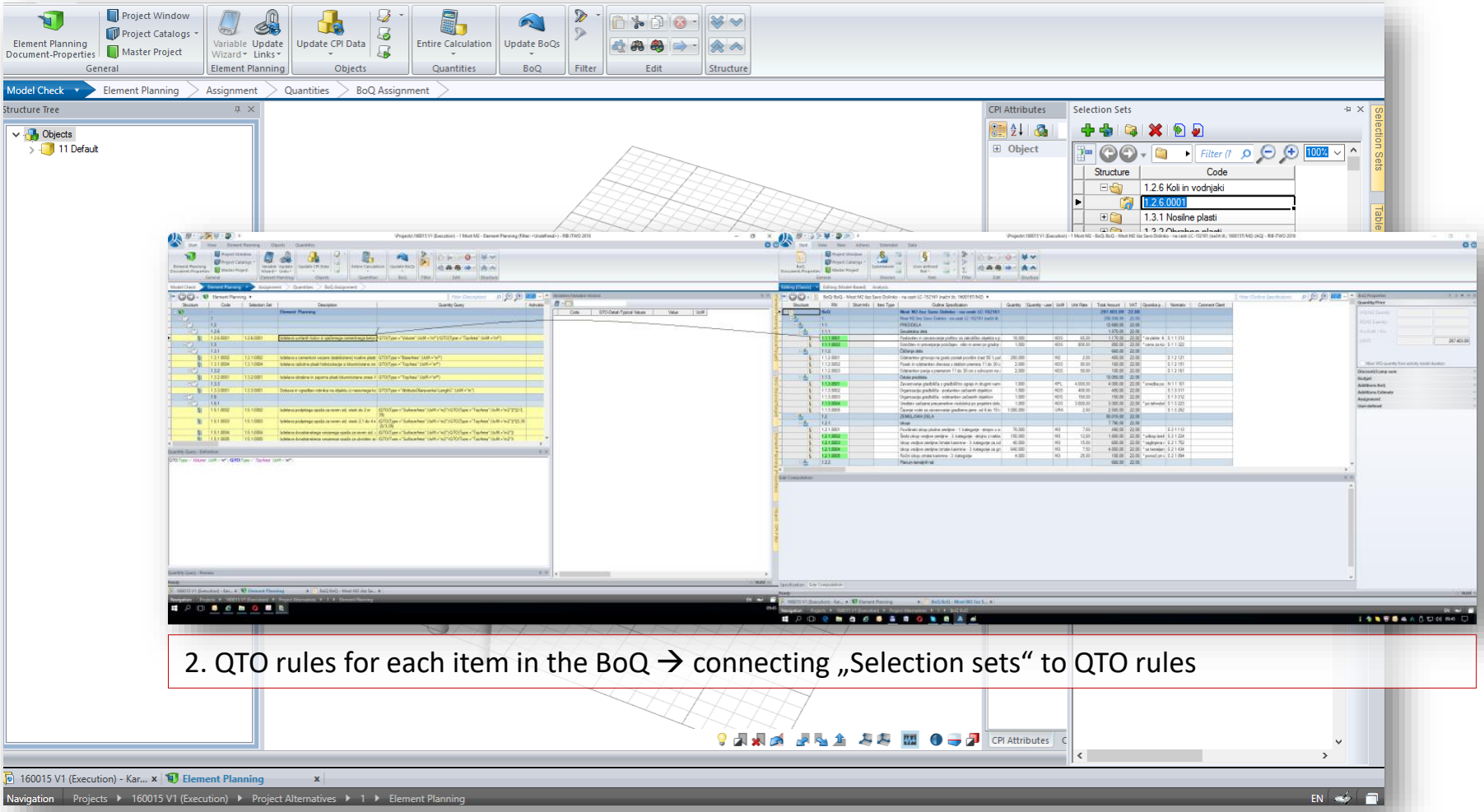








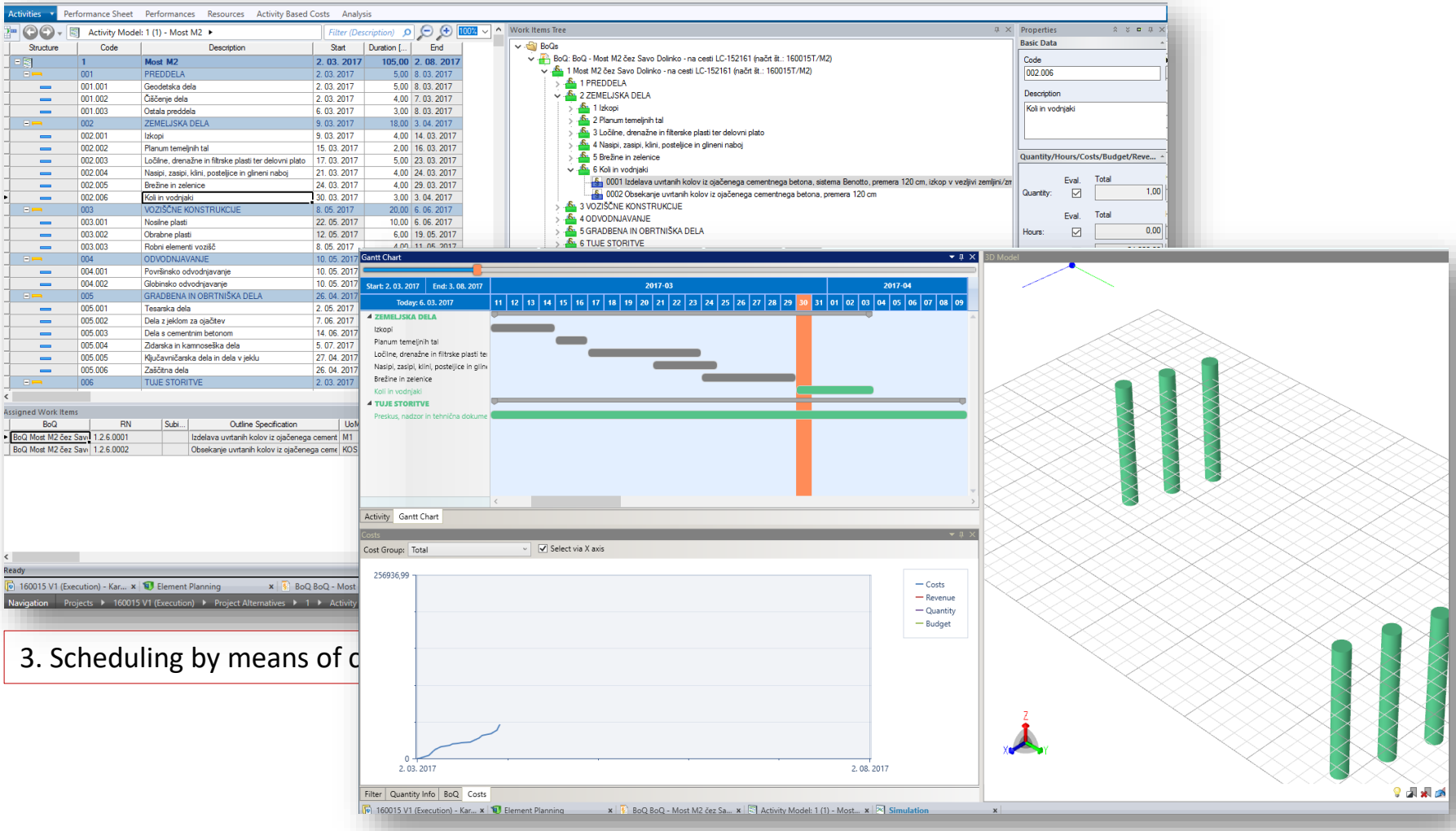
Detailed design stage – 4D and 5D Modelling



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

1. Creating „Selection sets“

Detailed design stage – 4D and 5D Modelling



3. Scheduling by means of c

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 uvrtanih kolov iz	QTO(Type:="Volume";UoM:="m³")/QTO(Type:="BaseArea";UoM:="m²")		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 uvrtanih 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 (cintractual) BOQs:**

RN	Outline Specification	Model based Quantity	Quantity – official BOQ	UoM	Unit Rate	Total Amount	VAT	Opomba postavke	Normativ	Comment Client
1.2.6.0001	Izdelava uvrtanih kolov iz	60,00	60,000	M1	390,00	23.400,00	22,00	* kompletna	S 2 7 115	

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Detailed design stage – 4D and 5D Modelling