TEEDEKLASTER

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TALLINNA TEHNIKAKÕRGKOOL

TTK UNIVERSITY OF APPLIED SCIENCES

RoadBIM Seminar
11.09.2013 Tallinn

Euroopa Liit
Euroopa
Regionaalarengu Fond

Eesti tuleviku heaks

Business from technology

Ongoing Finnish InfraBIM Activities and the Finnish Inframodel

Juha Hyvärinen, Senior Scientist

VTT Technical Research Centre of Finland

Background

- Building Information Modelling (BIM) has been a central part of Finnish building construction R&D since the 1980's.
  - Strong commitment to international OpenBIM development since mid-1990's (i.e. IFC in IAI – buildingSMART)
- The Finnish infrastructure construction sector becoming active in BIM related development since early 2000's.

InfraBIM history in Finland

- Pre-study: Analysis of situation and needs in infra information exchange (2001)
- Inframodel: Requirements and proposed solution (2002-03)
- Inframodel 2: Inframodel specification & software implementations (2005-06)
- Inframodel 2 piloting → Road & Rail Admininistrations' guideline for Inframodel use (2007)
- InfraTM (2009-13): (TM = Tieto-Malli = Data Model)
  - Driven by public client organisations (Finnish Transport Agency, 6 cities)
  - Inframodel 2 update, InfraBIM classification tables, preliminary studies for InfraFINBIM and participation in its execution
- InfraFINBIM (2010-2013):
  - Driven by design & construction companies and software vendors
  - Inframodel version 3, buildingSMART LandXML activity, InfraBIM guidelines, pilot projects

What is InfraFINBIM?

- InfraFINBIM is one of the six work packages in the RYM/SHOK PRE program
  - RYM Oy is the Strategic centre for Science, Technology and Innovation (“SHOK”) for the built environment in Finland
    - www.rym.fi
  - PRE is a RYM Oy research program “Built Environment Process Re-engineering”
- Duration of the program 1.11.2010–31.12.2013 (…30.4.2014?)
- The PRE program is co-funded by Tekes (the Finnish Funding Agency for Technology and Innovation)
- The budget of the PRE program is about 21 M€, with 43 parties, 37 companies and 6 research organisations
- The budget of Infra FINBIM is about 6 M€, with 18 consortium members

Consortium partners:

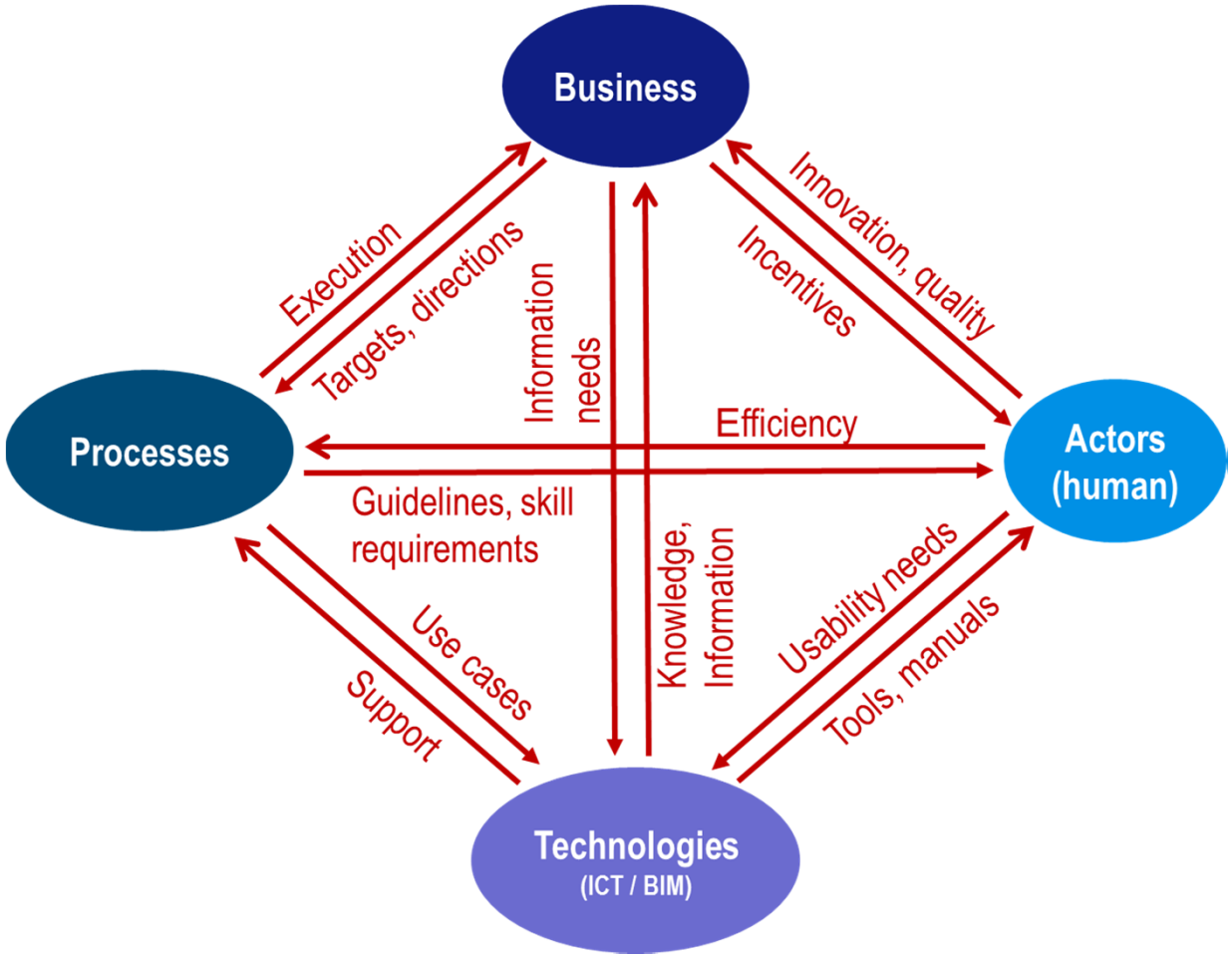
Construction (6):	VR Track Oy *WP Leader* Lemminkäinen Infra Oy NCC Road Oy YIT Rakennus Oy Infrapalvelut Terramare Oy Destia Oy
Design (5):	Ramboll Finland Oy Sito Oy WSP Finland Oy Pöyry Finland Oy Finnmap Infra Oy
ICT (2):	Vianova Systems Finland Oy Tekla Oyj
Other (2):	Building Information (RTS) Finnish Transport Agency (+ 6 InfraTM cities)
Research (3):	VTT Oulu University Aalto University

InfraFINBIM vision

Year 2014 major infra-sector clients procure only BIM based services, in all project phases from early planning and design to maintenance and operation

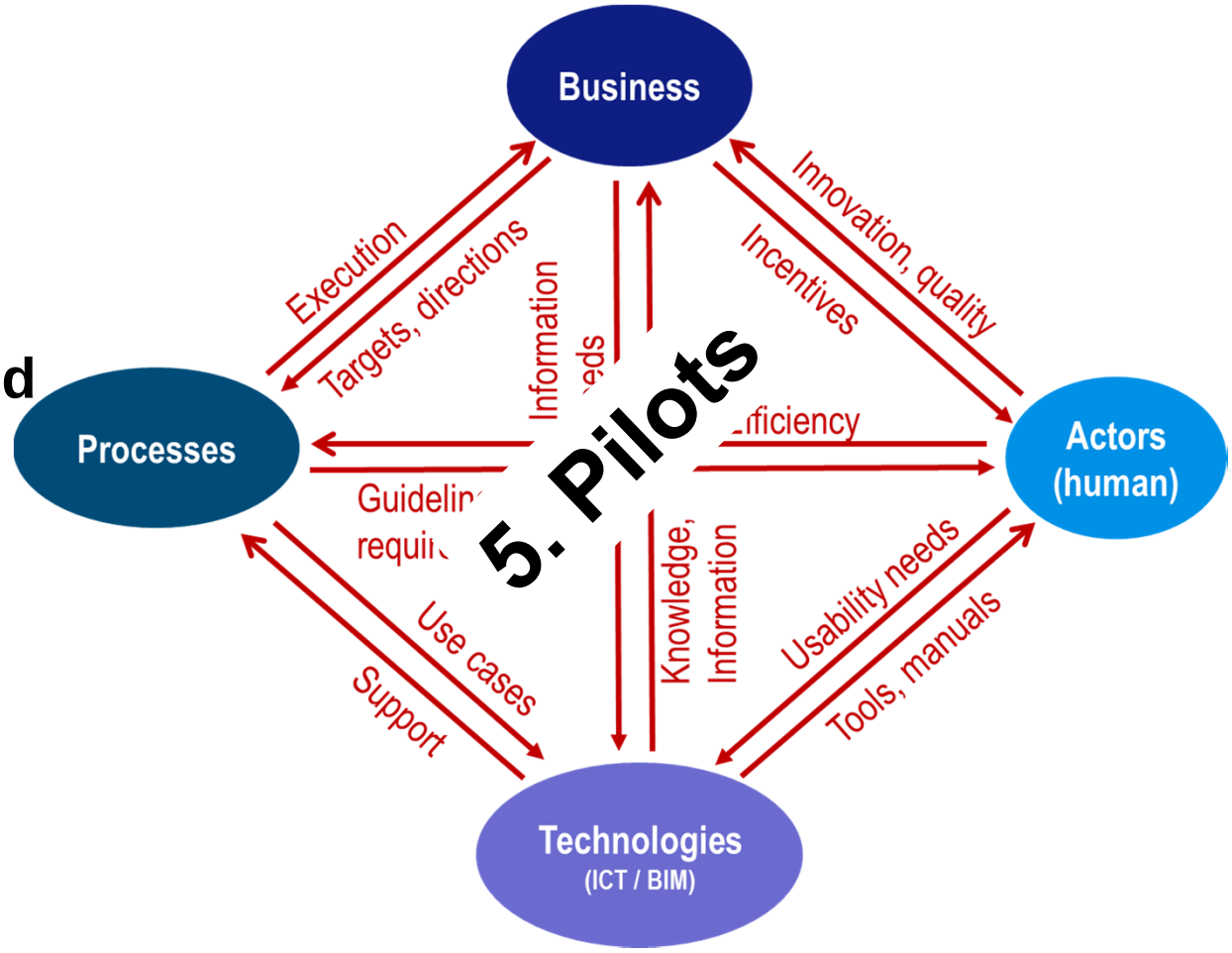
=>REQUIRES SYSTEMIC CHANGE!

Systemic innovation challenge



InfraFINBIM tasks

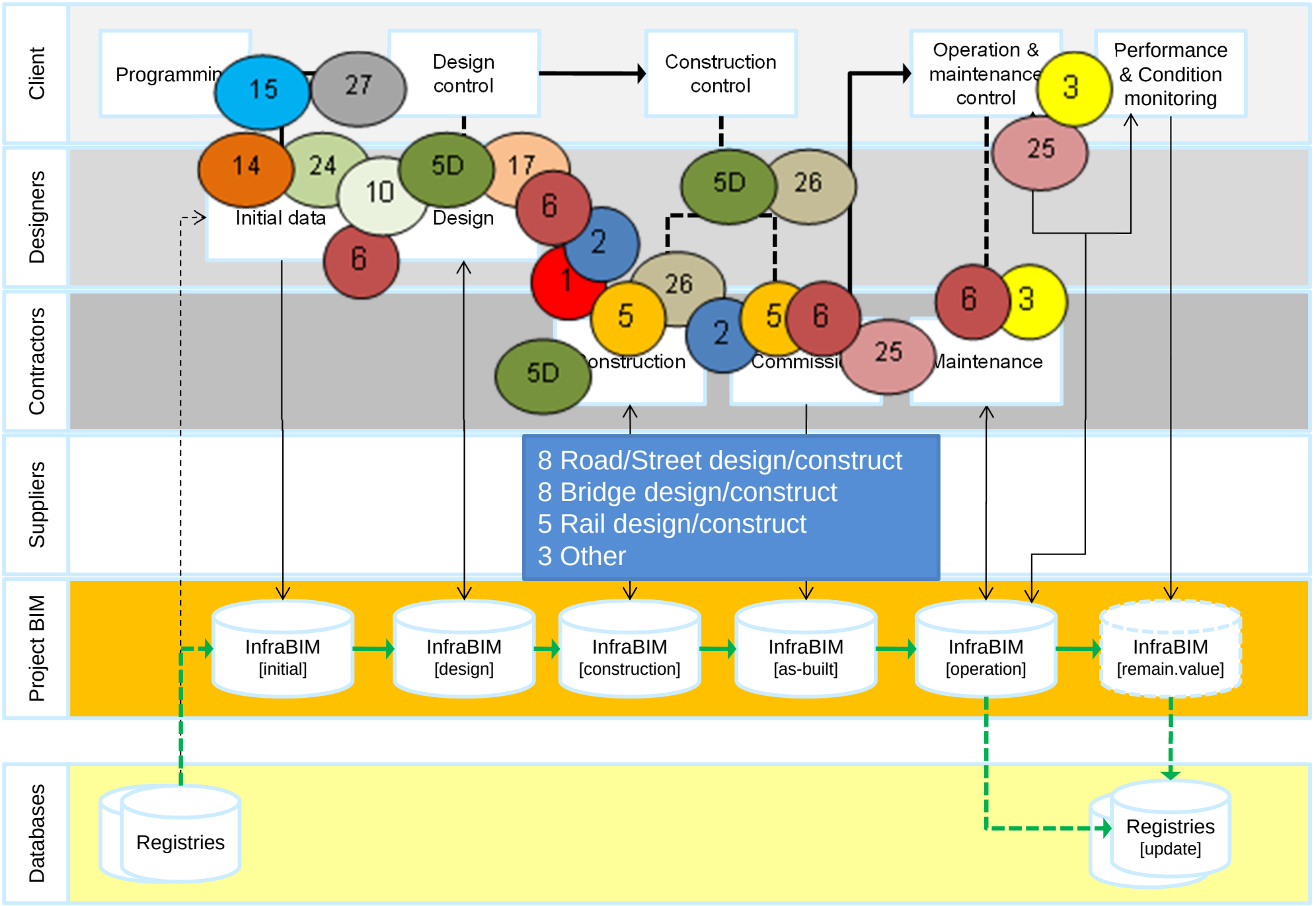
T1. Procurement methods



T3. Design and Construction Processes: InfraBIM guidelines

4. Dissemination –> Training & education

T2. Standards and interfaces: Inframodel & InfraBIM classifications


Client
Designers
Contractors
Suppliers
Project BIM
Databases
Programmin
Design control
Construction control
Operation & maintenance control
Performance & Condition monitoring
Initial data
Design
Construction
Commissi
Maintenance
15
27
14
24
10
5D
17
6
2
1
6
26
5
2
25
3
8 Road/Street design/construct
8 Bridge design/construct
5 Rail design/construct
3 Other
InfraBIM [initial]
InfraBIM [design]
InfraBIM [construction]
InfraBIM [as-built]
InfraBIM [operation]
InfraBIM [remain.value]
Registries
Registries [update]

BIM maturity assessment

A common assessment framework and tool for planning and evaluation of the InfraFINBIM pilots (developed based on capability maturity model).

- Maturity categories, 11
  - maturity levels 1...6 defined
- Impact categories, 3
  - maturity levels 1...6 defined

Context and content:

- developed for supporting the re-engineering in InfraFINBIM by assessing individual pilot cases and current industry practice (2010) vs. target level (2014)
- for certain type of infra construction cases: highways, roads, street, bridges and railroads.

Maturity Category	Maturity Level	
Procurement & delivery methods	BIM delivery/use required in multiple processes	5
BIM skills	Some experience in BIM projects	4
Project participant roles	Modelling and usage in some tasks specified	3
Process description	Non-formal process description	2
Initial data	Online, partly automatic	2
BIM scope	Most project information in BIM	4
GIS-BIM integration	Accurate GIS and data transfer with BIM	4
Geometric modelling	Smart 2D or basic 3D	3
OpenBIM / standards	Good quality exchange using open standards	4
Information delivery	BIM exchanges well-defined and managed	3
As-built information	Automated measuring and collation in some parts	2
	Maturity Score	**36,0**
	Maturity Level	**Solid**

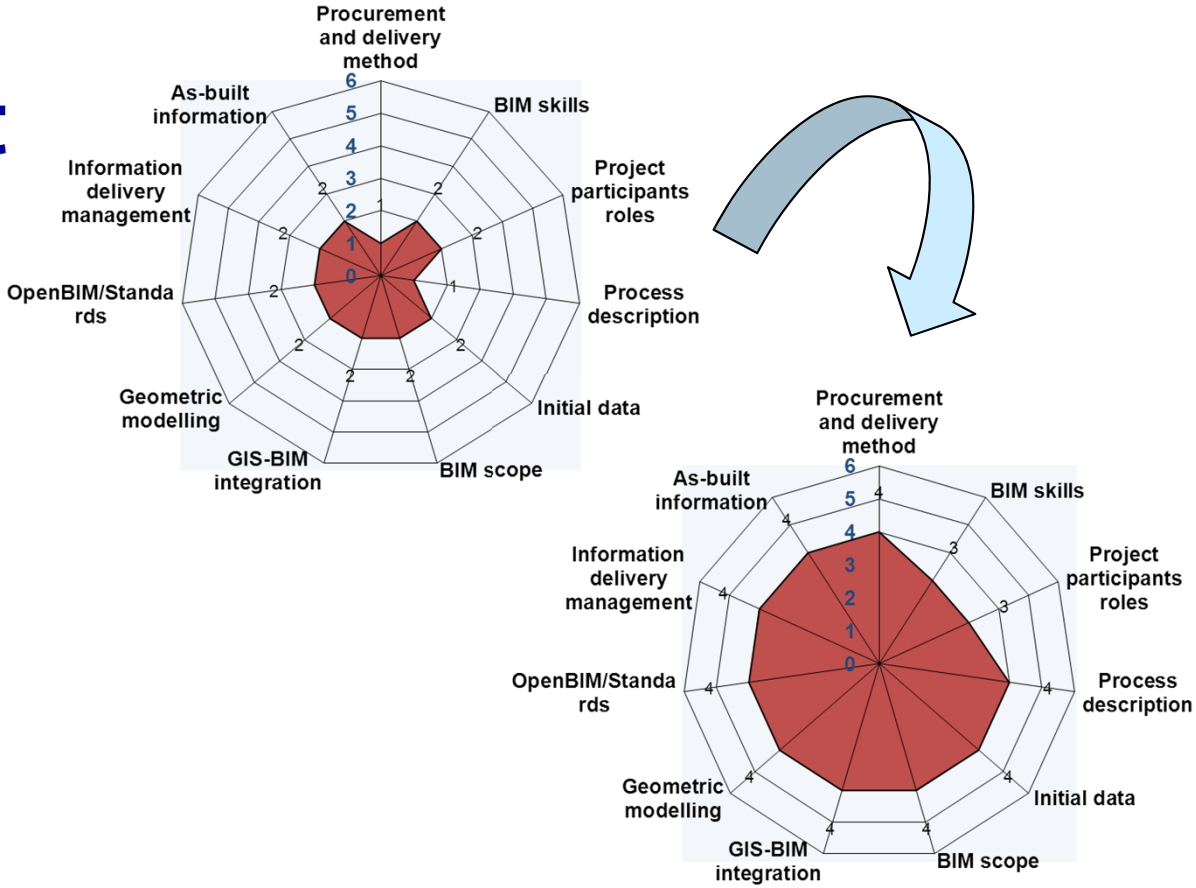
Impact Category	Impact Level	
Process improvement	Considerable improvement in collaborative processes	4
Information life-cycle integration	Modest improvement in few life-cycle stages	3
Business opportunities	Few local business improvements	2
	Impact Score	**9,0**
	Impact Potential	**Remarkable**

Total Evaluation	
Score	**324,0**
Level	**Basic**

General assessment

Big picture

- The goal of the InfraFINBIM project is to accelerate sector level systemic change and develop a new BIM focus setting for the whole line of businesses. Therefore it is extremely important to create a common idea of the present state and common vision after the change.
- The interviews for the expected outcome after the program were conducted by using the framework.
- Both maturity and impact levels were estimated.



- The framework tool was useful as a map and a way to quantify the level of ambition in terms of target levels in each category

InfraBIM guidelines

preliminary list of the InfraBIM guidelines for 2014: www.infrabim.fi

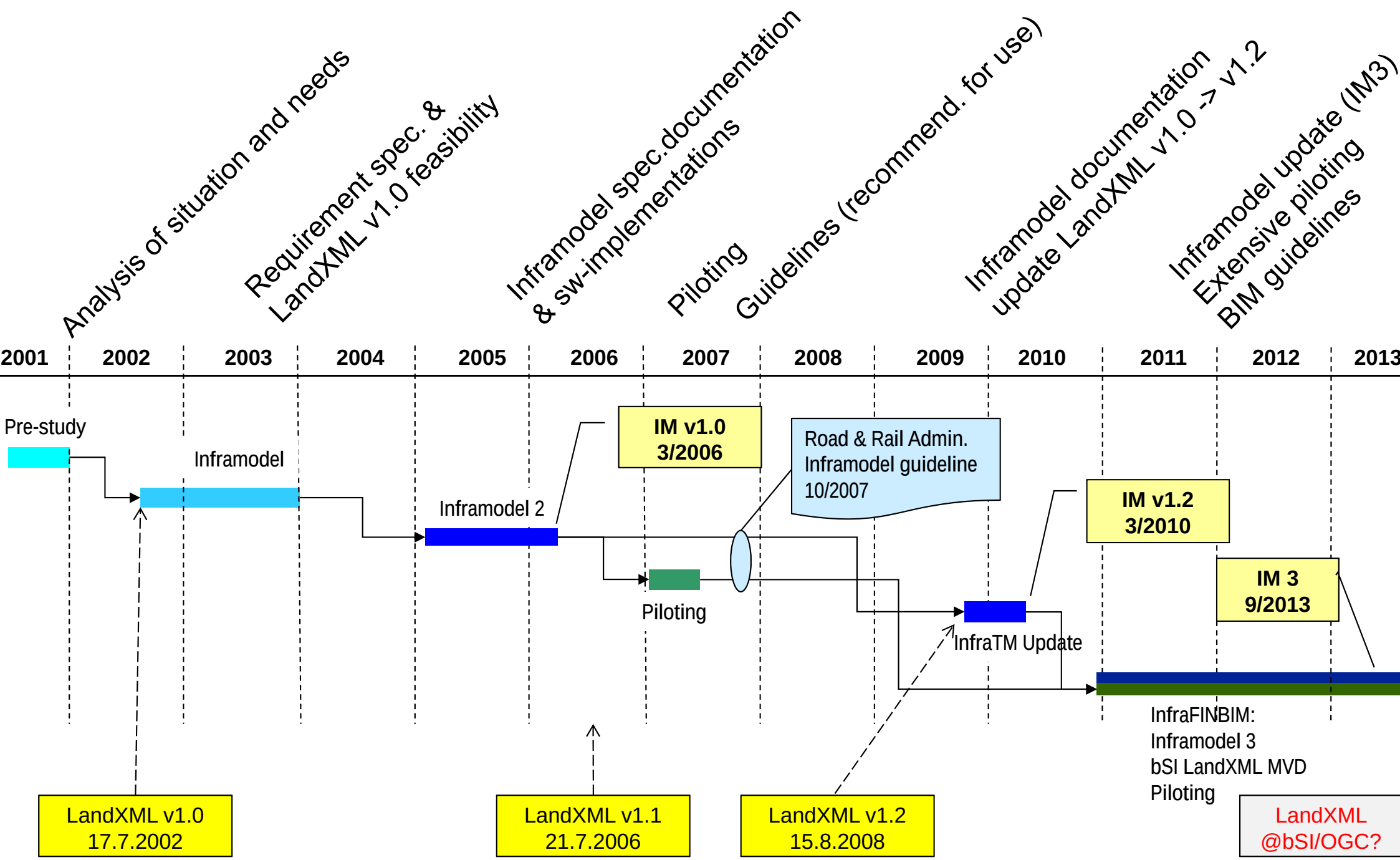
1. General requirements
2. Modelling the Initial State
3. Modelling in Different Stages of the project
4. Structural Models: Earth and Rock Structures, Foundations, Road and Railway Structures and Pavements
5. Structural Models: Municipal Utilities
6. Structural Models: Bridges and other Civil Engineering Structures
7. Quality Assurance
8. Quantity Take Off, Cost Calculation
9. Visualization
10. Analyses, Simulation and Structural Dimensioning
11. Utilization of BIM in Different Design Stages
12. Utilization of BIM in Infra Construction
13. Utilization of BIM in Use and Maintenance of Infra
14. Management of a BIM project

The Finnish Inframodel

”To improve information exchange between infra design applications and from design to construction, using international open standards.”

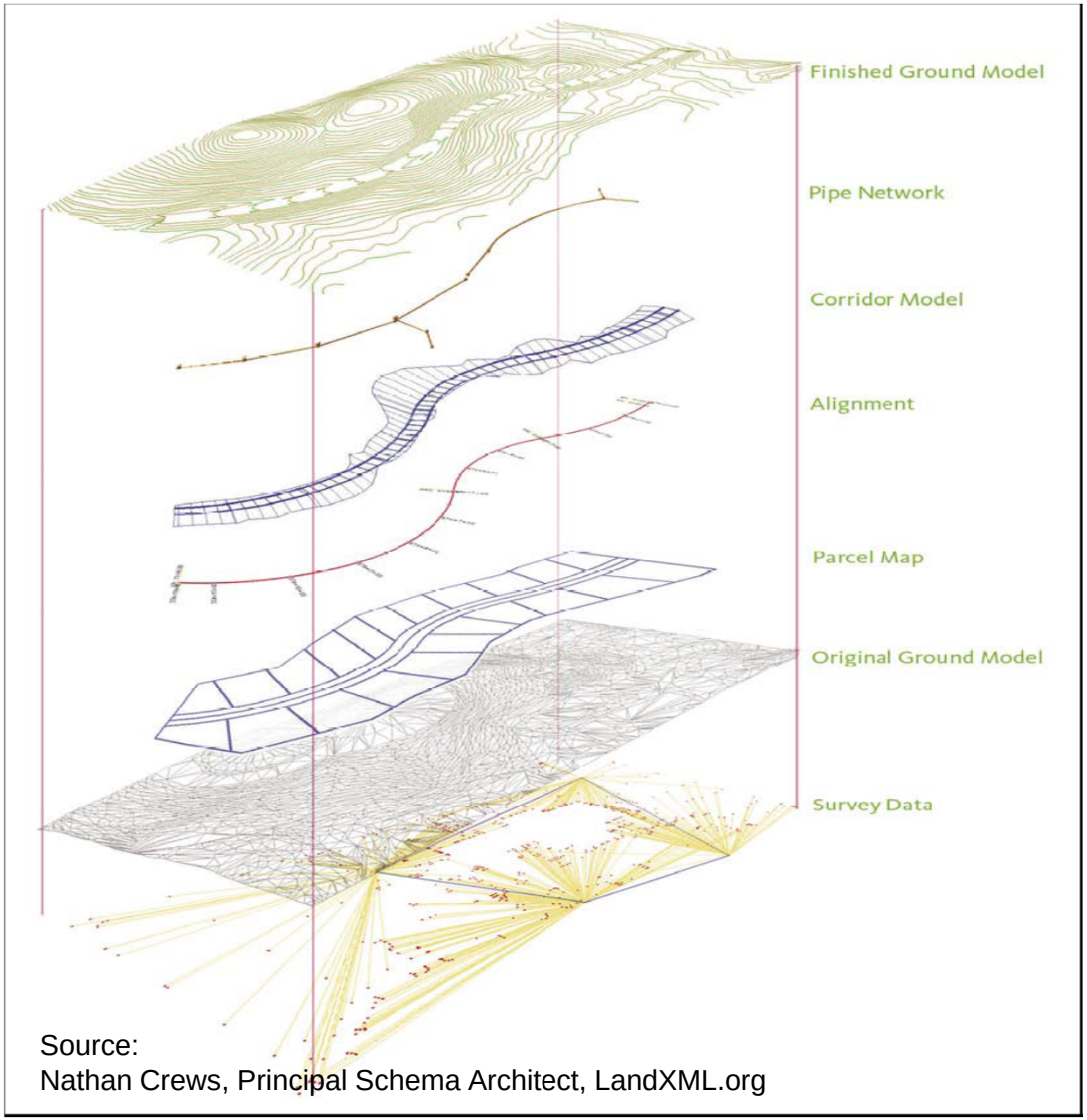
Inframodel:

- National application document for a subset of LandXML schema (~25% of XSD elements)
- Defined scope for prioritised exchange cases between design tasks and design to construction
  - Specific implementation agreements & guidance documented
  - Extensions as Feature-elements (“PSets”)
  - Supported by 3 major vendors in Finnish market (Sito/CityCad, Tekla/Civil, Vianova/Novapoint)
- Current version (IM3) developed in InfraFINBIM project and offered to bSI for international adoption as a Model View Definition for LandXML

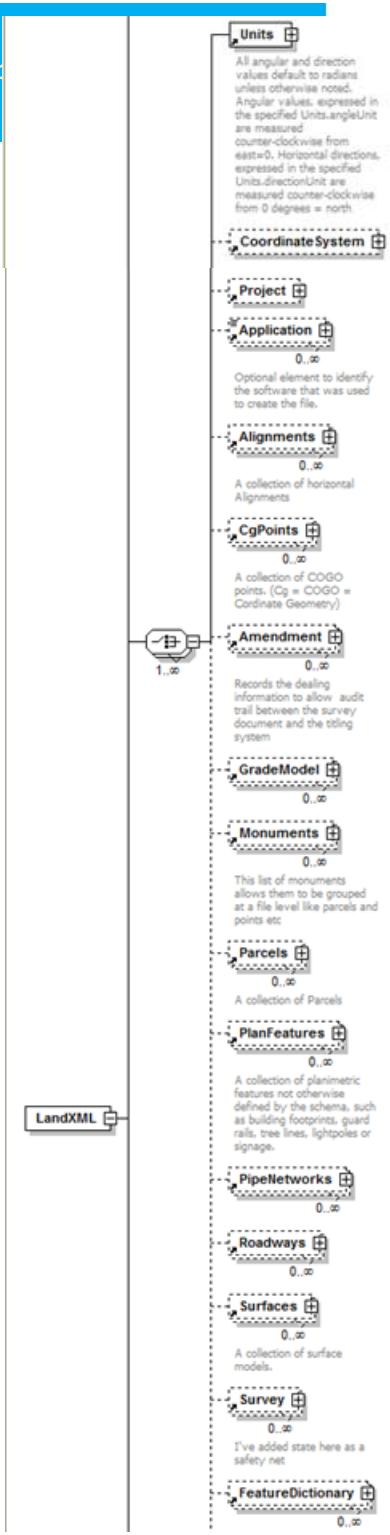

Analysis of situation and needs
Requirement spec. & LandXML v1.0 feasibility
Inframodel spec.documentation & sw-implementations
Piloting
Guidelines (recommend. for use)
Inframodel documentation update LandXML v1.0 -> v1.2
Inframodel update (IM3)
Extensive piloting
BIM guidelines
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013
Pre-study
Inframodel
Inframodel 2
IM v1.0 3/2006
Road & Rail Admin. Inframodel guideline 10/2007
Piloting
IM v1.2 3/2010
IM 3 9/2013
InfraTM Update
InfraFINBIM:
Inframodel 3
bSI LandXML MVD
Piloting
LandXML v1.0 17.7.2002
LandXML v1.1 21.7.2006
LandXML v1.2 15.8.2008
LandXML @bSI/OGC?

What LandXML?

- A specialized XML data file format containing civil engineering and survey measurement data commonly used in the Land Development and Transportation Industries.
- Specification as XML schema published under LandXML.org



Source:
Nathan Crews, Principal Schema Architect, LandXML.org



Can support (ideally) several business cases in infra design and construction, but…
Implementations currently poorly interoperable: the schema rather open for interpretation and its documentation not very informative

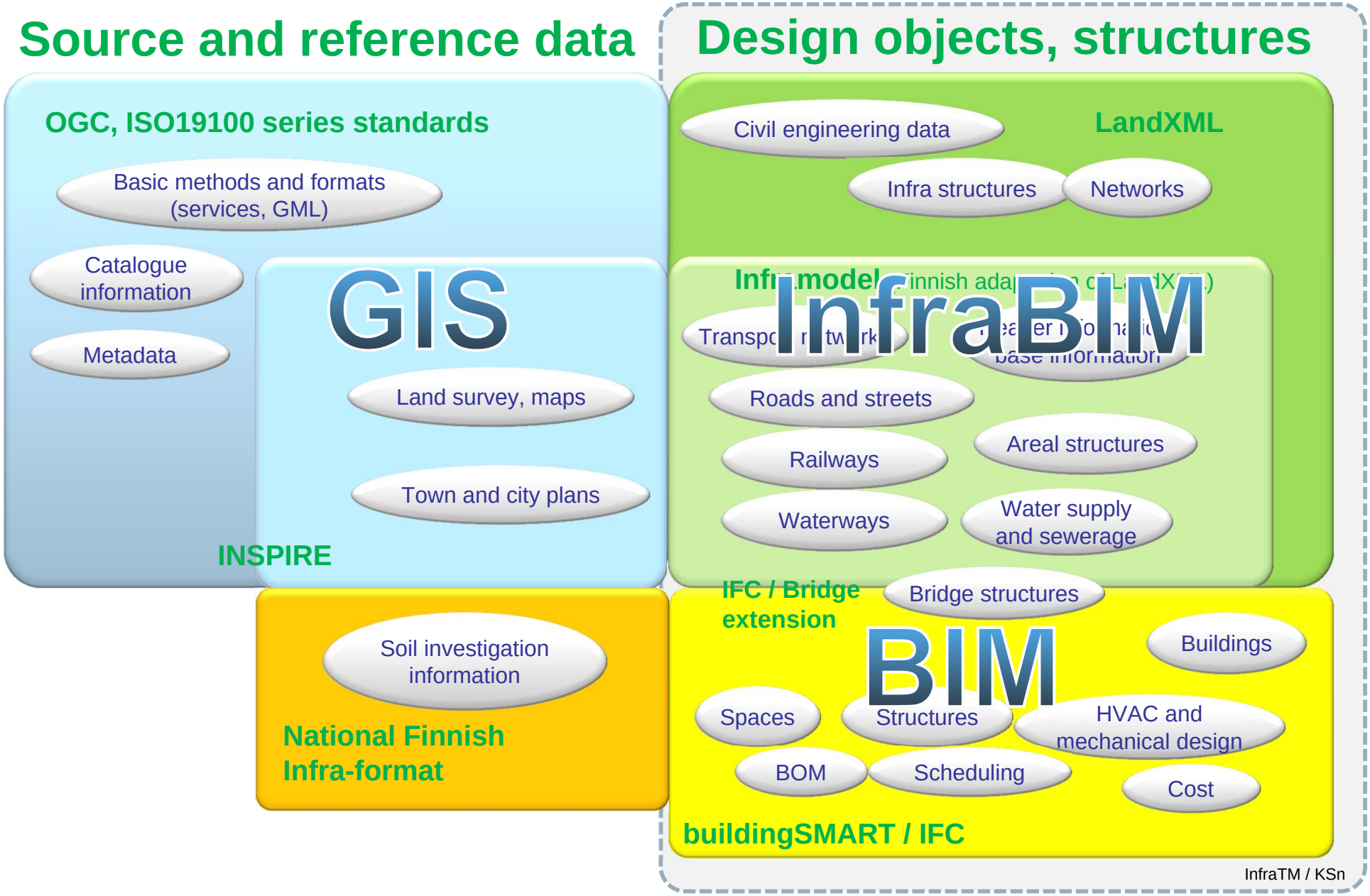
Why LandXML?

- IFC most directly applicable/extensible for bridges etc.
- LandXML has its shortcomings, but…
  - Short term alternatives for infra design&construction are few (if any)
  - Supported by major software vendors
  - Making (just) its way into practise

=> InfraFINBIM committed to extensive piloting and further development of Inframodel specification (new functionality, internationalisation)

- Shifting development & adoption on international level: buildingSMART Model View Definition for LandXML (ongoing)
- Development stopped at LandXML.org --> buildingSMART and OGC (Open Geospatial Consortium) assessing options for future LandXML maintenace

Infra-standards – general information map



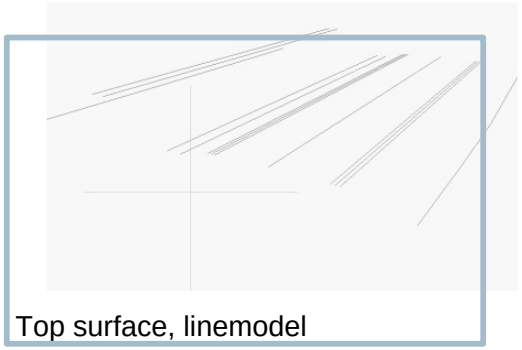
Inframodel content

IM2 +> IM3

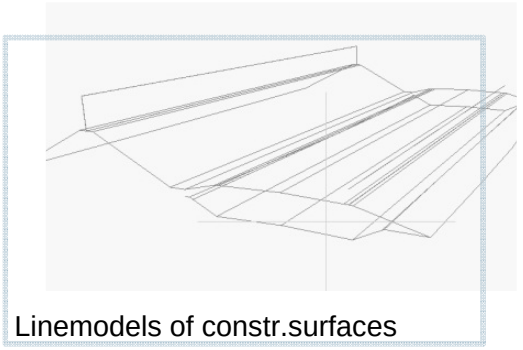
- Project data
  - project, plan, application, units, coordinatesystem, codings
- Base data
  - Terrain model, subsoil model surfaces
- Road, street, railway, water way
  - Geometry lines
  - Construction layers
  - Cross sect design parameters
- Water supply and sewerage
  - Wells, equipments, pipes , culverts
- Soil reinforcement, areal plannig
  - E.g. massexcavation, noise barriers, landscaping surfaces

- Railway
  - Stationing (kilometer referencing system)
  - cant
  - switches
- Equipments
  - railings
  - fences
  - pedestals (lighting column, traffic signs)
  - properties
- Infra classification (type codings)
- FeatureDictionary

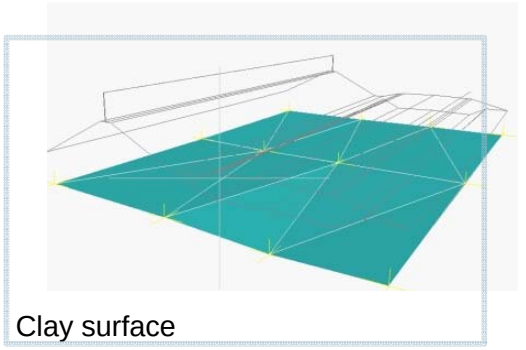
Examples of Inframodel3 information



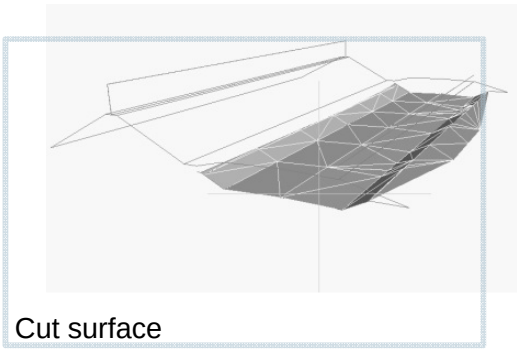
Top surface, linemodel



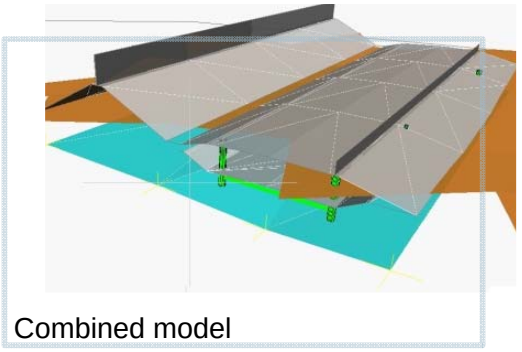
Linemodels of constr.surfaces



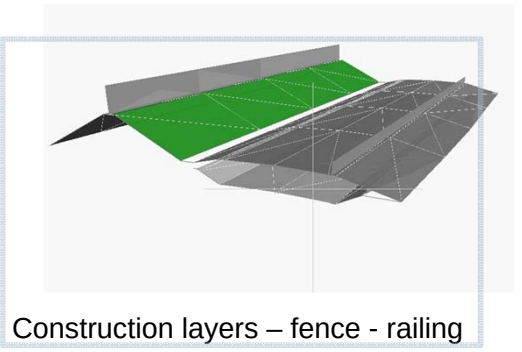
Clay surface



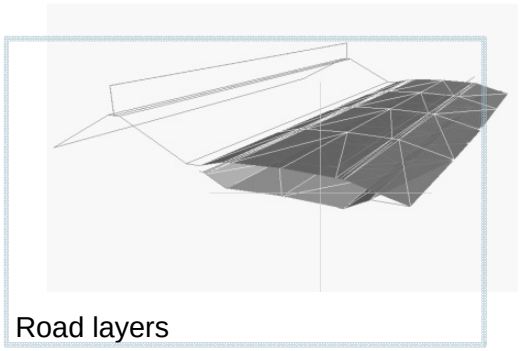
Cut surface



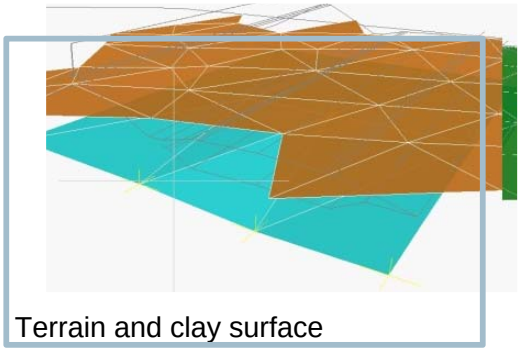
Combined model



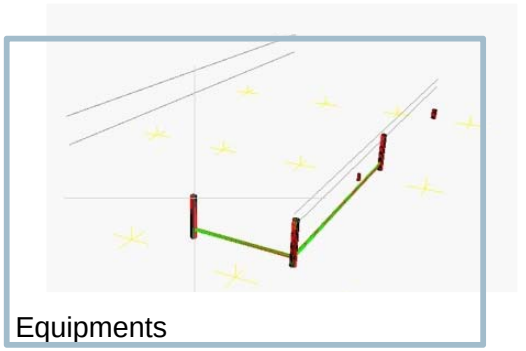
Construction layers – fence - railing



Road layers

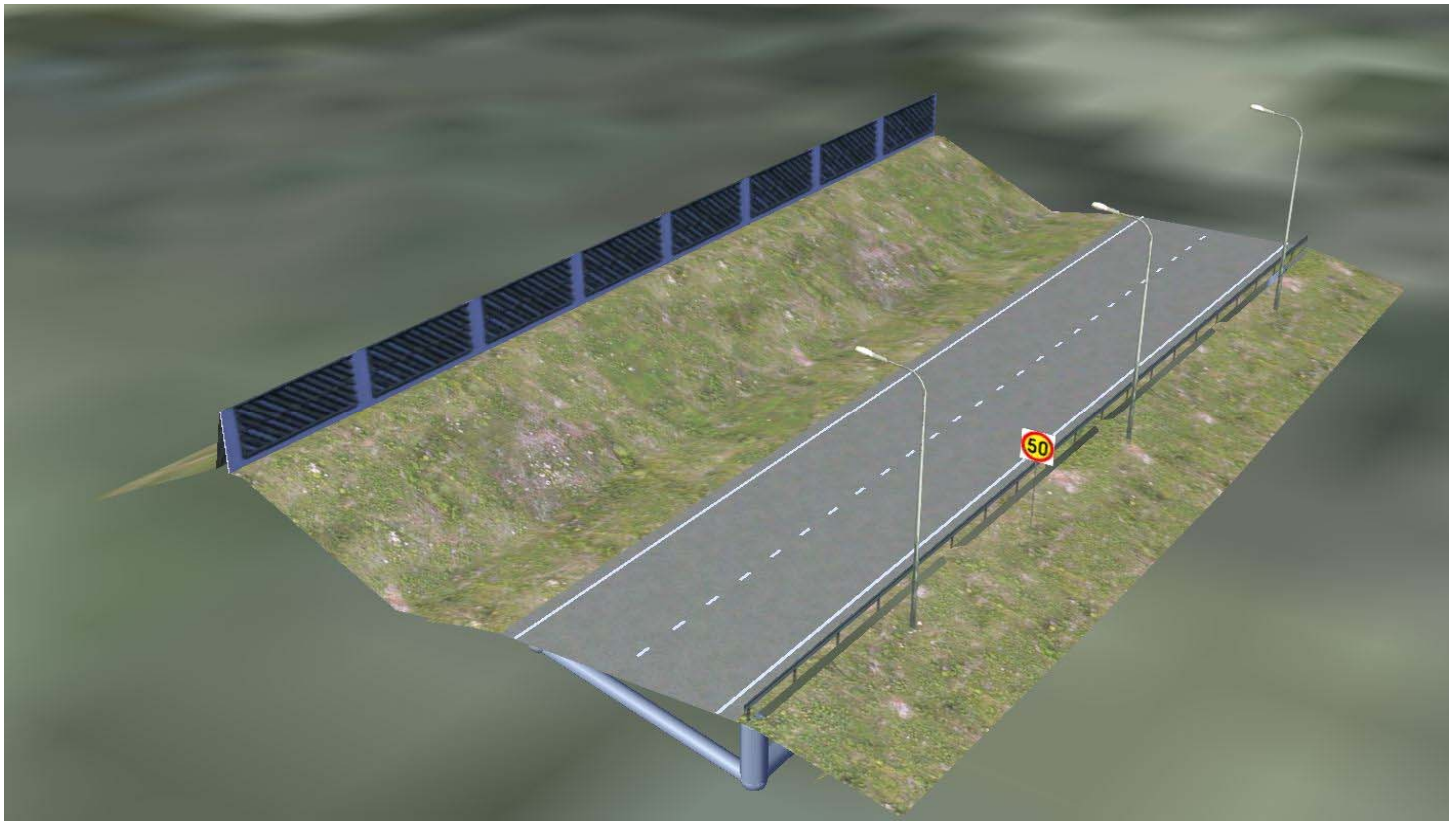


Terrain and clay surface



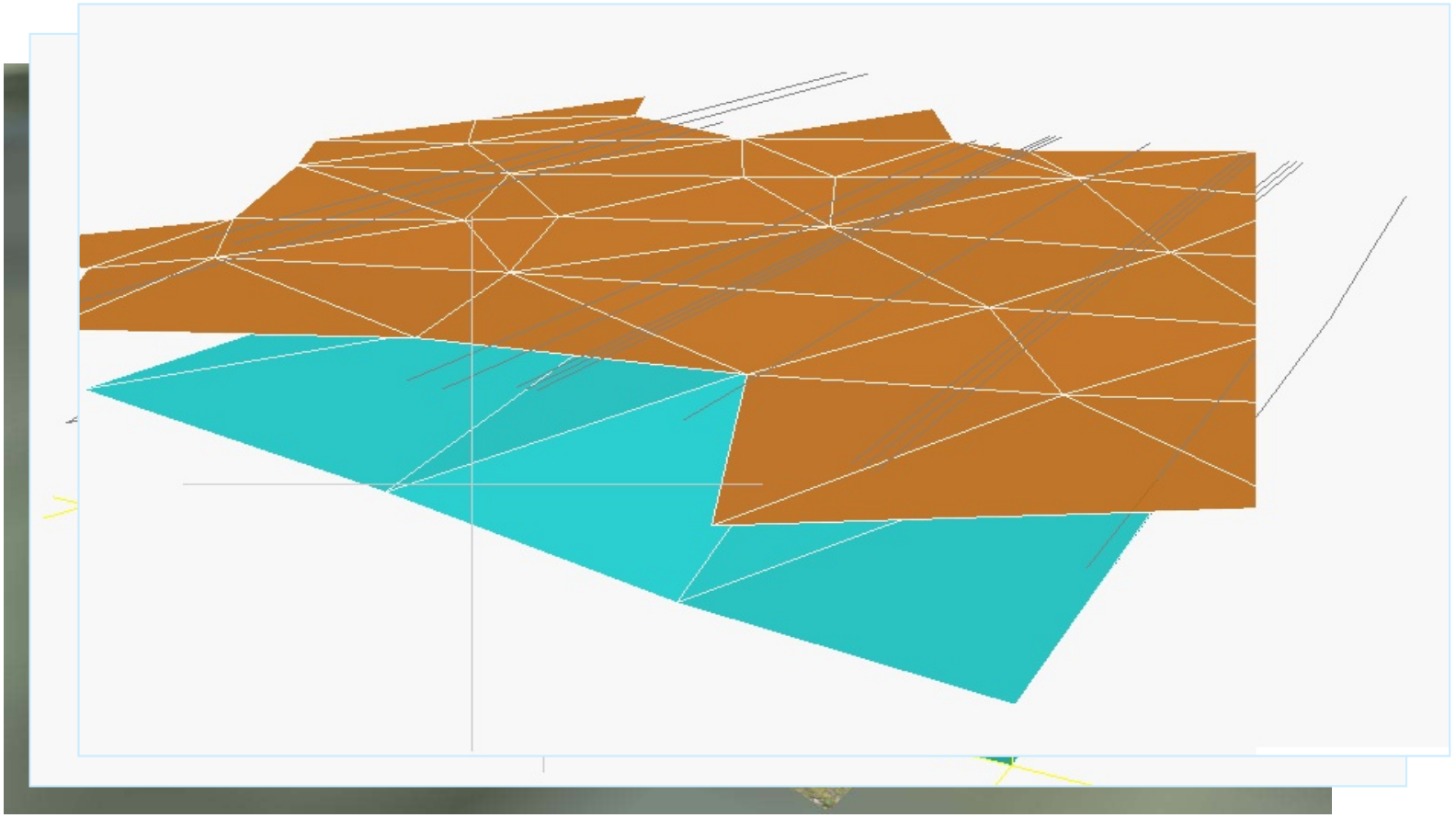
Equipments

Example of Inframodel3 information



- Project
- Terrain model: points/lines/triagles
- Clay surface: points. triangles
- Cut surface
- Road construction surfaces
- Soundbarrier, fence, railing
- Wells, pipes
- Pedestals (lightnig), pedestals, traffic signs

Example of Inframodel3 information



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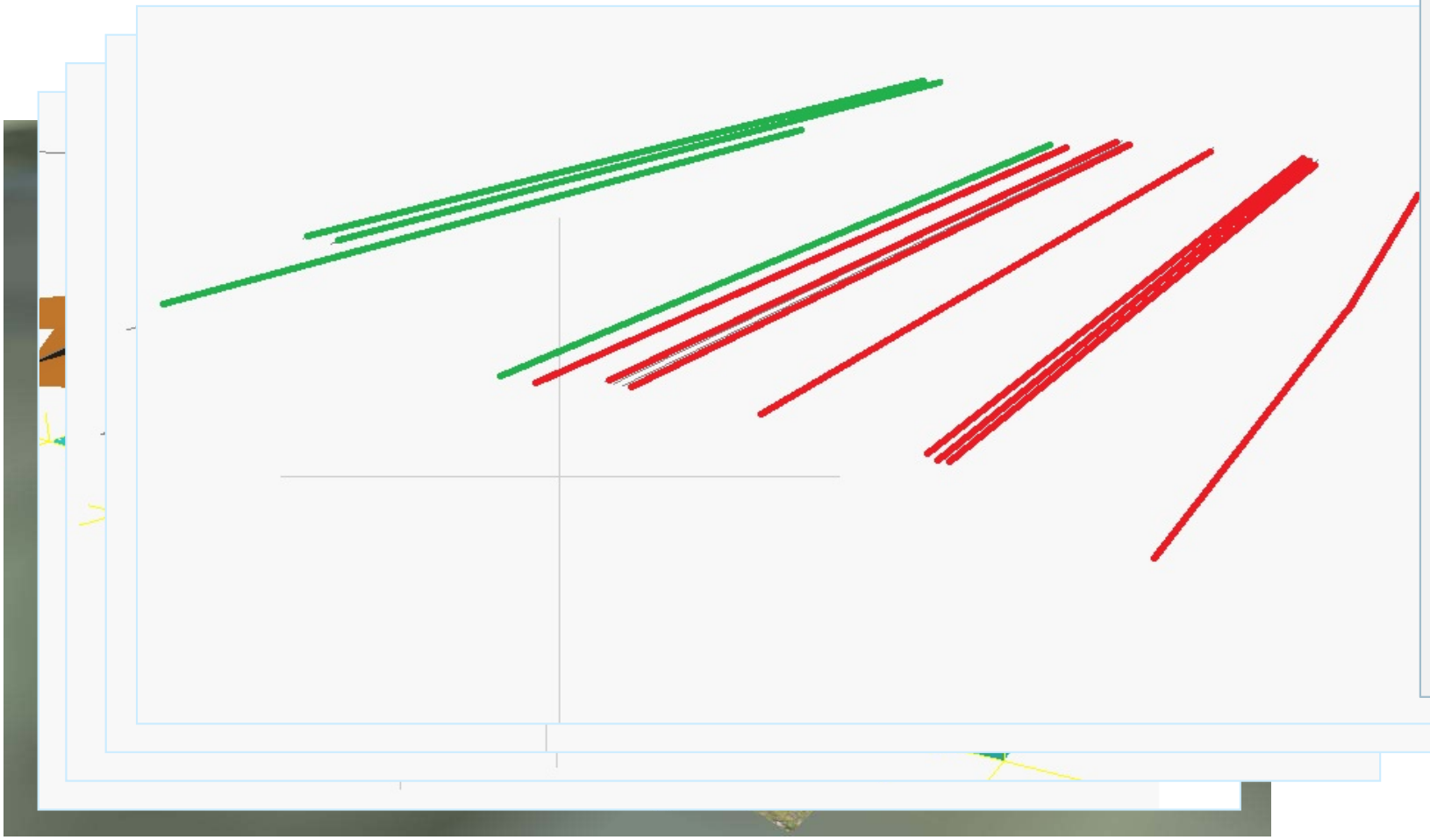

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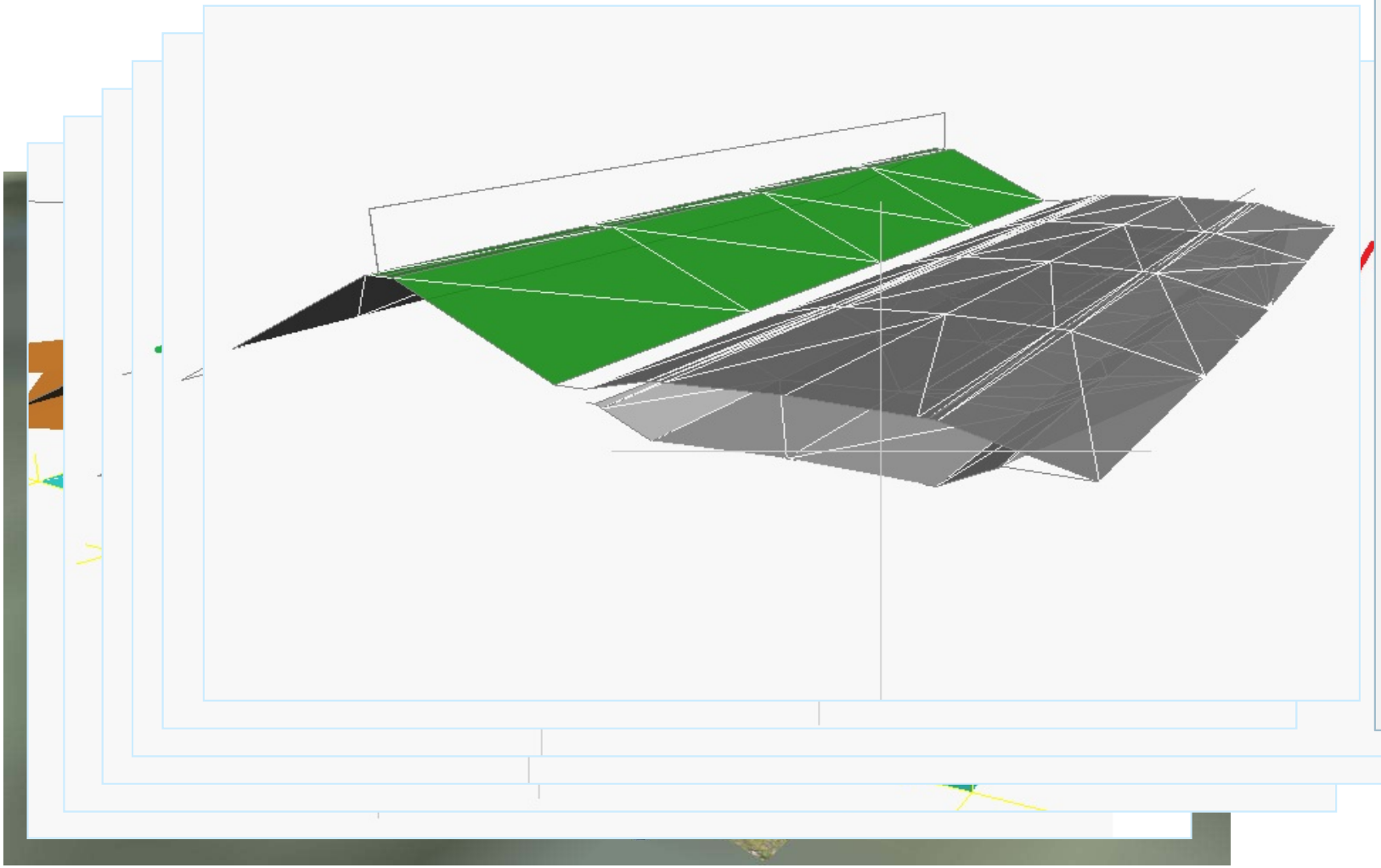

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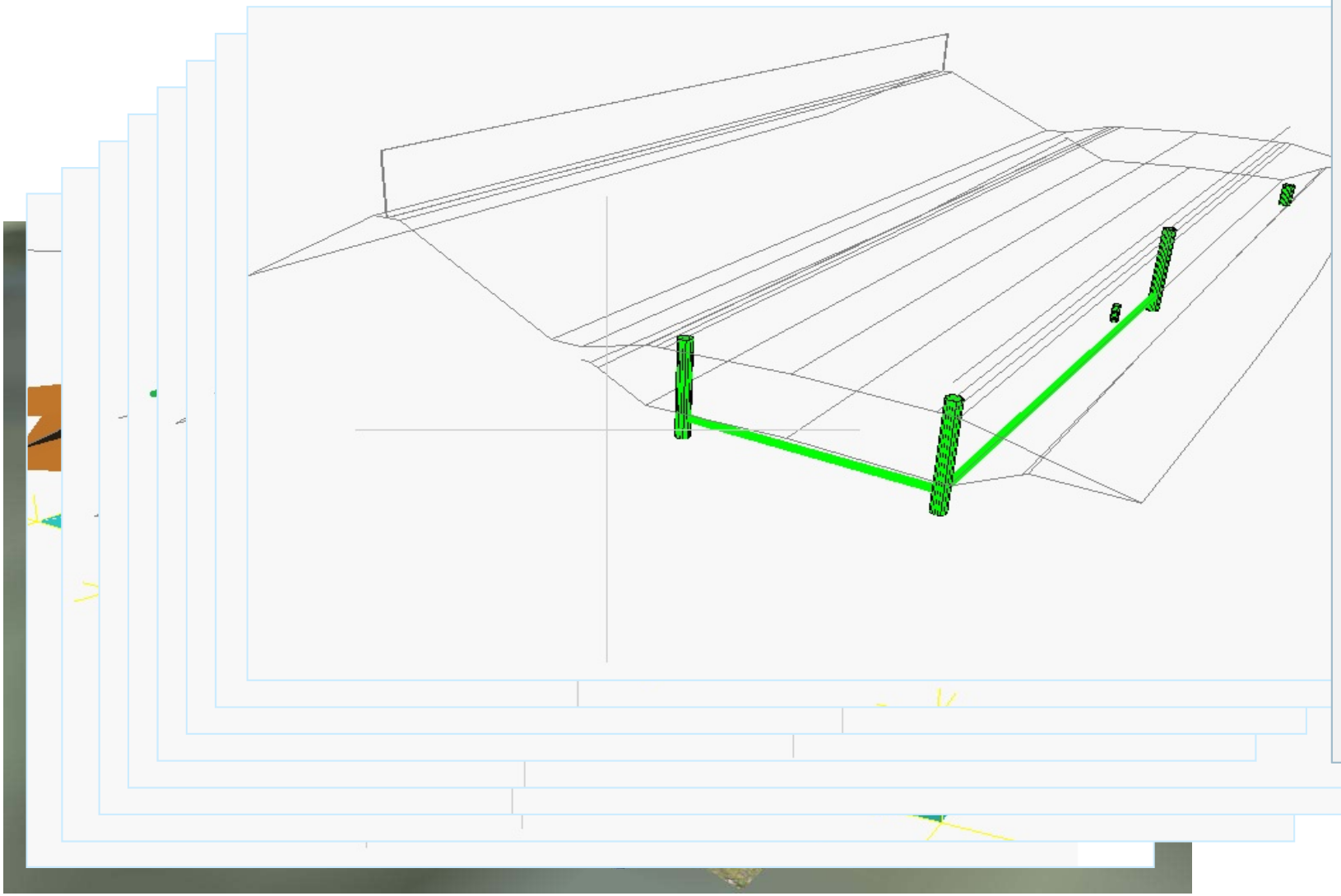

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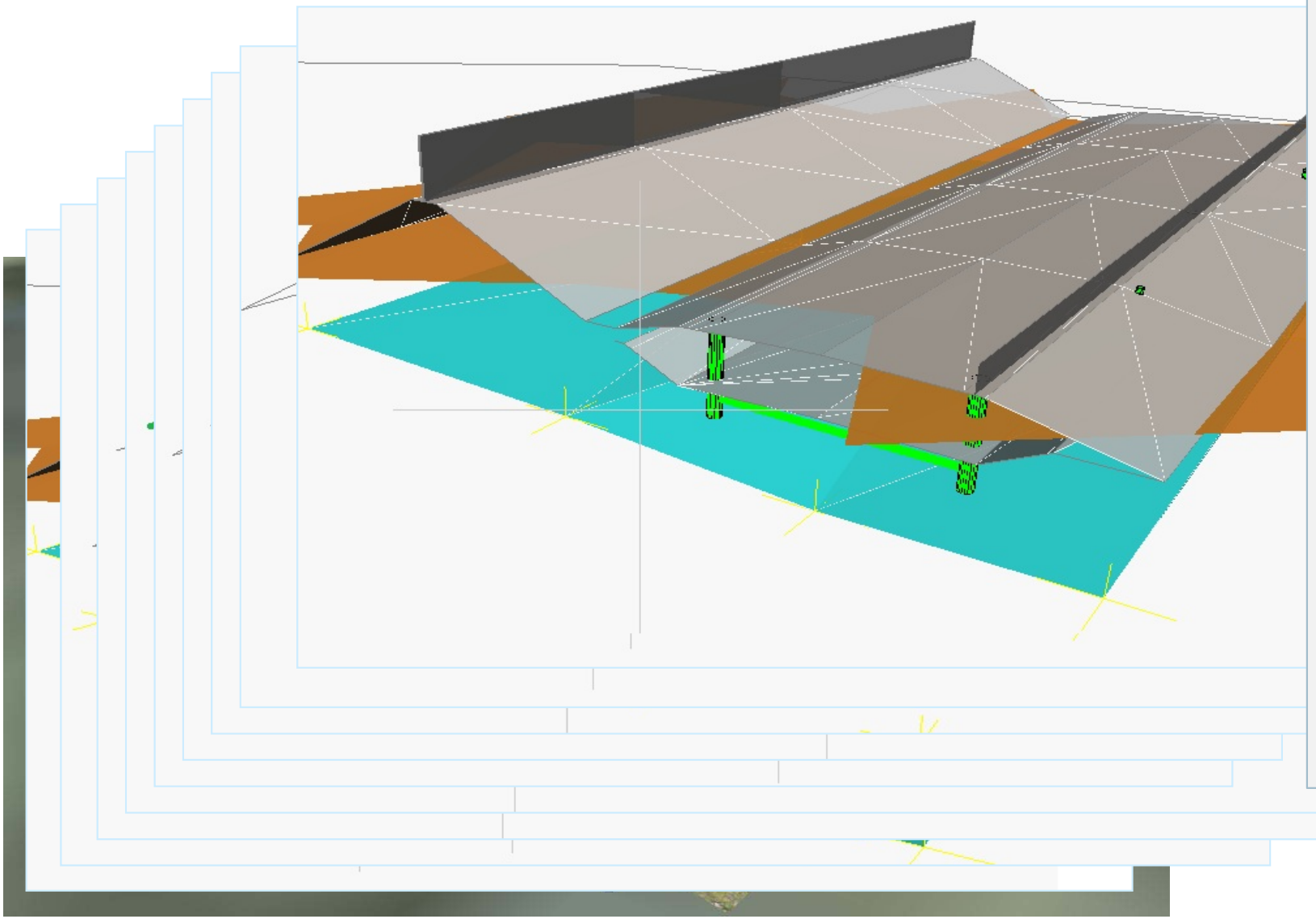

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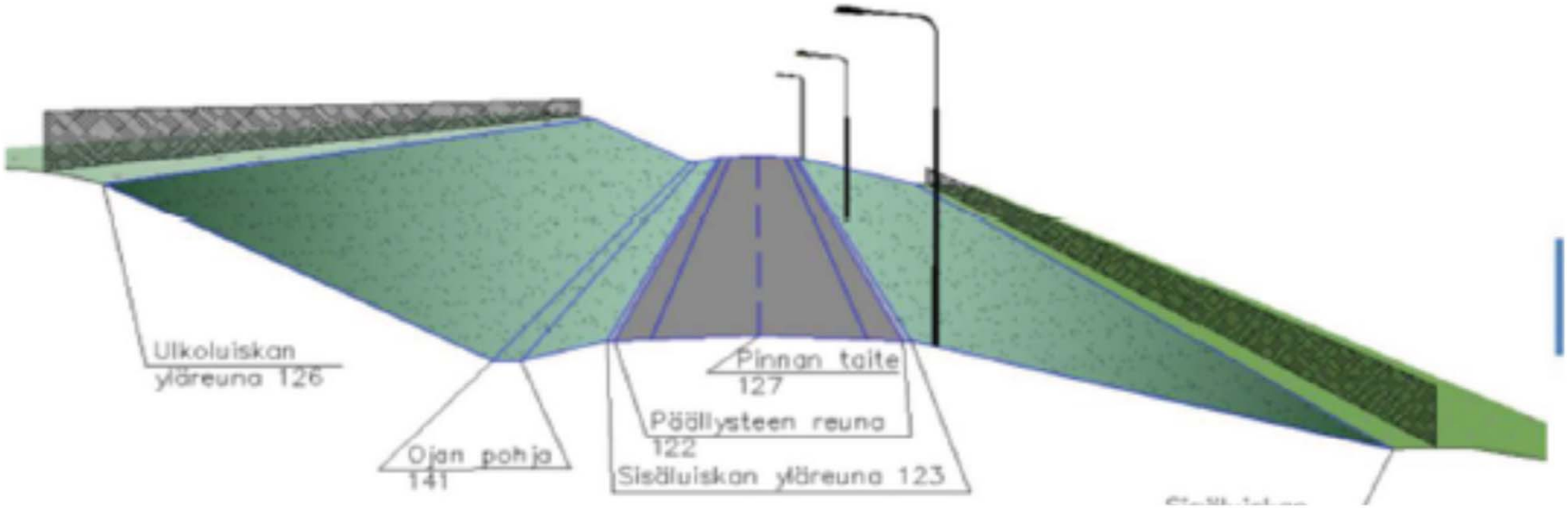
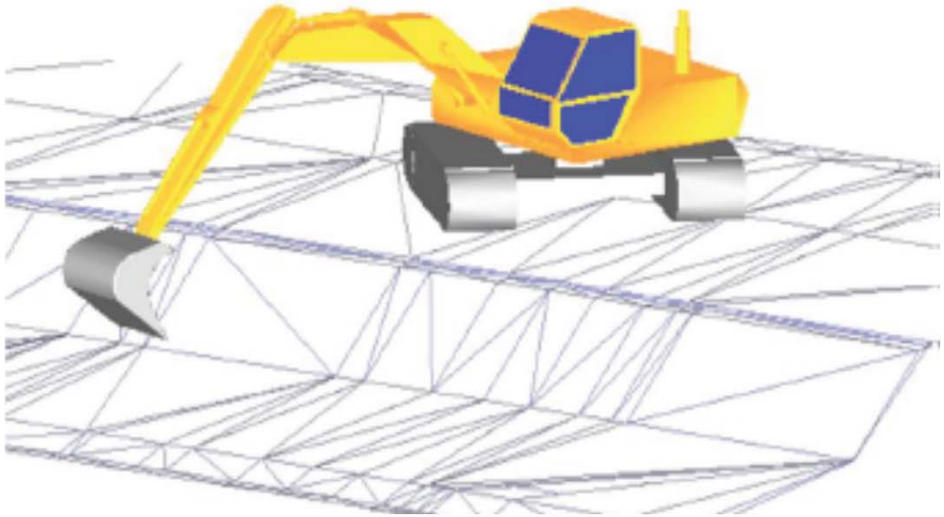
- Pedestals ,traffic signs
- **Combined model**

InfraBIM classifications in Inframodel3…



…and following BIM guideline part 4 for Structural models: Road structures



Inframodel specifications

inframodel.xsd

http://www.inframodel.fi

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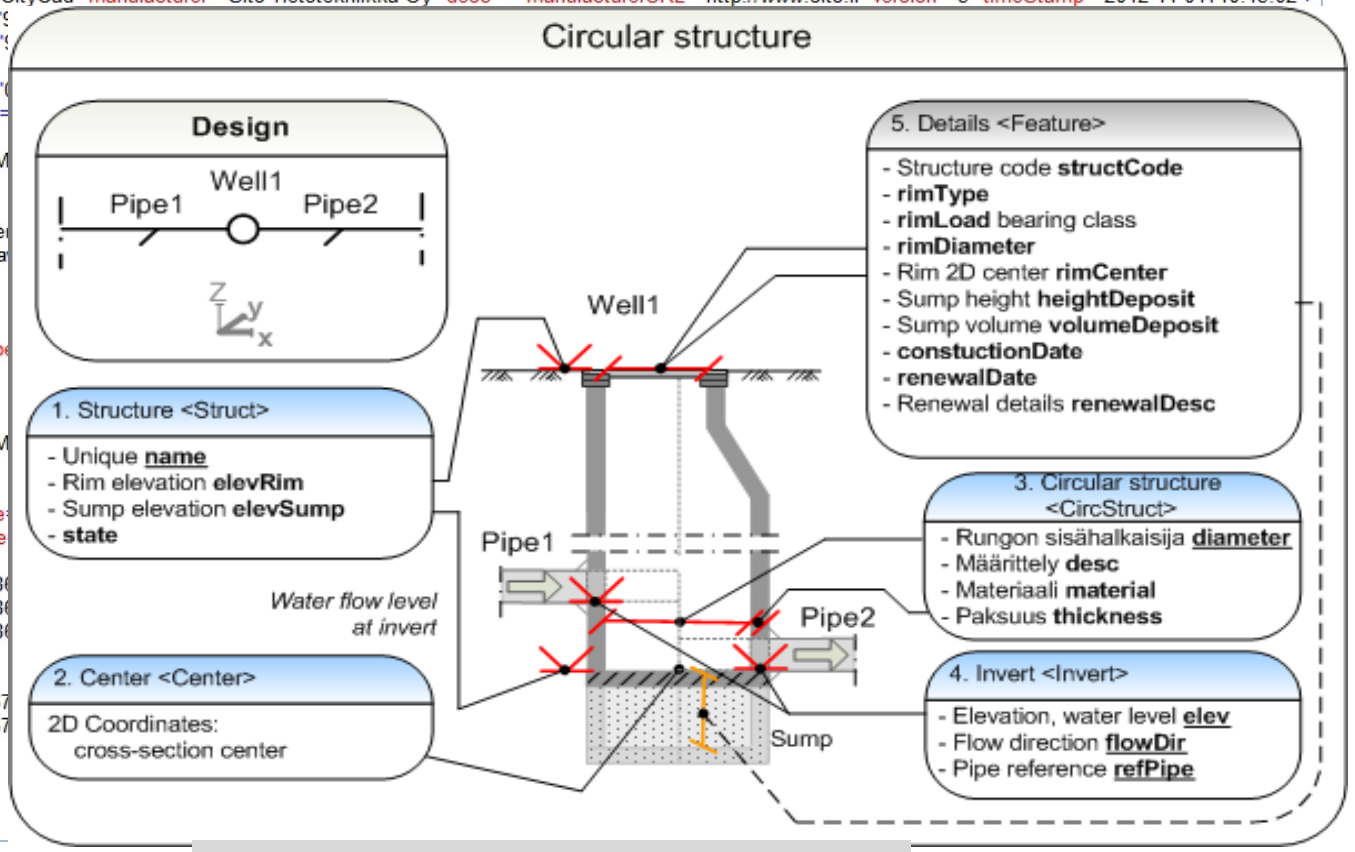

Online-documentation

http://cic.vtt.fi/inframodel

inframodelEnumerations.xsd

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 value="tiili" />
 value="kivi" />
 value="valurauta" />
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 value="muovi" />
 value="Betoni" />
 value="muuMateriaali" />
 value="alumiini" />
 value="kupari" />
 value="lyijy" />
 value="haponkestavaTeras" />
 value="ruostumatonTeras" />
 value="harmaavalurauta" />
 value="pallografiittivalurauta" />
 value="asbestisementti" />
 value="lasitettuSavi" />
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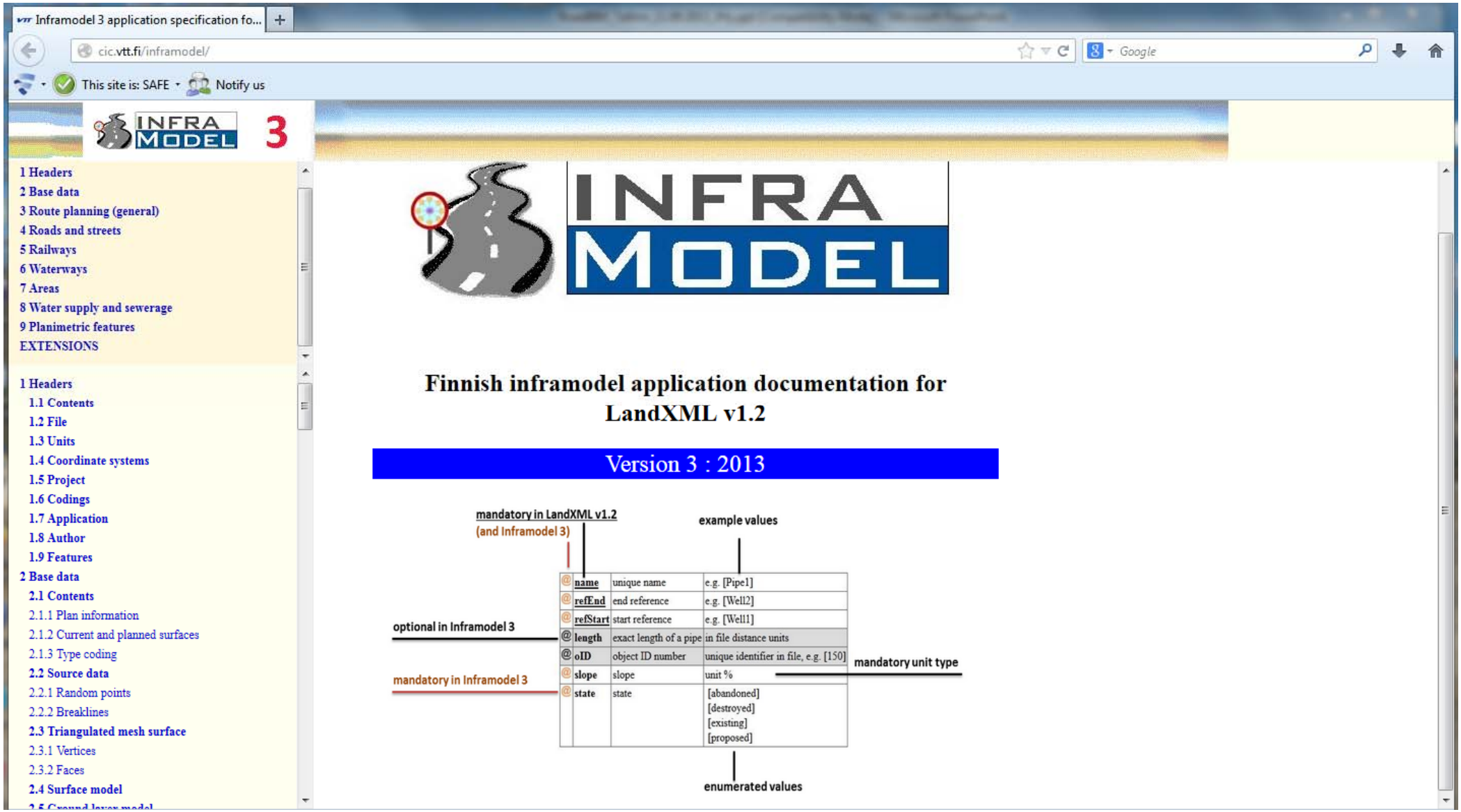


Inframodel online documentation published at http://cic.vtt.fi/inframodel

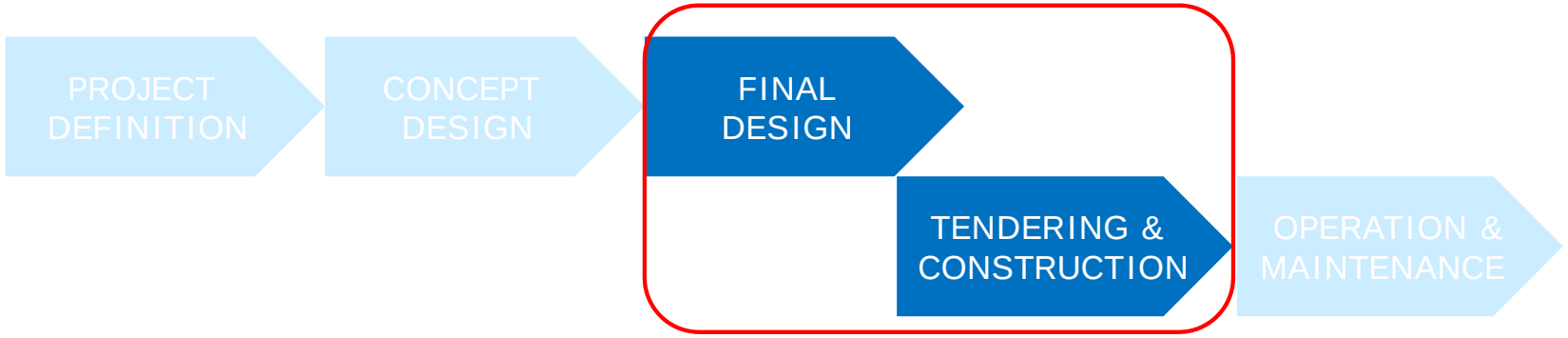
buildingSMART action

- Model view definitions with implementation guidelines and improved documentation needed to support LandXML use until IFC Infra-extensions are available (IFC 5 tentative release 2017)
- Resolution 17.10.2012
  - ITM/IUG accept the new project "OpenINFRA: buildingSMART MVD for LandXML v1.2" as proposed by the Nordic chapter and encourages all chapters to participate in development of this model view definition and to support its implementation and use.

=>MVD to be completed by end 2013

MVD (Model View Definition)= a well-defined subset of the totality from a specific viewpoint or specific purposes, with documented implementation agreements

Scope of bSI LandXML work



1. Contextual information: exchange data set (file author, date...), project, coordinate systems, units

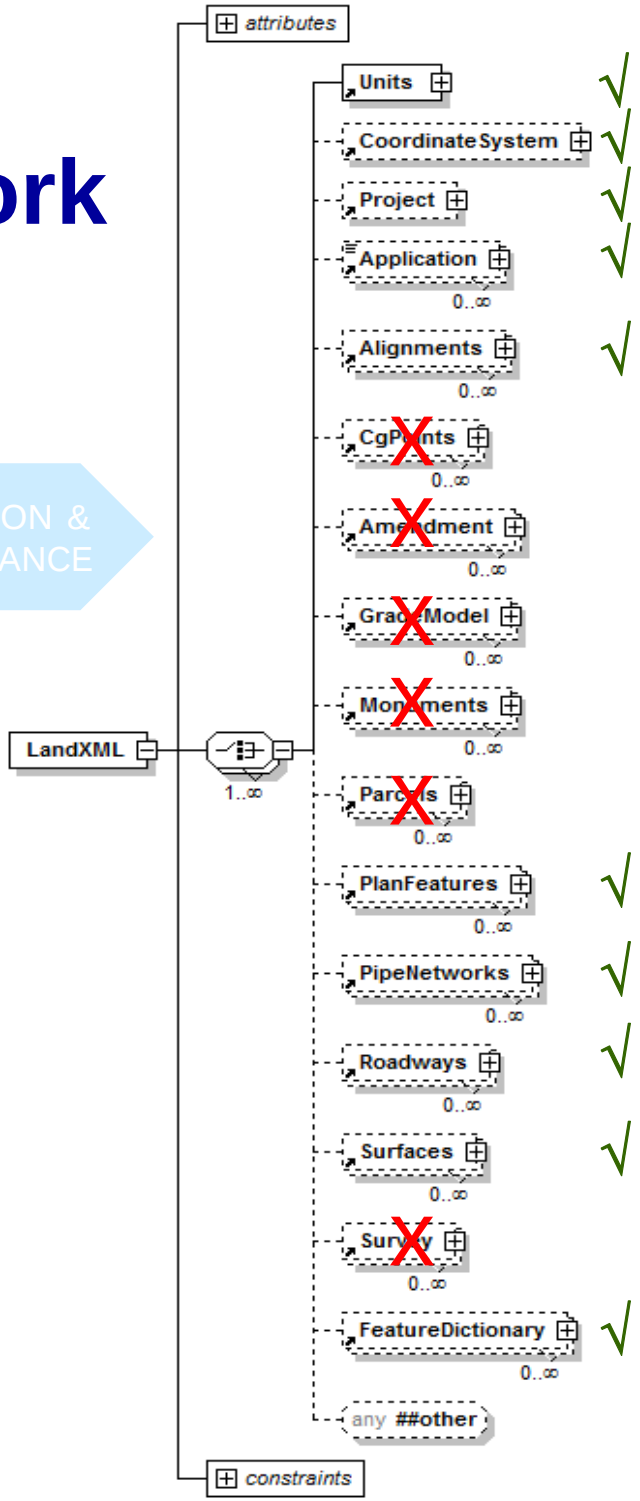
2. Source data (surfaces, breaklines, data points): geometric data and type codings

3. General transport infrastructure design (roads, waterways and railways): alignment and surface model geometry and type codings

4. Road, railway and waterway design: design parameters, cross sections, properties, base quantities

5. Areal planning: landscaping, noise barriers, geo-structures

6. **Water supply and sewerage**: pipe networks with pipes, structures, connections and equipments



Thank You for Your Attention!

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