

BIM in Tunnelling

Webinar – March 18, 2021

Designing the „I“ in BIM

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1. Introduction
2. Motivation: Designing the „I“ in BIM
3. Result: A tunnelling data dictionary
4. A look in the crystal ball

DEGES: (road)ways are our goal

- 30 years of experience
- Shareholders:
 - Federal republic of Germany
 - 12 federal states of Germany
- Public contracting authority
- Project management company until handover to operation phase
- ~ 2900 km highways / ~ 40 bn €



B 90n, Ilmtalbrücke. Foto: Nürnberg Luftbild, Hajo Dietz

BIM-Projects by DEGES (already outdated again)

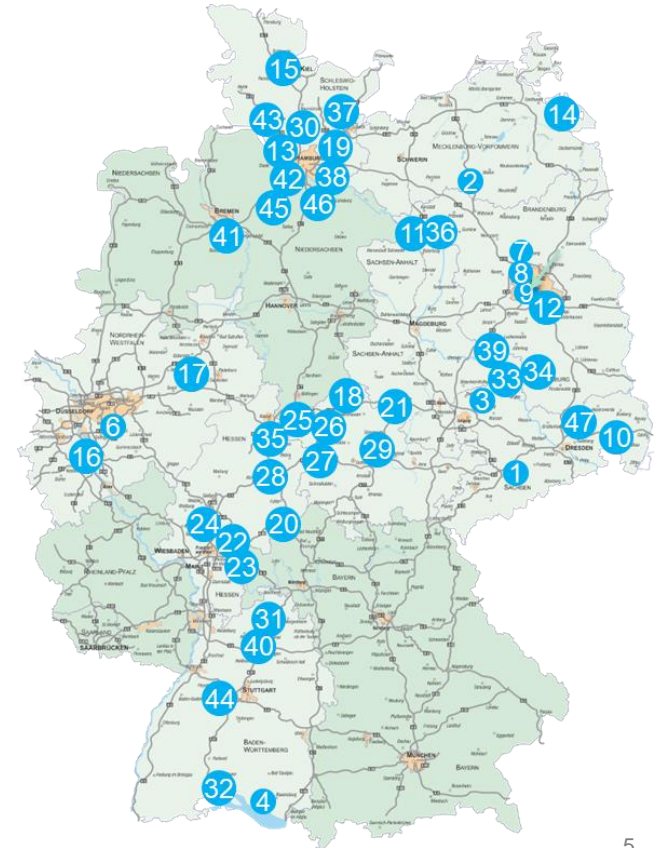
Extract

....

- 38 - A1, 8-streifige Erweiterung, Abschnitt Süd
- 39 - B101, OU Elsterwerda
- 40 - A81, Eberbach-und Brettachtalbrücke
- 41 - A1, Ersatzneubau Weserstrombrücke
- 42 - A7/A26, AS Neu Wulmstorf (o) - LGr. NI/HH
- 43 - A23, AS Tornesch - AD HH-Nordwest - 6-streifige Erw.
- 44 - A81, AK Stuttgart - AS Sindelfingen Ost, Erw.
- 45 - A7/A26, LGr. NI/HH - AK HH-Hafen
- 46 - A7/A26, AK HH-Hafen - A1/A26, AD Süderelbe
- 47 - A4, AD Dresden-Nord (m) - AS Pulsnitz (o)

....

Currently ~70 BIM projects



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Motivation: Designing the „I“ in BIM



- 3D-modelling is nothing “new”
- 3D-modelling is not “necessary” for engineering success

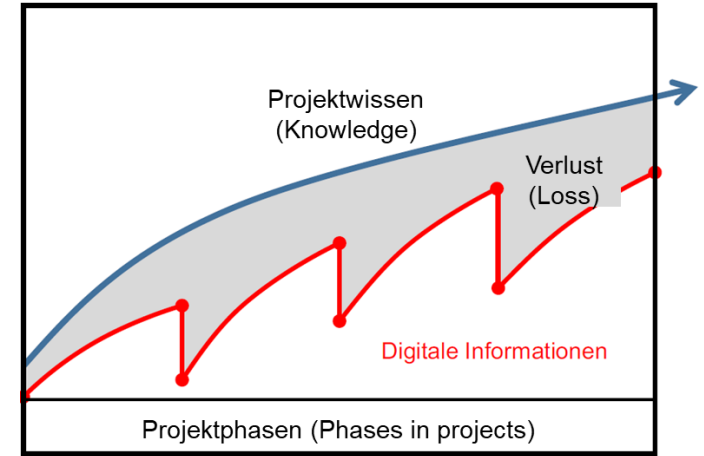
But:

- BIM is more than only 3D-modelling
- Effective information management enables knowledge-based decision making

***The “I” in BIM contributes to engineering success
... and thus also to commercial success***

Motivation: Effective information management

- BIM can help reduce the loss of information when changing phases in projects
- Reducing information loss requires definition of projected (and anticipation of later) use case requirements
- Effective information management requires also the definition of use cases, actors, deliverables, ...



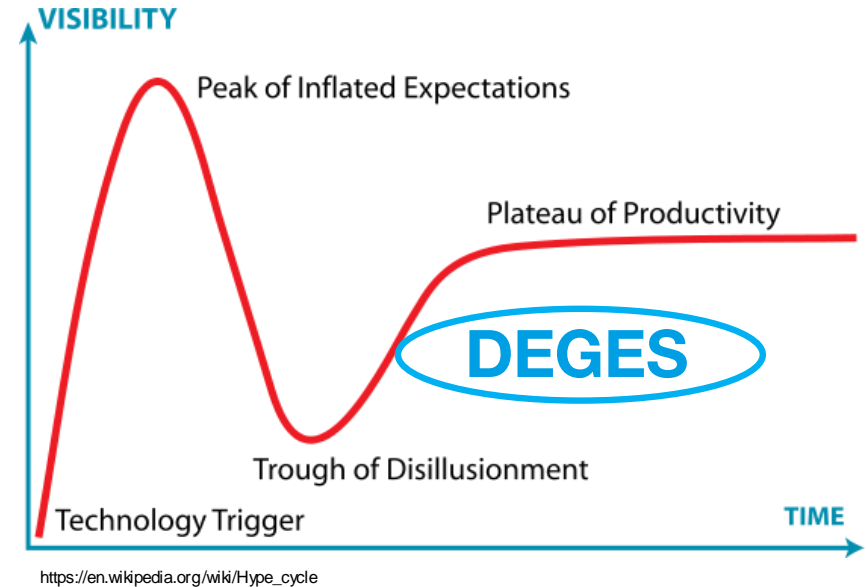
Source: Building Information Modeling – Techn. Grundlagen u. industrielle Praxis, Bormann et al. 2015

*First, construction (and optimization) in the digital world.
Then, realization in the real world.*

Motivation: we are not quite there yet ...

Gartner's Hype Cycle

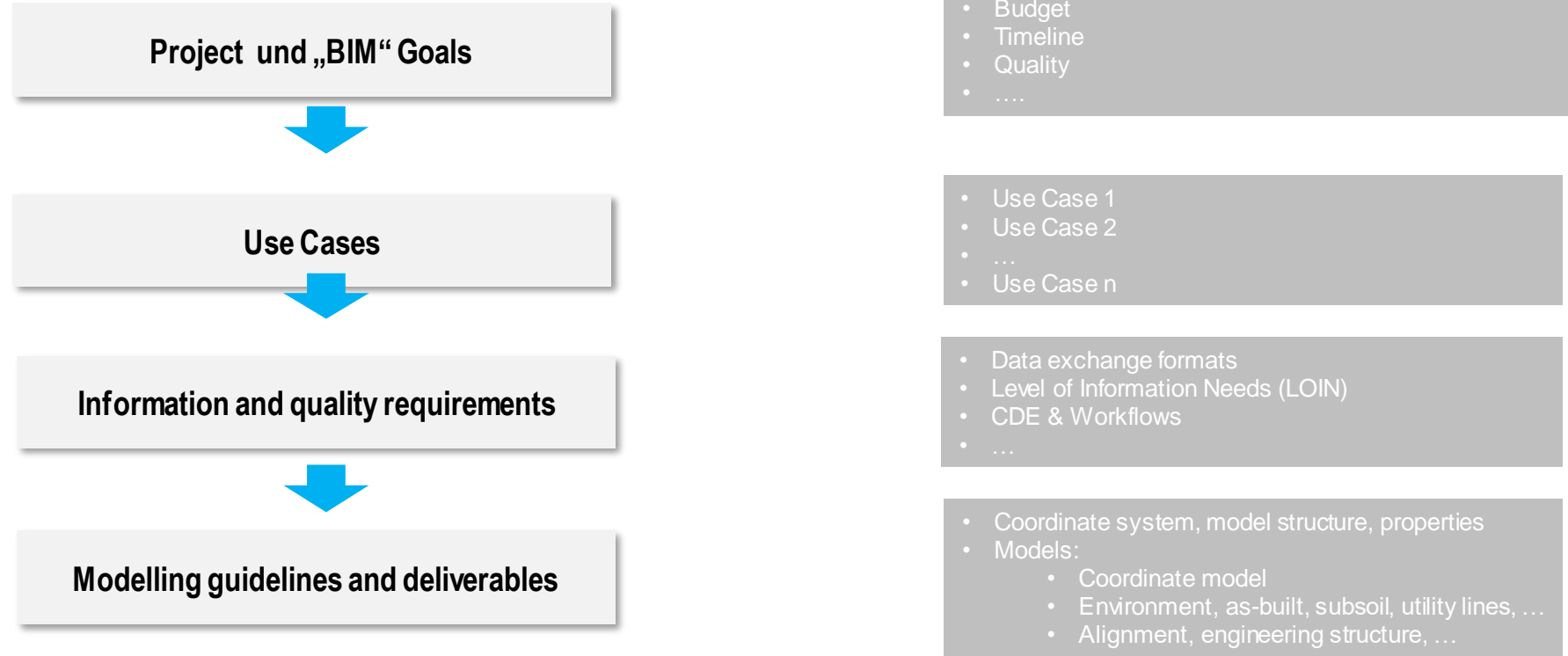
- 5 Phases of technology maturity
- Although criticised, it fits to the feeling when implementing BIM



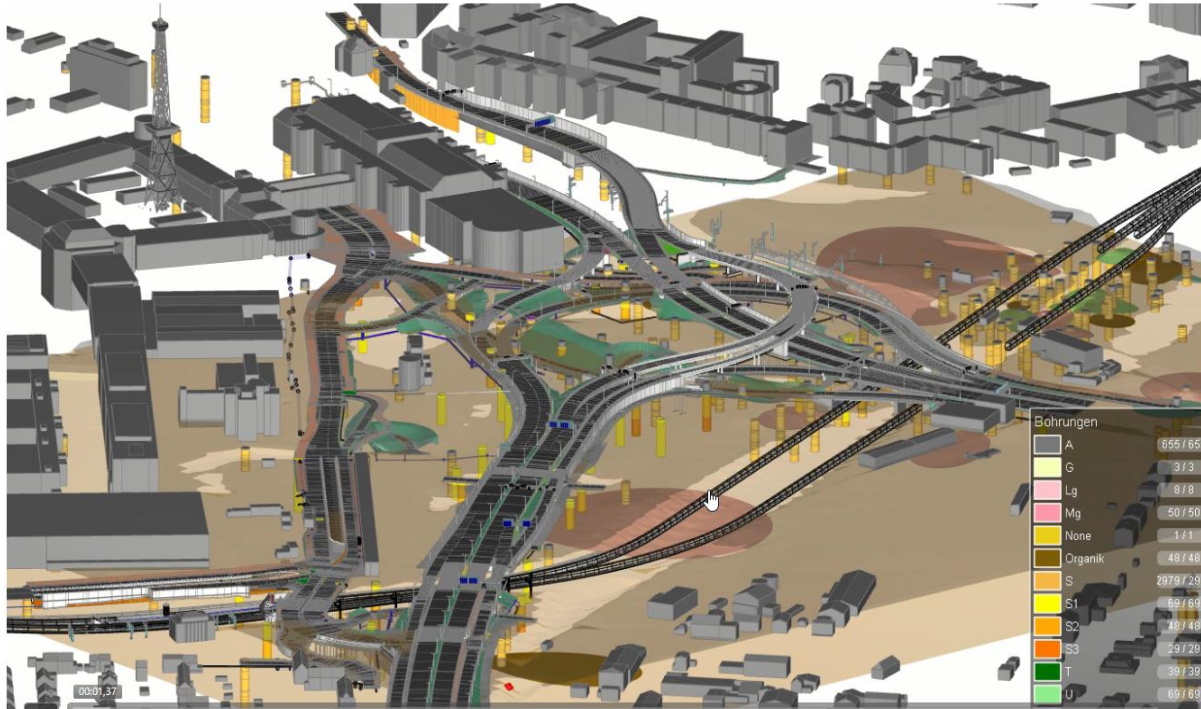
Where do you see yourself?

Where do you see your organization ?

DEGES: Employer Information Requirements



Use cases in planning (and approval) phase

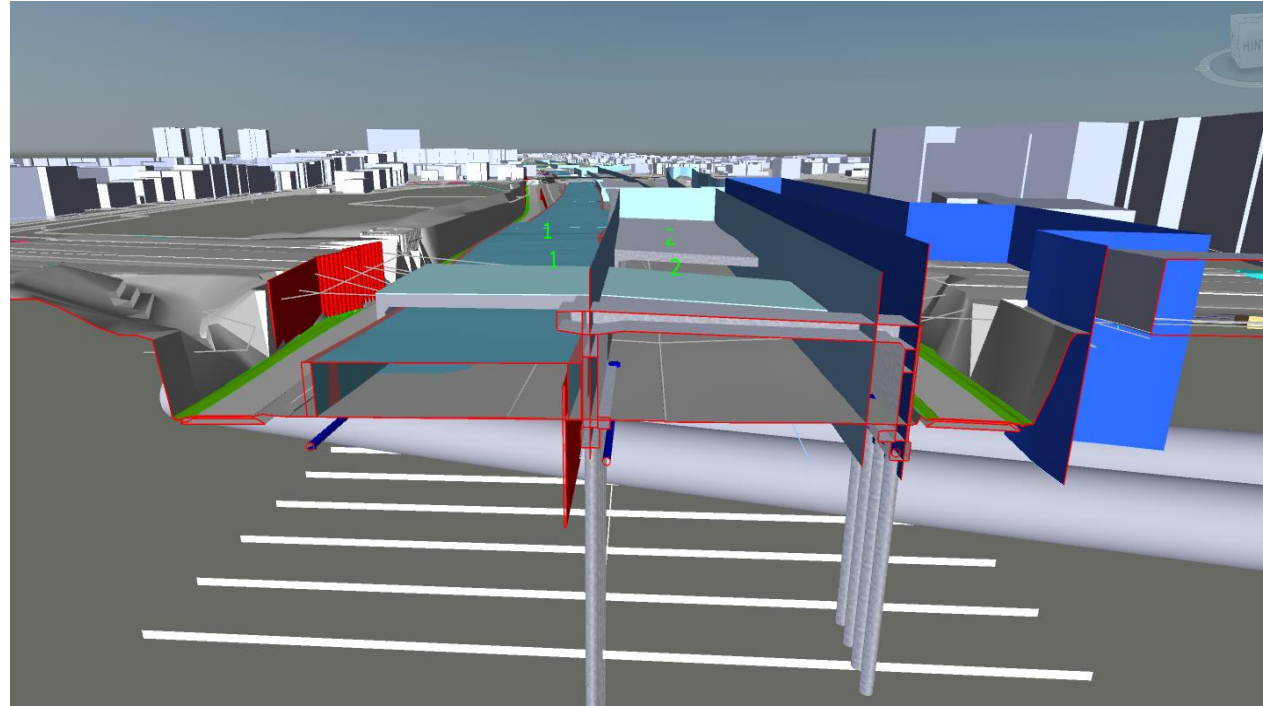


Coordinate model of AD Funkturm – Berlin

- Design preparation
- Survey of existing situation
- As-built modelling
- 3D ground modelling
- Design variants investigation
- Visualisation
- Coordination of discipline (models)
- Progress control of design
- Derivation / production of drawings
- Cost estimation and cost calculation
- Bill of quantities, tendering, award

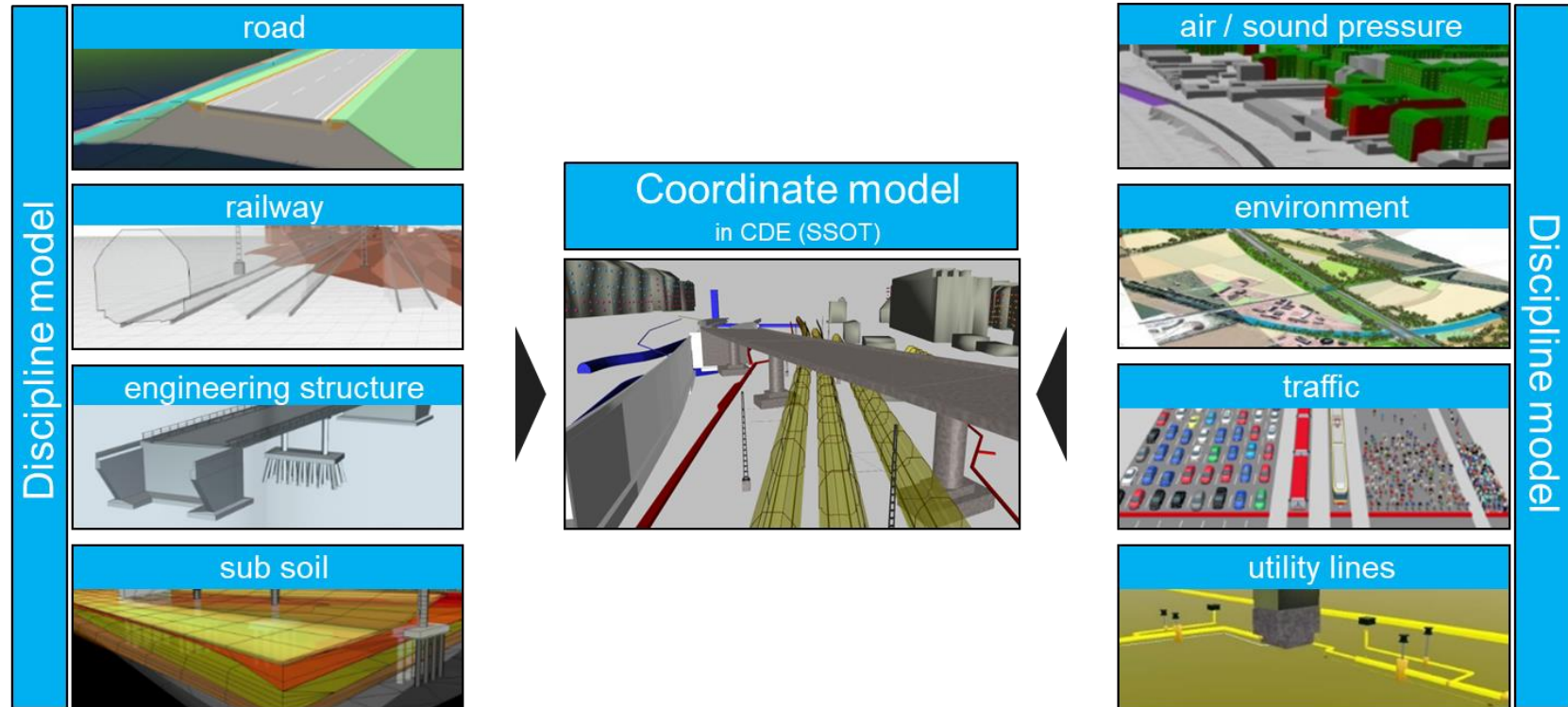
Use cases in construction phase

- Bill of quantities, tendering, award
- Construction Scheduling
- Logistics planning
- Derivation / production of construction drawings
- Construction progress control
- Change management
- Invoicing of construction works
- Issue management
- (Structure) Documentation



Coordinate model of Highway A7 – Hamburg Altona

From discipline models to one coordinate model



Designing the “I” in BIM

- What questions need to be answered?
- Are these questions the same throughout the project?
- What actors / roles are involved in a use case?
- What information / model do these actors provide or require?
- Is it possible to facilitate the (conventional) process?
- Are there additional process requirements (external standards and regulations)?
- What documents and data formats are exchanged?
- Who has what kind of access to the CDE?
- What kind of CDE-workflows are necessary?
- Who is responsible for a workflow step / status ?



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DEGES

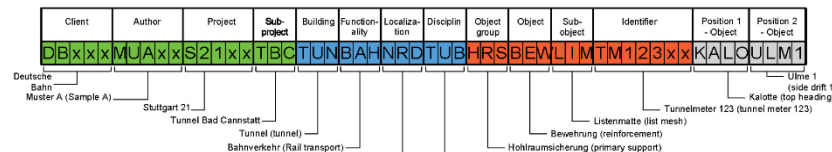
- Tunnelling data dictionary in German & Englisch (release 2021)
- ~ 200 objects with ~ 100 sub-objects
- Alphanumeric abbreviations used for object code (14 levels / 54 positions)

Diagram illustrating the structure of the data dictionary:

Client	Author	Project
DBx x x	MUAx x	S21 x x

Deutsche Bahn
Muster A (Sample A)

Stuttgart 21
Tunnel Bad Cannstatt



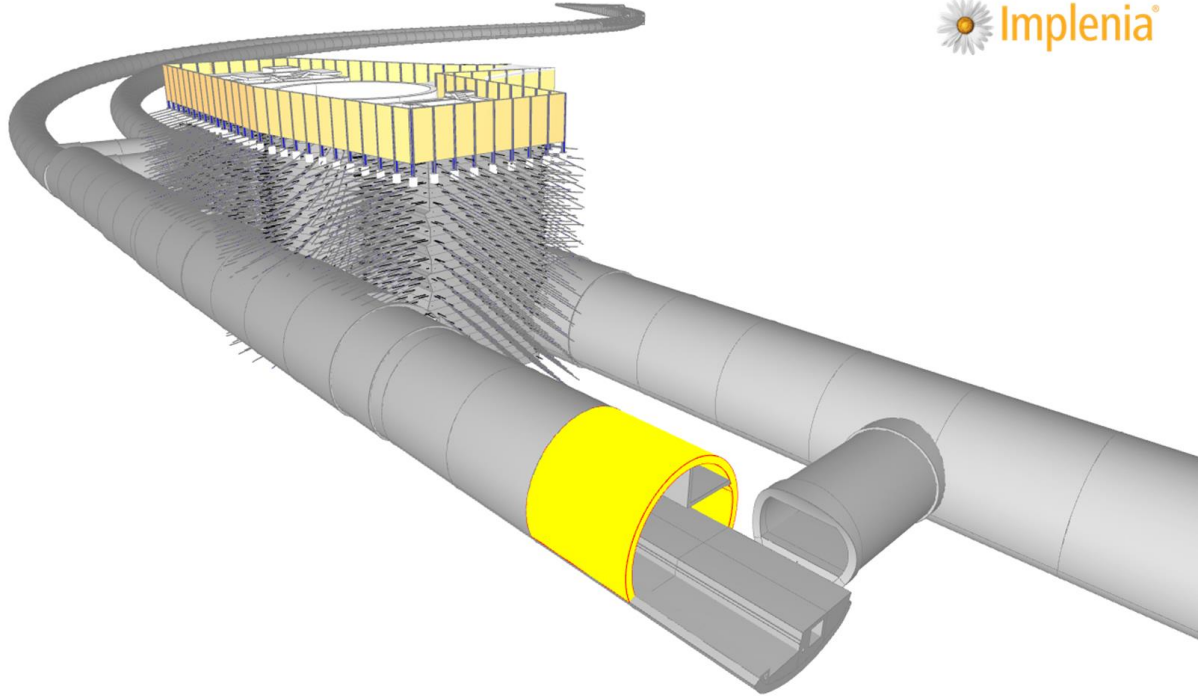
DAUB object catalogue: Application to models

Objekte, verknüpfte Dokumente

Datenblatt Objektdaten Dokumente

☒ Nur aktive Eigenschaften zeigen

	Eigenschaftname	Wert	Datentyp
1	010_Auftraggeber	D8 Projekt Stuttgart-Ulm GmbH	xs:string
2	020_Autor	Implenia Construction GmbH	xs:string
3	030_Projekt	LOS S21, PFA 1.3a, VE Rohbau Flughafenanbindung	xs:string
4	040_Teilprojekt	Los 1_VE 10 light	xs:string
5	050_Bauwerk	Bahnsteigbereich	xs:string
6	060_Funktionalität	Bahnverkehr	xs:string
7	070_Lokalisierung	Süden	xs:string
8	080_Gewerk	Tunnelbau	xs:string
9	090_Objektgruppe	Innenschale / Massivbau	xs:string
10	100_Objekt	Auskleidung	xs:string
11	110_Teilobjekt	Leibung	xs:string
12	120_Identifikator	BL000018	xs:string
13	130_Lage 1 (vertikal)	Gewölbe	xs:string
14	140_Lage 2 (horizontal)	XXX	xs:string
15	83_Regelquerschnitt_100	false	xs:boolean
16	83_Regelquerschnitt_60	true	xs:boolean
17	83_Regelquerschnitt_80	false	xs:boolean
18	83_Sonderquerschnitt_100	false	xs:boolean
19	83_Sonderquerschnitt_Ost	false	xs:boolean



14 properties according to the
14 levels of DAUB object code

DAUB object catalogue: Application to models

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Datenblatt Objekt Daten Dokumente

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Eigenschaftsnamen fl...

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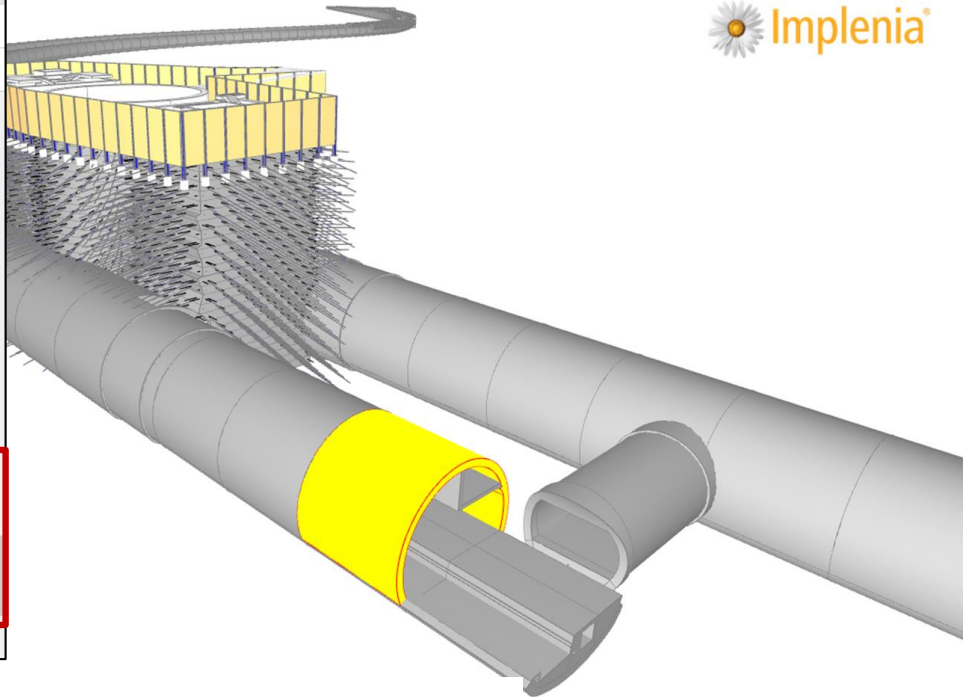
Objekte, verknüpfte Dokumente

Datenblatt Objekt Daten Dokumente

☒ Nur aktive Eigenschaften zeigen

Eigenschaftsnamen fl...

88	Familie und Typ	1546460	xs:IDREF
89	Familienname	83_Innenschale_Gewölbe	xs:string
90	Fläche	1.414.8744 [m2]	xs:double
91	GR_A	2.5612 [m]	xs:double
92	GR_E	2.5858 [m]	xs:double
93	Guid	f1f3ca53-54e5-4d8f-94a6-0efa879ab711	xs:ID
94	Host-ID	-1	xs:IDREF
95	Höhe Abzugskörper	10.0000 [m]	xs:double
96	Höhe Längsneigung konstruktives Ende	-0.0197 [m]	xs:double
97	Id	1574726	xs:ID
98	IMP_Bauteil	Gewölbe	xs:string
99	IMP_Bauwerk	Tunnel Bahnsteigbereich	xs:string
100	IMP_Disziplin	Tunnelbau	xs:string
101	IMP_Lage	Süden	xs:string
102	IMP_Subgruppe	Innenschale	xs:string
103	IMP_Zone	Flughafentunnel	xs:string
104	Importieren	PFA18_SCC_23_PFA_TUN_T81_300_01	xs:string

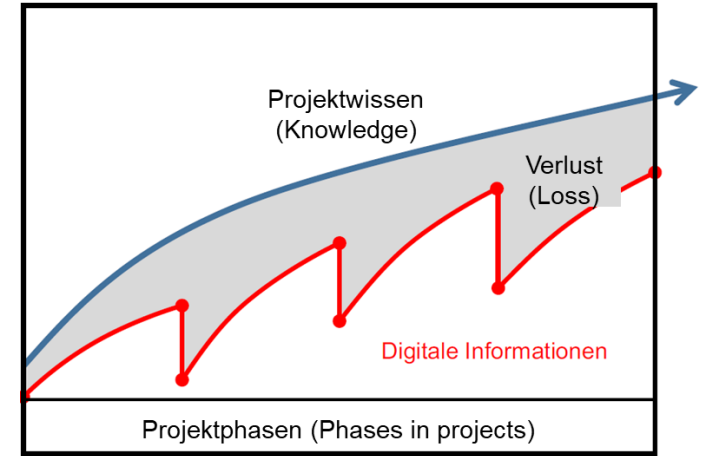


Parallel application of separate object catalogue
(e.g. company-specific)

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Quick summary

- 3D-modeling is not necessary for engineering success (*but it helps ;-)*)
- The “I” supports engineering success with knowledge-based decision making
- Reducing information loss requires definition of projected (and anticipation of later) use case requirements
- **DAUB provides a tunneling data dictionary**



Source: Building Information Modeling – Techn. Grundlagen u. industrielle Praxis, Bormann et al. 2015

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Then, realization in the real world.

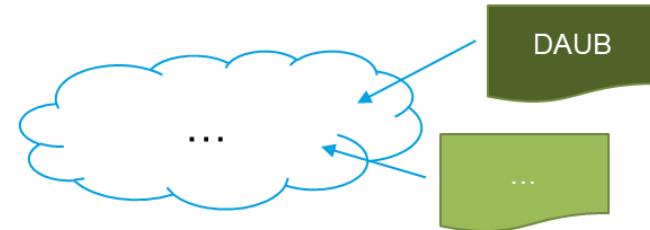
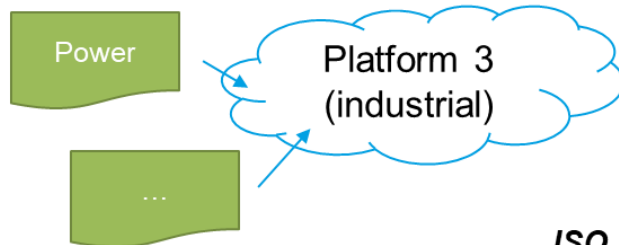
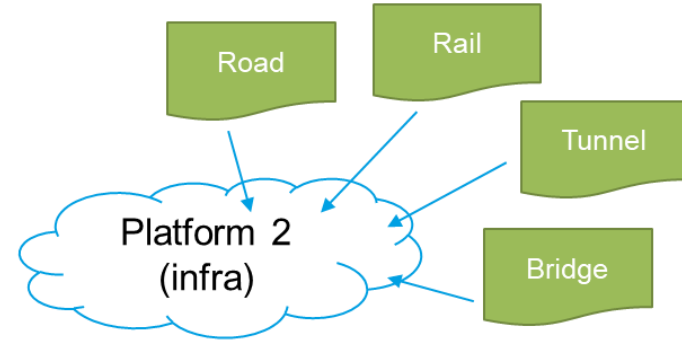
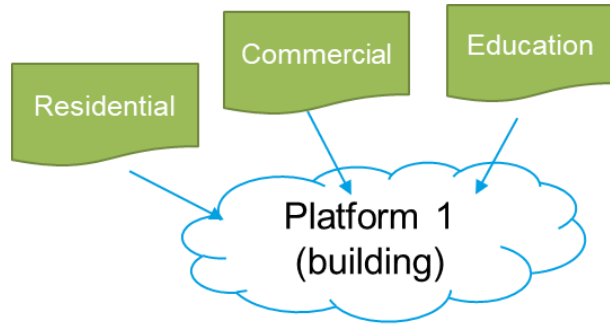
What's next?

- DAUB is working on properties in relation to defined use cases for tunneling
- *DAUB object catalogue* will be moved from excel to database solution
- DAUB is (also) working on the concept of interconnected data dictionaries



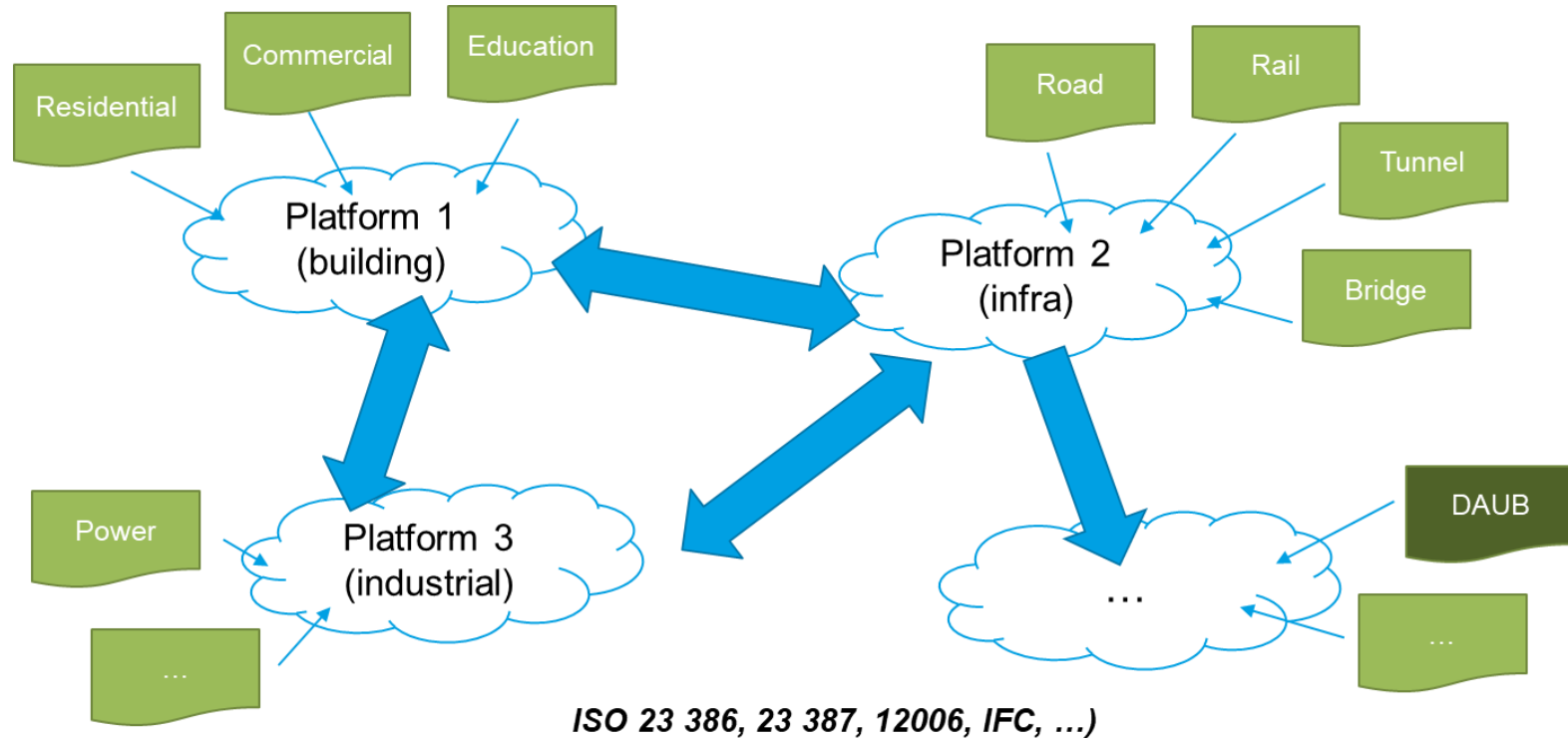
Image from Xuxuxu97 on Pixabay.com

Interconnected data dictionaries



ISO 23 386, 23 387, 12006, IFC, ...)

Interconnected data dictionaries





Thank you.

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