BIM Model 'Landscape_Open Spaces':
An Approach für Landscape and Environmental Planning in Infrastructure Projects

by Ilona Brückner, Matthias Remy

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Ilona Brückner

Lecturer BIM, CAD, 3D-Visualiszation

Research
- Teaching digitalization and BIM
- BIM based building application
- BIM model 'Landscape' for infrastructure projects

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Agenda

Status BIM infrastructural projects and landscape and environmental planning
-> Requirements – Situation – Weaknesses – Goals

How to integrate landscape and entvironmental planning in infrastructural projects?
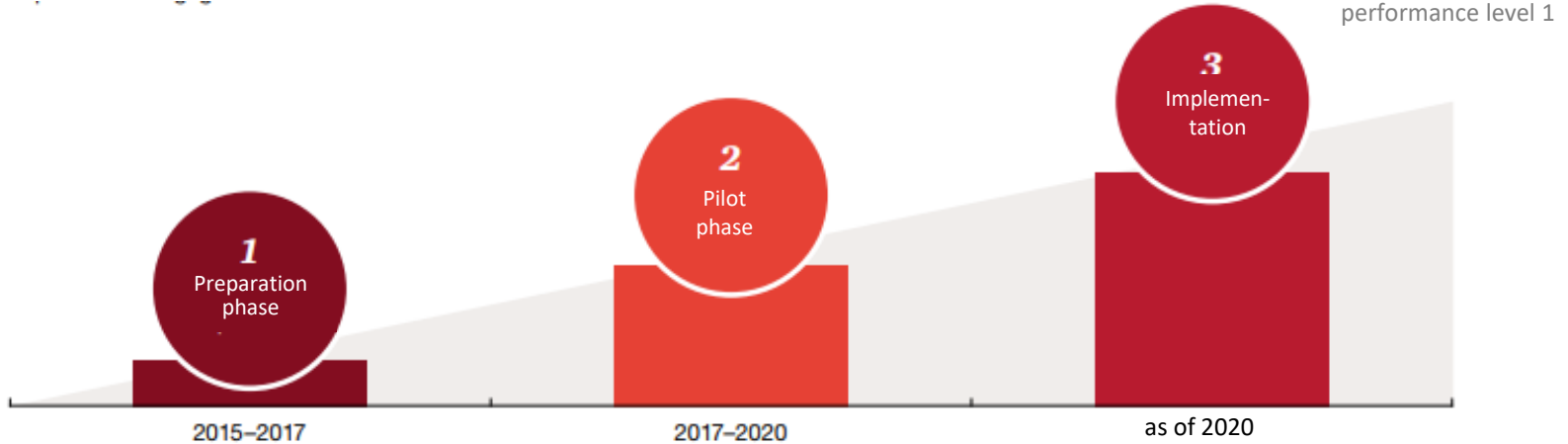-> BIM Pilot Project Highway A10/A24
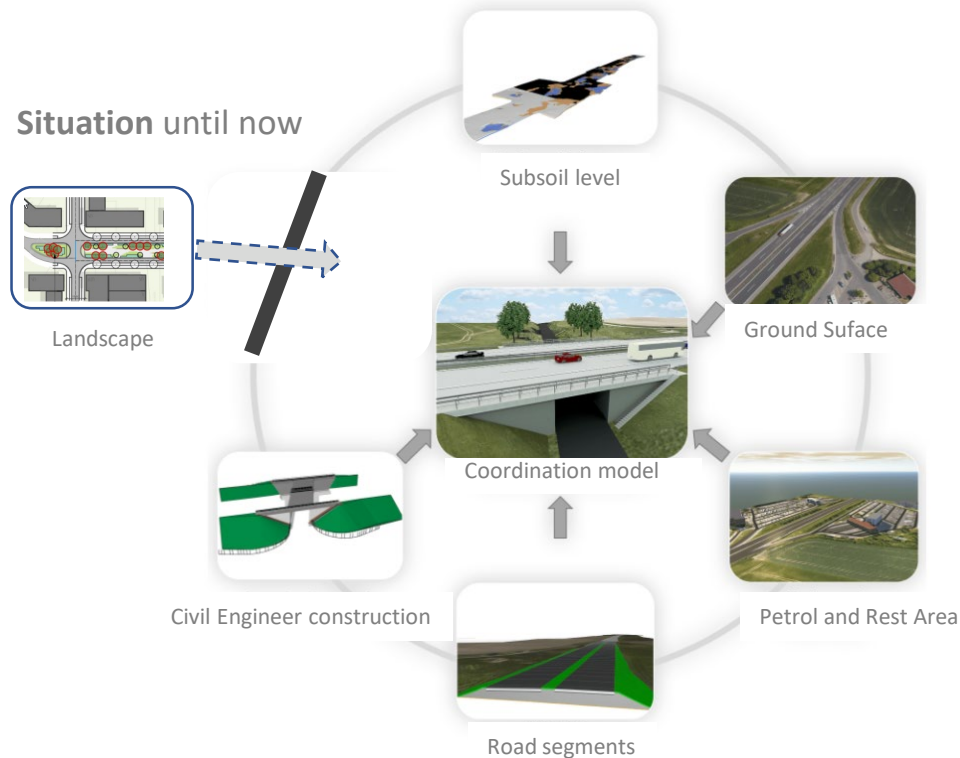-> Model Structure
-> 4D Simulation

Conclusions and Outlook

BIM three-step-plan for german government projects of infrastructure

Implementation level
performance level 1

3
Implemen-
tation

2
Pilot
phase

1
Preparation
phase

2015–2017 2017–2020 as of 2020

- Government **projects of infrastructure** (> 5 Mill. €)
  goals of the three-step-plan -> not yet fully realized

- up to now -> no universal german BIM-guid
- some first guidelines -> also helpful for Landscape architects

- Government **projects of building construction** (> 5 Mill. €) -> planned for 2022

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Situation until now

Landscape

Subsoil level

Ground Suface

Coordination model

Petrol and Rest Area

Civil Engineer construction

Road segments

Graphic: ARGE Havellandautobahn, adapted
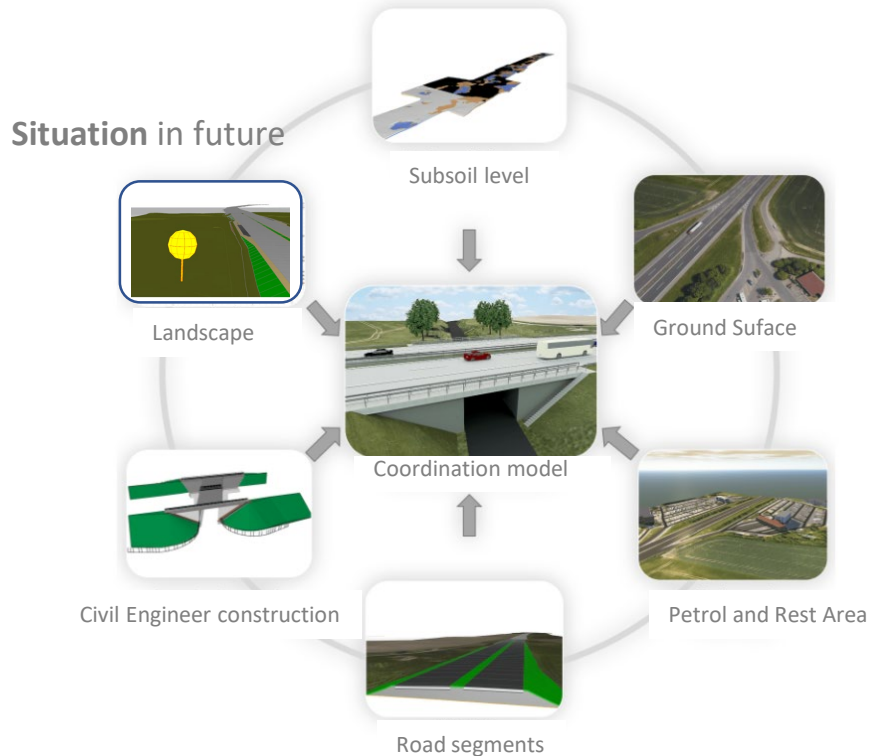
Requirement
- close integration with architecture/engineering requires integration of landscape planning into the BIM method

Situation until now
- landscape and environmental planning 2D
- BIM in landscape and environmental planning is rarely tested
- possible advantages of BIM are barely perceived in the practice

Weaknesses of conventional landscape and environmental planning in 2D
- susceptible to information loss
- disadvantages in communication between project participants foreseeable

Status | Landscape planning in BIM-projects of Infrastructure

Situation in future

Subsoil level

Landscape

Ground Suface

Coordination model

Civil Engineer construction

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Goals
- development of a model 'Landscape'
- representation of mesures along the time axis for environmental monitoring of construction

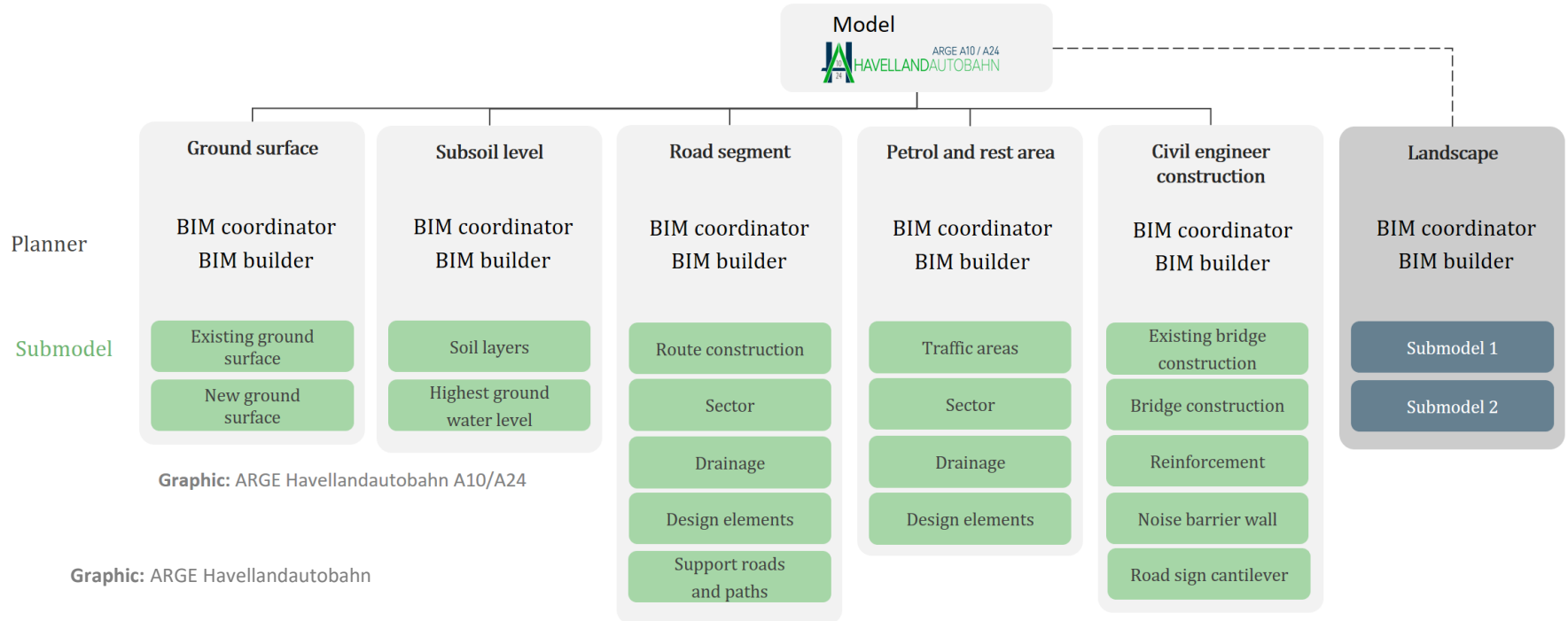# How to integrate landscape | BIM pilot project A10/A24
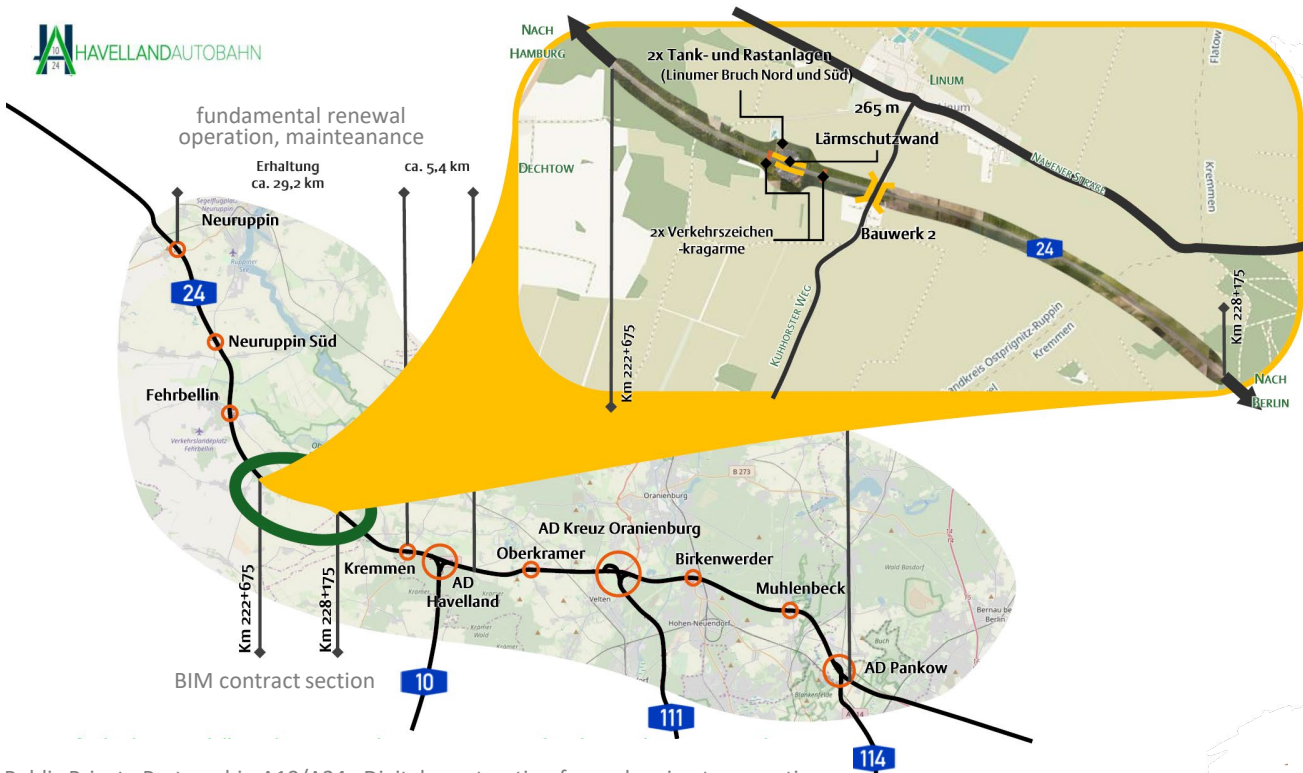
- Highway 65 km
- BIM pilot project 5 km
- contracting authorities German federal government
- in construction 2018-2023
- Public Private Partnership

comprehensive measures for protection of
- nature and species
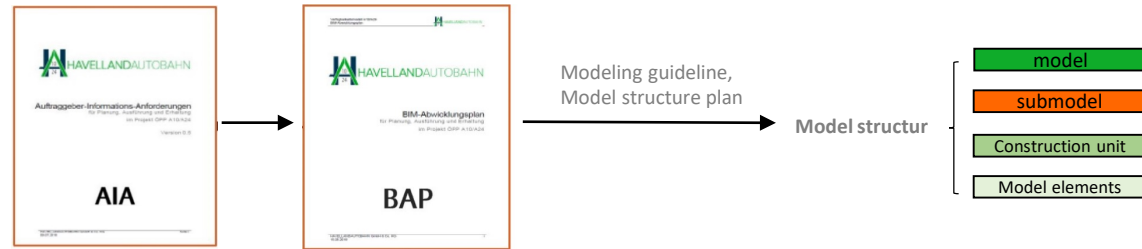- soil, water and other

Public Private Partnership A10/A24 : Digital construction from planning to operation

Graphic: ARGE Havellandautobahn, adapted

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How to integrate landscape | Model 'Landscape'

- Missing **model 'Landscape'** in BIM model of pilot project A10/ A24

- Landscape planning is further accompanying in 2D

Graphic: ARGE Havellandautobahn A10/A24

Graphic: ARGE Havellandautobahn
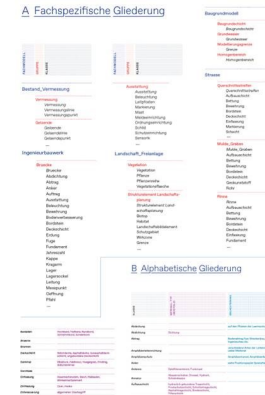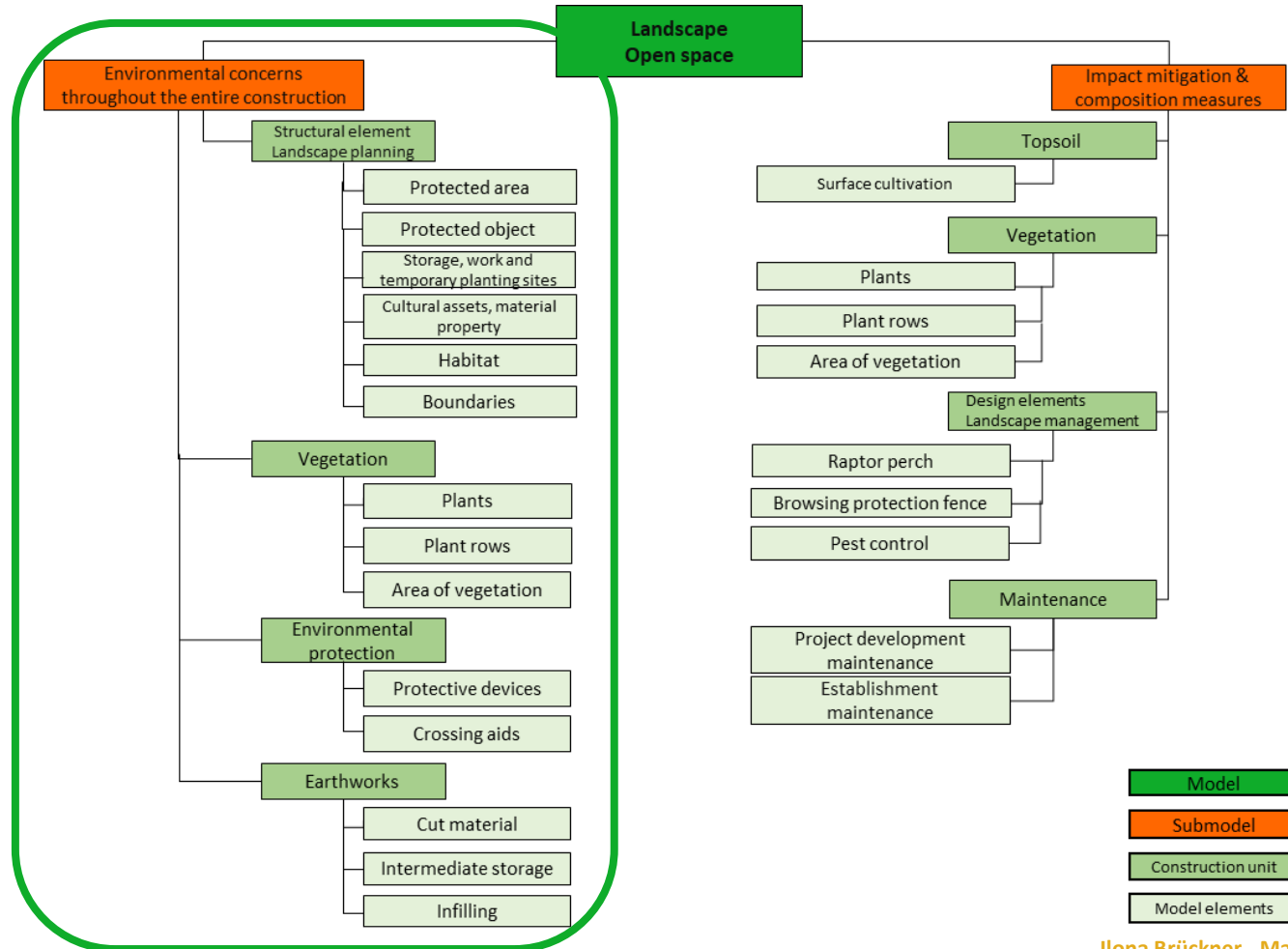
How to integrate landscape | Preconditions

(1) landscape and environmental planning (2D)

- environmental impact assessment (german: Landschaftspflegerische Begleitplanung LBP)
- landscape management detailed designe phase (german: Landschaftspflegerische Ausführungsplanung LAP)

(2) New planned ground surface as digital terrain model

(3) BIM-Guidelines A10/A24

- Employer Information
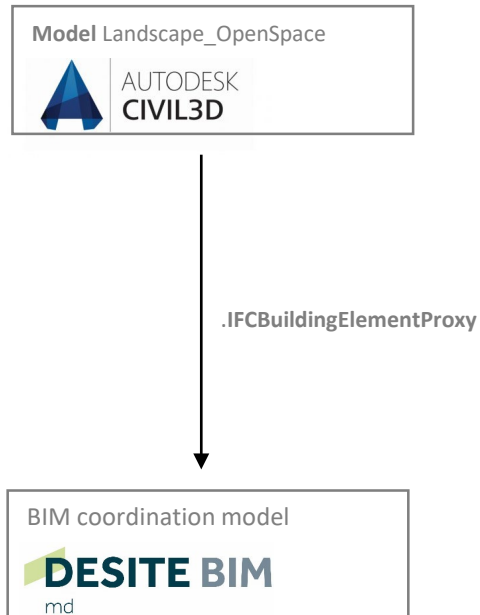 Requirements EIR (german AIA)
- BIM Execution Plan BEP (german BAP)

Modeling guideline,
Model structure plan

Model structur

model
submodel
Construction unit
Model elements

(4) german pre-standardization project

- traffic routes
- including BIM classes 'Landscape_OpenSpace'

BIM – Klassen der Verkehrswege

How to integrate landscape| Model structure

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Landscape
Open space

Environmental concerns throughout the entire construction

Structural element Landscape planning
- Protected area
- Protected object
- Storage, work and temporary planting sites
- Cultural assets, material property
- Habitat
- Boundaries

Vegetation
- Plants
- Plant rows
- Area of vegetation

Environmental protection
- Protective devices
- Crossing aids

Earthworks
- Cut material
- Intermediate storage
- Infilling

Impact mitigation & composition measures

Topsoil
- Surface cultivation

Vegetation
- Plants
- Plant rows
- Area of vegetation

Design elements Landscape management
- Raptor perch
- Browsing protection fence
- Pest control

Maintenance
- Project development maintenance
- Establishment maintenance

Legend:
- Model
- Submodel
- Construction unit
- Model elements

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How to integrate landscape | Modeling landscape objects

Software architecture

Model Landscape_OpenSpace

AUTODESK
CIVIL3D

.IFCBuildingElementProxy

BIM coordination model

DESITE BIM
md

CAD-BIM Software Autodesk Civil3D

- AutoCAD features + 3D tools for civil engineering and infrastructural planning
  - Route planning, **topography modeling & editing**, construction pit

- Individual 3D modeling + Link with properties (as well with 2D & 2,5D objects)

- IFC interface

Coodination and quality control of models - BIM DESITE Pro

- Coordination model (pilot project A 10/A 24)

- Loss free IFC import

- Visualisation, analysis, evaluation and testing of the 3D model
  4D-,5D-,6D-7D-planning possible

Autodesk Civil 3D | Plant modeling

How to integrate landscape | Modeling landscape objects

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Autodesk Civil 3D | IFC export

IFC export (Civil 3D)

1

IFC import (DESITE BIM md)

2

Properties

Objekte, verknüpfte Dokumente		
(i) **Datenblatt**	☑ Nur aktive Eigenschaften zeigen	
68	: Ambient	0,000/0,647/0,000
69	: AmbientBlue	0,0000
70	: AmbientGreen	0,6471
71	: AmbientRed	0,0000
72	: Diffuse	0,000/0,647/0,000
73	: DiffuseBlue	0,0000
74	: DiffuseGreen	0,6471
75	: DiffuseRed	0,0000
76	: ID	m:00a500ff
77	: Name	m:00a500ff
78	: Transparency	0,0000
	Einzelobjekt	
79	: Boden	sandig- tonig
80	: deutscher_Name	Ahorn
81	: Herkunft	Europa-Nordiran
82	: Kronenbreite	7 m
83	: Pflanze	Baum
84	: Stammhöhe	8 m
85	: Standort	Sonne- Halbschatten
86	: Volumen	180,2702
87	: wissenschaftl. Name	Acer campestre
88	: Wuchsform	kugelförmig
89	: Wuchshöhe	12 m
90	ElevationOfRefHeight	0,0000 [m]
91	ElevationOfTerrain	0,0000 [m]

3

Result

- All class properties were imported successfully

How to integrate landscape | Modeling landscape objects

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Model structure: Protected area
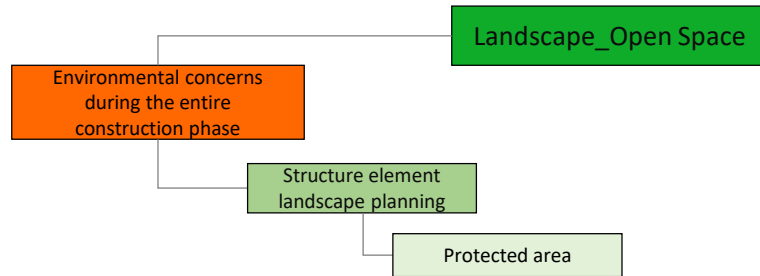
Submodel: Protected area

Klasse
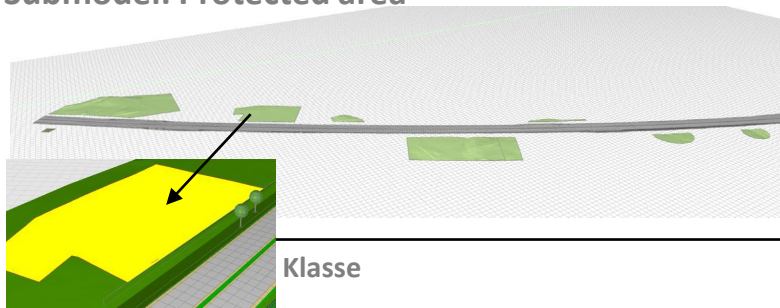
	LAP_SG	
93	: Biotoptyp	WSM
94	: Maßnahmenziel	Inanspruchnahme Vermeiden
95	: Schutzstatus	hoch
96	: Vermeidungsmaßnahme	V3 (2)
97	: Verortung	linke RF: 223,40-223,60

Protected area

Properties	Property value	Description
Type of biotope	WS, WSM, WQM,	- Deciduous forests with native tree species - Deciduous forests of mediocre sites - Mixed oak forest
Protection status	high, medium, little, very little	-
Prevention	V3 (2) V9 (2) V/CEF	- Avoidance of losses during construction and impairments of biotopes - Avoidance of amphibia loss, protection fence
Objective of actions	Avoid utilization	-
Location	Left RF: -right RF: -	-

How to integrate landscape | Modeling landscape objects

Overall submodle 'Environmental Concerns throughout the Entire Construction'

Model structure

```
                              ┌─────────────────────────┐
                              │  Landscape_Open Space   │
                              └─────────────────────────┘
┌──────────────────────┐
│ Environmental concerns│
│ throughout the entire │
│  construction phase   │
└──────────────────────┘
        │
        │   ┌──────────────────────┐
        ├───│  Structure element   │
        │   │  landscape planning  │
        │   └──────────────────────┘
        │        ├───│ Protected area │
        │        ├───│ Protected object │
        │        ├───│ Storage, work and temporary planting sites │
        │        └───│ Habitat │
        │
        │   ┌──────────────┐
        ├───│  Vegetation  │
        │   └──────────────┘
        │        └───│ Plants │
        │
        │   ┌──────────────┐
        ├───│  Protection  │
        │   │ Environment  │
        │   └──────────────┘
        │        └───│ Protection device │
        │
        │   ┌──────────────┐
        └───│  Earthworks  │
            └──────────────┘
                 └───│ Intermediate storage │
```
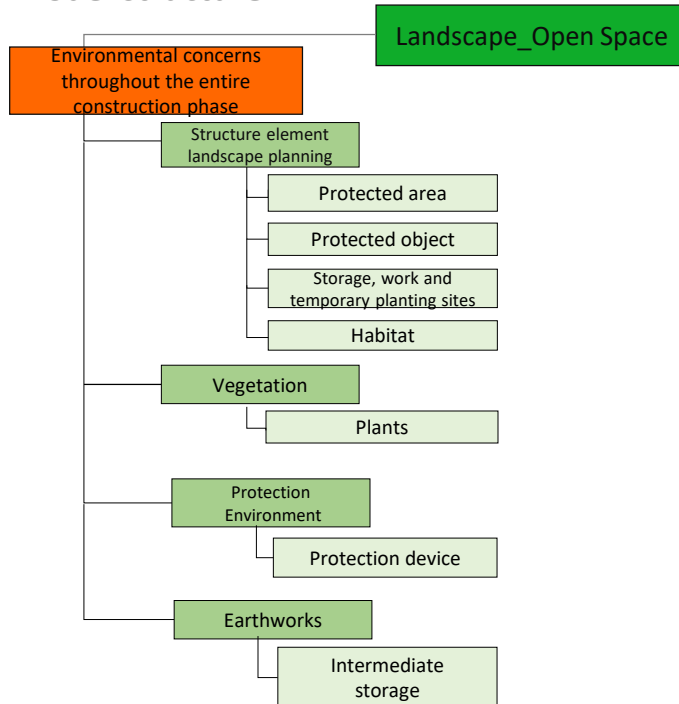
Model structure in Desite BIM

Submodel UwbB

How can the model be used in practice for environmental monitoring of construction?

Approach: BIM-classes of landscape will be linked to timeline

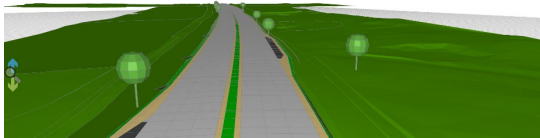-> environmentally relevant measures are displayed along the time axis
-> information is available in a simple and comprehensible way for all planners
   during the entire construction process
-> can be used as a part of the entire construction scheduling and coordination of the trades

Goal: Optimization of nature and environmental protection throughout construction

How to integrate landscape | 4D simulation

Example: Site clearance

Start - Clearing

Active – Clearing

Result – Clearing

How to integrate landscape | 4D simulation

4D simulation

- on basis of submodel 'Environmental Concerns throughout the Entire Construction phase'
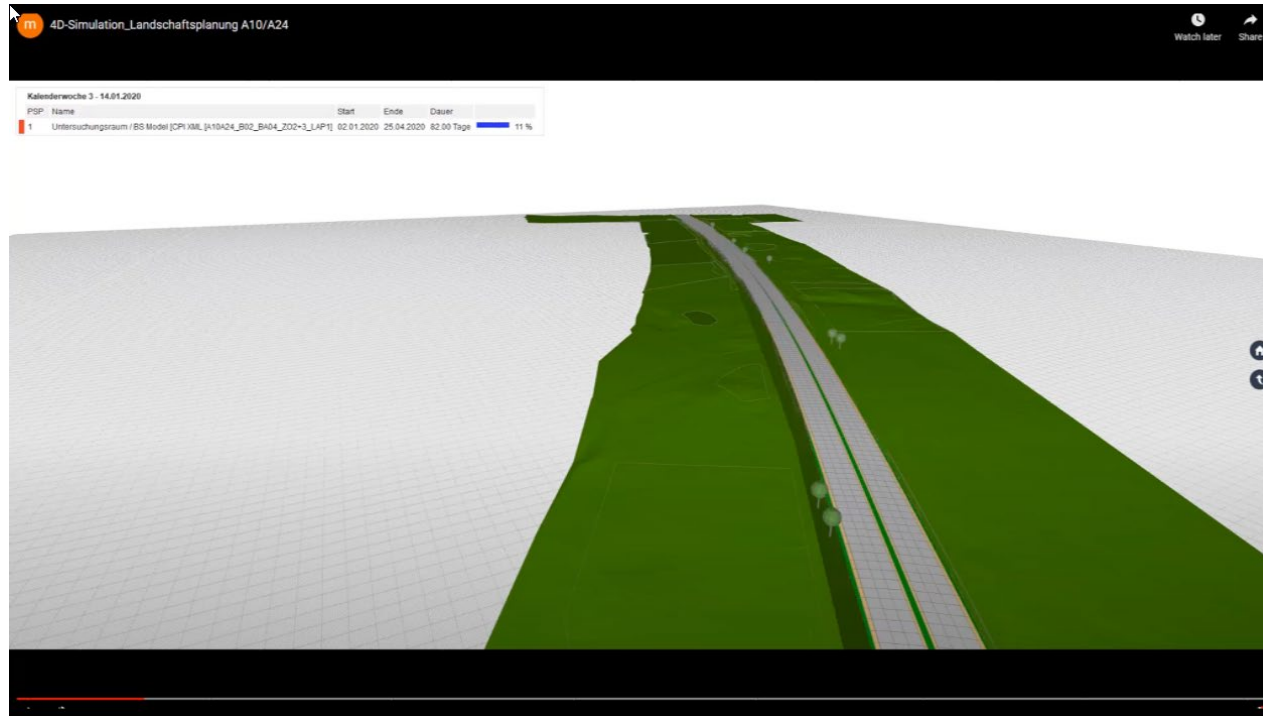
Simulation_landschaftspflegerische Begleitplanung on Vimeo

Conclusions and Outlook

- Integration of landscape and environmental planning in BIM is considered necessary

- Can improve communication between planning participants
  -> Optimization of landscape and environmental protection

- Findings flow into BIM pilot project A10/A24

Further development and testing necessary

    -> GIS/CAD workflow needs to be developed
    -> Standardization for BIM Landscape
        national: BIM classes 'Traffic Roads / Landscape_Openspace'
        international: IFC
    -> Submodel 'Impact Mitigation and Composition Mesures', including operation phase

Thank you for your attention

Contact

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