

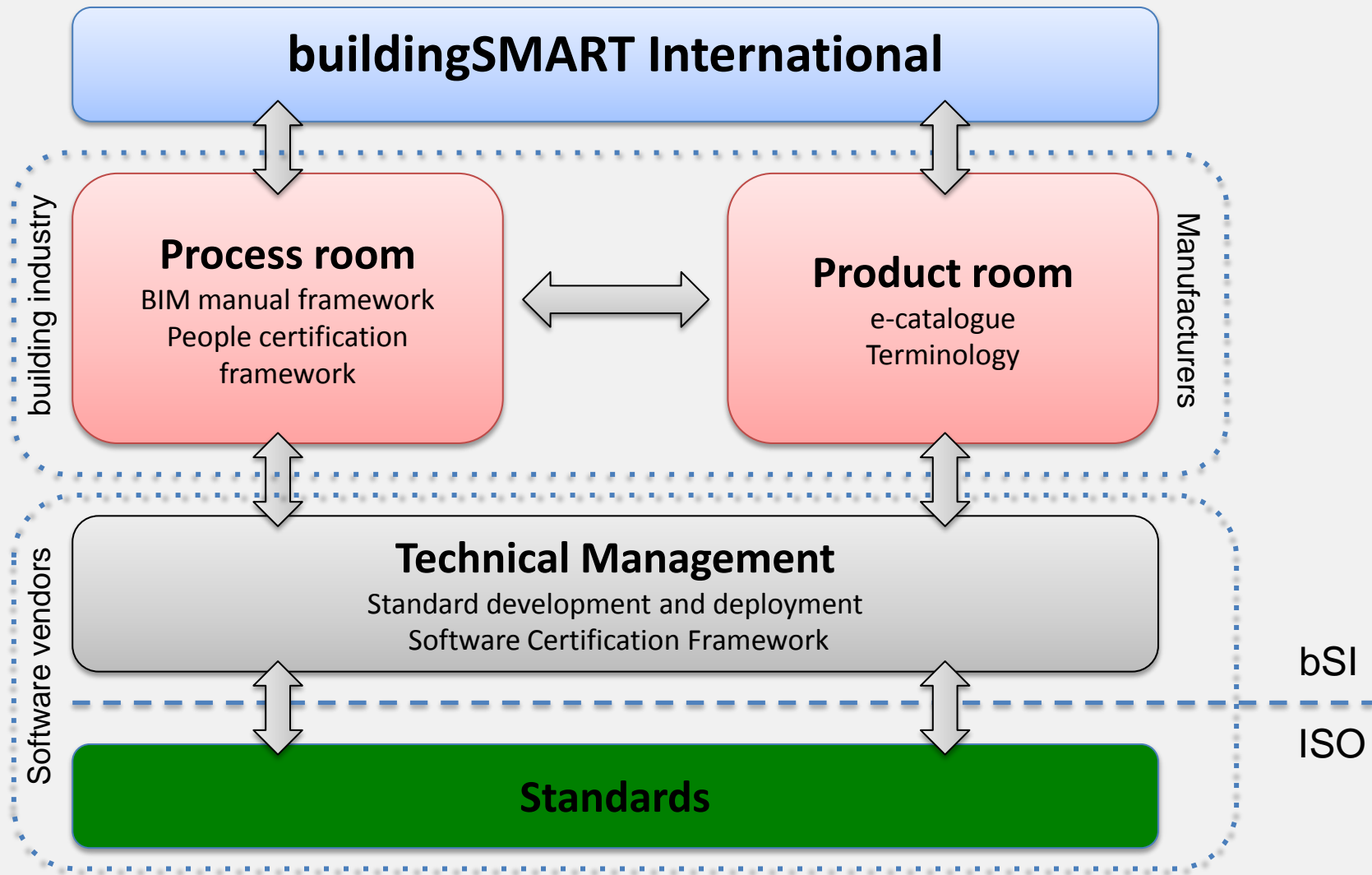
# IFC for INFRAstructure

INFRA-BIM Workshop, Helsinki, 19.11.2013

*Dr. Thomas Liebich*

*MSG Chair, AEC3 Director*

# buildingSMART – An organization to develop standards



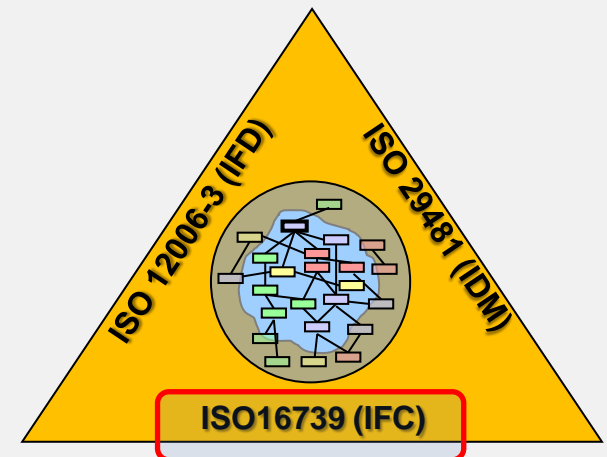
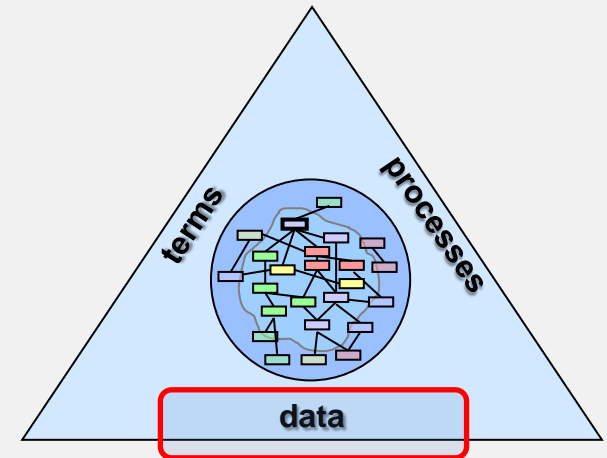
# IFC – a buildingSMART standard

## buildingSMART an organization being

- Independent
- International
- Not for profit
- Open to all in construction

## buildingSMART standards

- Consensus based industry standards
- Requirements are project driven
- Standards are open and maintained
- Standards are implemented and available
- Collaboration with ISO for formal standards

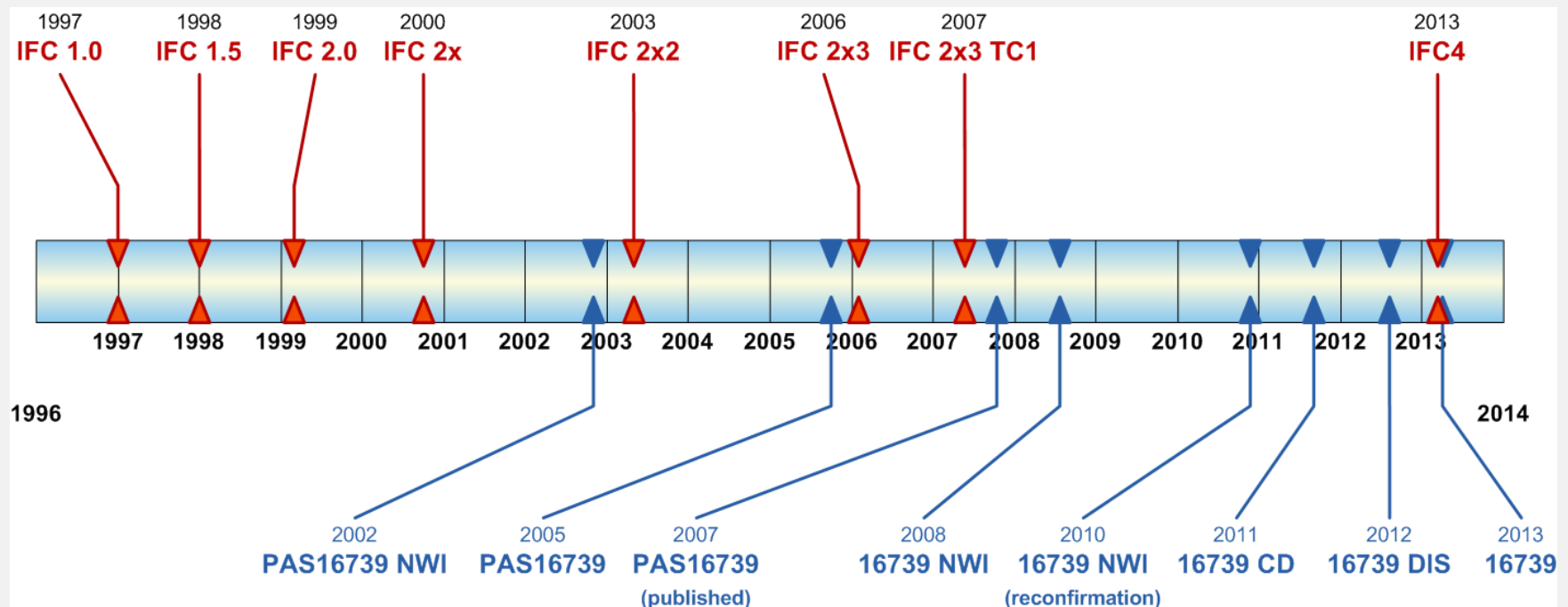


# STATUS OF IFC TODAY

Current status of IFC in software products and next developments

# History of IFC Development

- IFC 1.0 to IFC 2.0 – early prototypes use: 2000 - 2002
- IFC 2x to IFC 2x2 – early adopters use: 2002 - 2008
- IFC 2x3 – in practical use today use: 2008 - 2016
- IFC 4 – forthcoming use: from 2014 onwards



# IFC Status for users today – IFC2x3 CV2.0



## Use IFC2x3 certified software

- for well supported workflows, i.e. mainly for reference workflow
- check official certification status: <http://www.buildingsmart.org/certification/currently-certified-software-products>



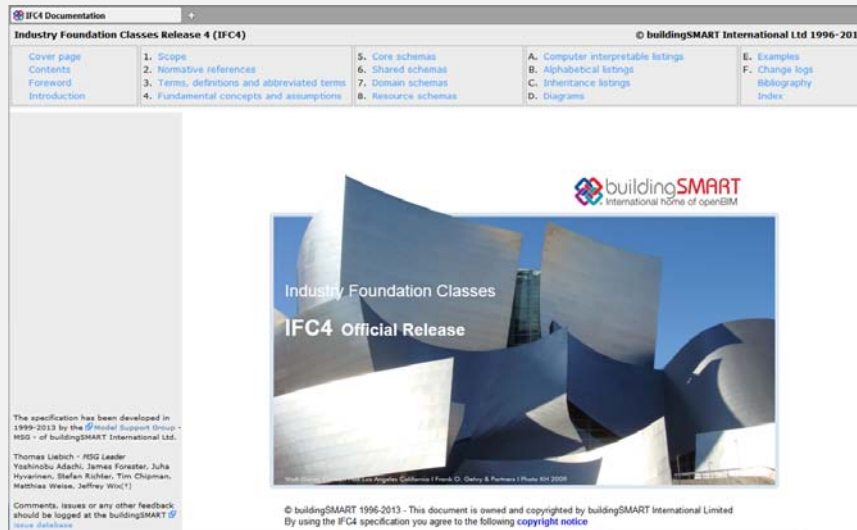
# IFC status for developers today – IFC4

## Current buildingSMART release

- IFC4 is released with many important enhancements
- Available since March 2013

## Full ISO Standard as ISO 16739

- Same time full ISO accreditation achieved
- ISO 16739 released April 2013



IFC4 Documentation

Industry Foundation Classes Release 4 (IFC4) © buildingSMART International Ltd 1996-2013

Cover page	1. Scope	5. Core schemas	A. Computer interpretable listings	E. Examples
Contents	2. Normative references	6. Shared schemas	B. Alphabetical listings	F. Change logs
Foreword	3. Terms, definitions and abbreviated terms	7. Domain schemas	C. Inheritance listings	Bibliography
Introduction	4. Fundamental concepts and assumptions	8. Resource schemas	D. Diagrams	Index

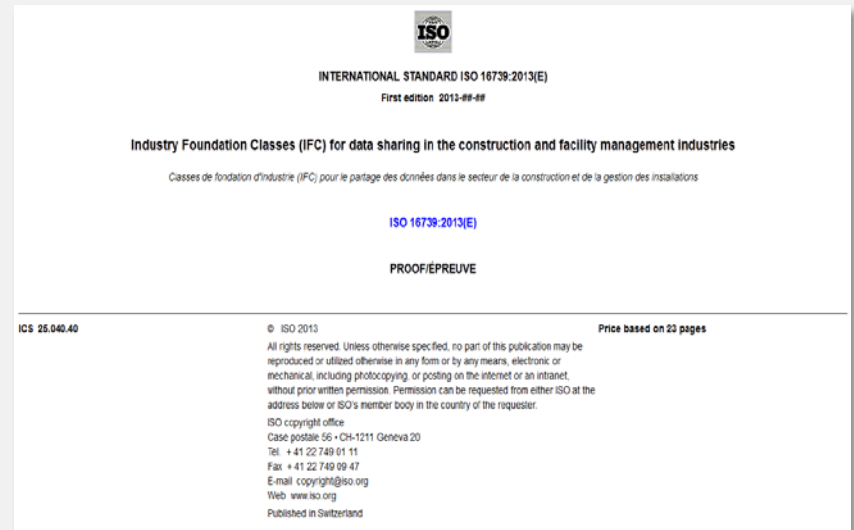
Industry Foundation Classes  
IFC4 Official Release

The specification has been developed in 1999-2013 by the Model Support Group - MSG - of buildingSMART International Ltd.

Thomas Liebich - MSG Leader  
Yashinobu Adachi, James Forester, Juha Hyytiäinen, Stefan Rübner, Tim Chapman, Matthias Weisse, Jeffrey Wu(1)

Comments, issues or any other feedback should be logged at the buildingSMART [Issue Tracker](#).

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INTERNATIONAL STANDARD ISO 16739:2013(E)  
First edition 2013-#-#F

Industry Foundation Classes (IFC) for data sharing in the construction and facility management industries  
Casses de fondation d'industrie (IFC) pour le partage des données dans le secteur de la construction et de la gestion des installations

ISO 16739:2013(E)  
PROOF/ÉPREUVE

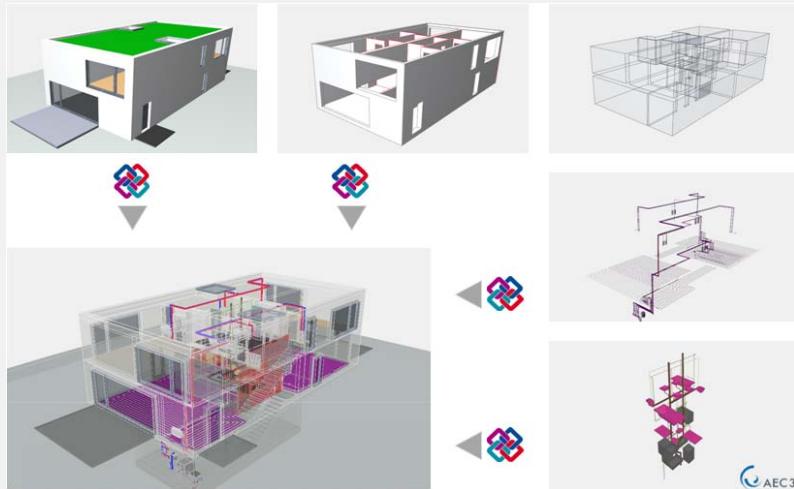
ICS 25.040.40 © ISO 2013 Price based on 23 pages

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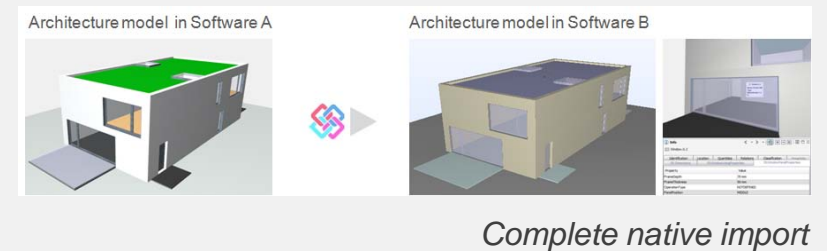
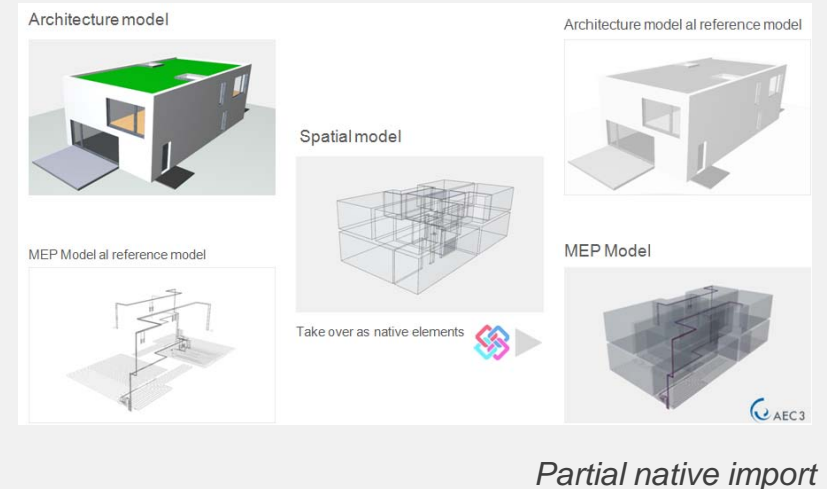
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Published in Switzerland

# Development of “Coordination View” for IFC4

## MVD for Reference workflow



## MVD for Handover workflow





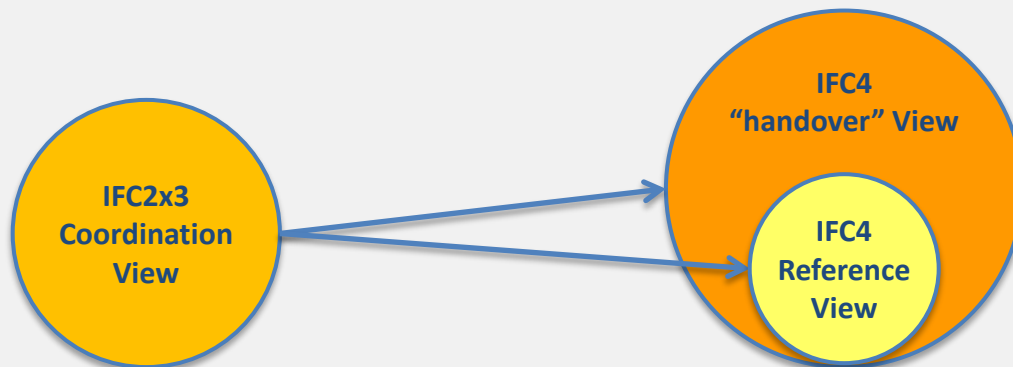
# Development of two model view definitions

## IFC4 Reference View

- referencing work flow, result of the import is “read-only” (not modified)
- scenario includes
  - “background” reference
  - clash detection
  - any viewer based work flow
- expected user experience
  - frequent updates
  - 100% validity, no rework expected

## IFC4 “handover” View

- reuse of the import for further editing (import into native elements)
- scenario includes
  - takeover architecture in structural
  - import spaces into MEP
  - takeover a previous design
- expected user experience
  - low frequency, sometimes “one of”
  - some rework accepted, if limitations are known



# Development schedule for IFC4 coordination view

## Deliverables

- MVD expressed as electronically readable mvdXML specifications
- Full documentation packages generated by ifcDoc
- EXPRESS sub schemas
- ifcXML sub schemas


### Schedule

Work package	2013		2014					
	11	12	1	2	3	4	5	6
WP1 baseline mvdXML specification for implementation		x	x	x	x	x	x	
WP4 Project management and communication	x	x	x	x	x	x	x	

x – Project plan and governance, mobilisation of resources, set-up expert panel

### Milestones

The draft deliverables will be presented at the Spring meeting of buildingSMART International.  
The final deliveries will be handed over end of May, 2014

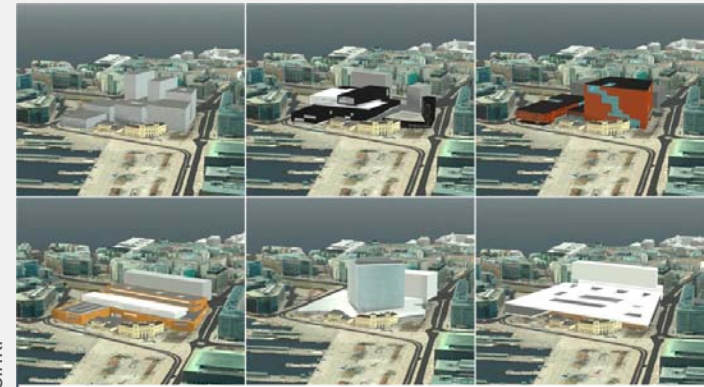
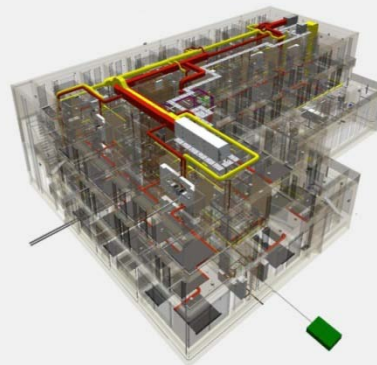
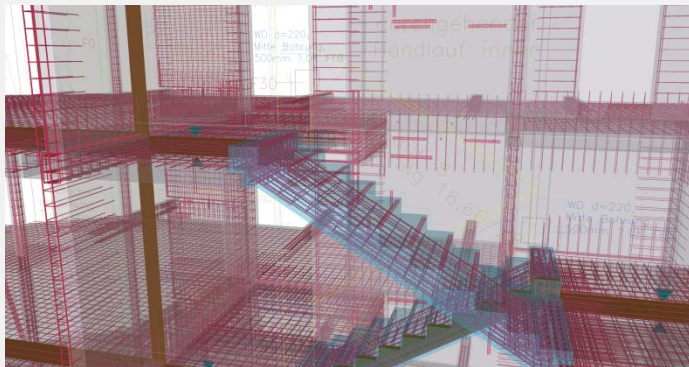
Work package	2013		2014					
	11	12	1	2	3	4	5	6
Draft IFC4 Coordination view specification					x			
Final IFC4 Coordination view specification							x	
<i>ready to start with IFC4 software implementation</i>								x

# IFC Application Scenarios

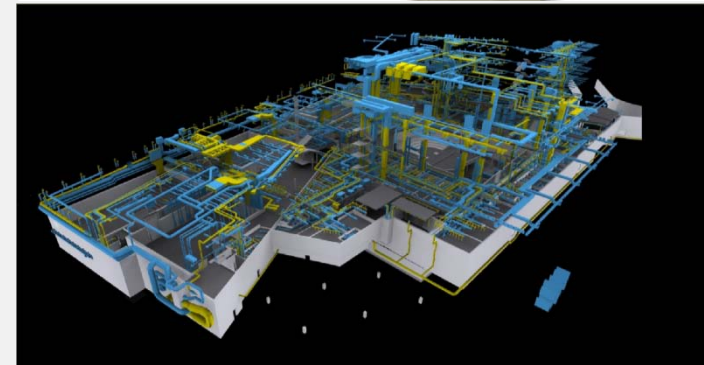
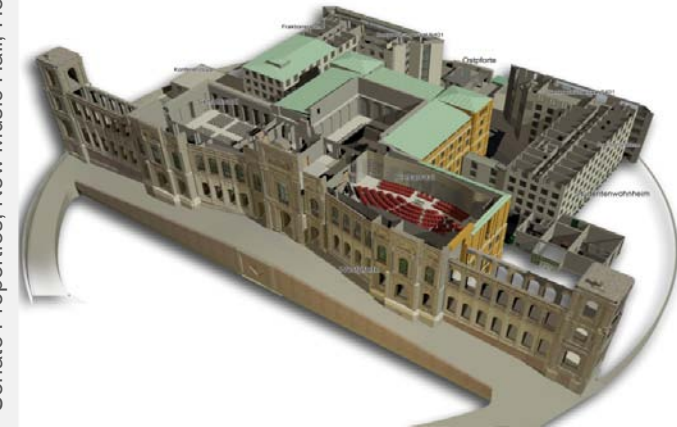
## used in many building projects

- for openBIM collaboration
- for openBIM reporting
- for architectural competitions
- for handover process to the client
- for code checking and evaluation
- ...

Oltmanns & Partner, Germany, smart building, Oldenburg  
Veccins, BIM Prize 2011, Netherlands



Statsbygg, National Museum Oslo, Competition  
CAD Stelle Bayern, Bavarian Parliament Building  
Senate Properties, New Music Hall, Helsinki



## Model Support Group

Dr. Thomas Liebich, MSG Chair / AEC3 Director | IFC for Infrastructure

# Can IFC also be applied to infrastructure BIM ?



**Model Support Group**

Dr. Thomas Liebich, MSG Chair / AEC3 Director | IFC for Infrastructure



# SCOPE FOR BIM AND GIS IN INFRASTRUCTURE

Large scale vs. small scale – and where does it meet?

# Infrastructure Scope between GIS and BIM Standards – 1

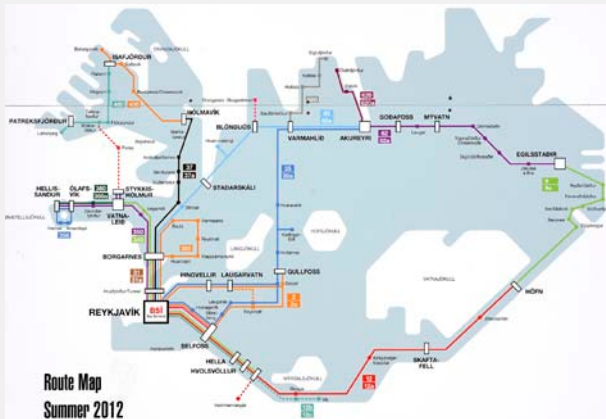
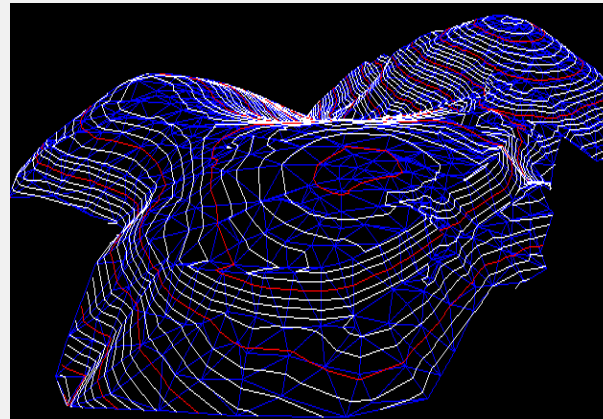


Photo: Thomas Liebich

Traffic network



Source <http://de.wikipedia.org>  
[http://de.wikipedia.org/w/index.php?title=Image%3ADigitales\\_Gel%C3%A4ndemodell.png](http://de.wikipedia.org/w/index.php?title=Image%3ADigitales_Gel%C3%A4ndemodell.png)

Digital Terrain Model (of area)



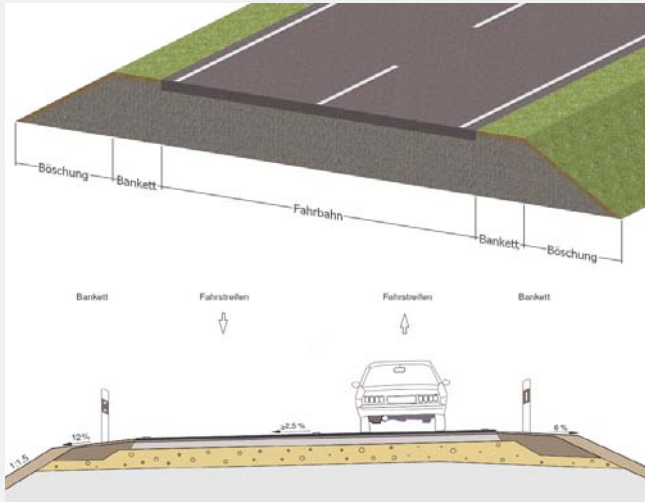
Source <http://de.wikipedia.org>  
[http://de.wikipedia.org/w/index.php?title=Datei:Strassennetz\\_nuernberg.png](http://de.wikipedia.org/w/index.php?title=Datei:Strassennetz_nuernberg.png)

Road network

**clearly GIS scope**

- small scale
  - geospatial CRS
  - mainly surfacic
  - topological network
  - surveying as source
- 
- OGC / TC211
  - gml / ...

# Infrastructure Scope between GIS and BIM Standards – 2



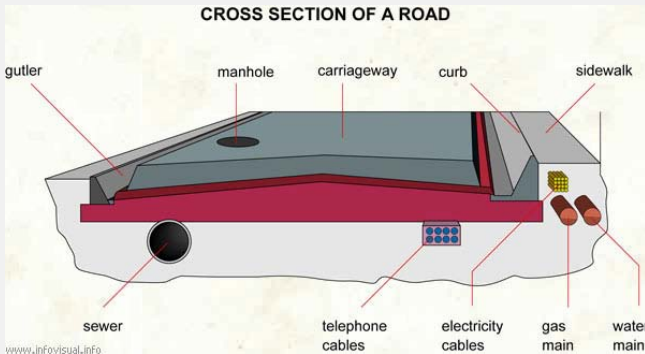
Road Construction Sectioning

source: <http://de.wikipedia.org>  
<http://de.wikipedia.org/wiki/Str%C3%9Fenquerschnitt>



Road Construction - Bridges

<http://www.roadtraffic-technology.com/projects/svinesund/svinesund3.html>



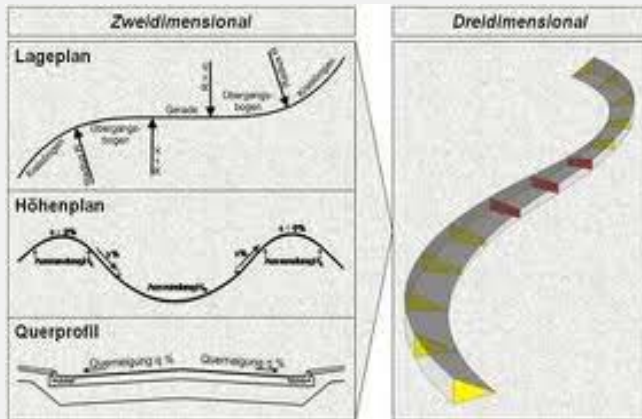
Road Construction Detailing

[http://www.infovisual.info/05/025\\_en.html](http://www.infovisual.info/05/025_en.html)  
 Copyright © 2005-2011 - All rights reserved

**clearly BIM scope**

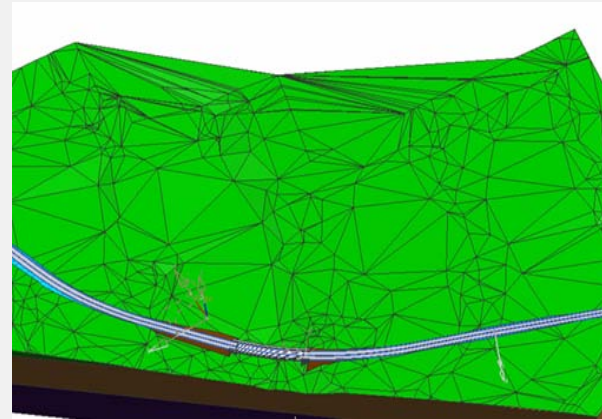
- big scale
  - engineering CRS
  - mainly volumetric
  - longitudinal structure
  - element composition
- 
- open – bSI / TC59
  - open – IFC (upcoming)

# Infrastructure Scope between GIS and BIM Standards – 3



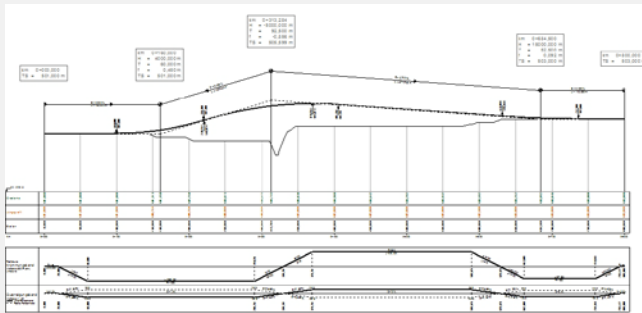
Road Alignment (traditional 2D and 3D)

source: Universität Stuttgart, VALIDATE  
<http://www.validate-stuttgart.de/projekte/fahrbahn/>



Digital Terrain Model for a section (cut & fill)

source: André Borrmann, Yang Ji,  
 TU München / ForBAU Project



Road Sections at Stations along Alignment

source: <http://de.wikipedia.org>  
<http://de.wikipedia.org/wiki/Gradiente#Stra.C3.9Fentrassierung>

**overlapping scope**

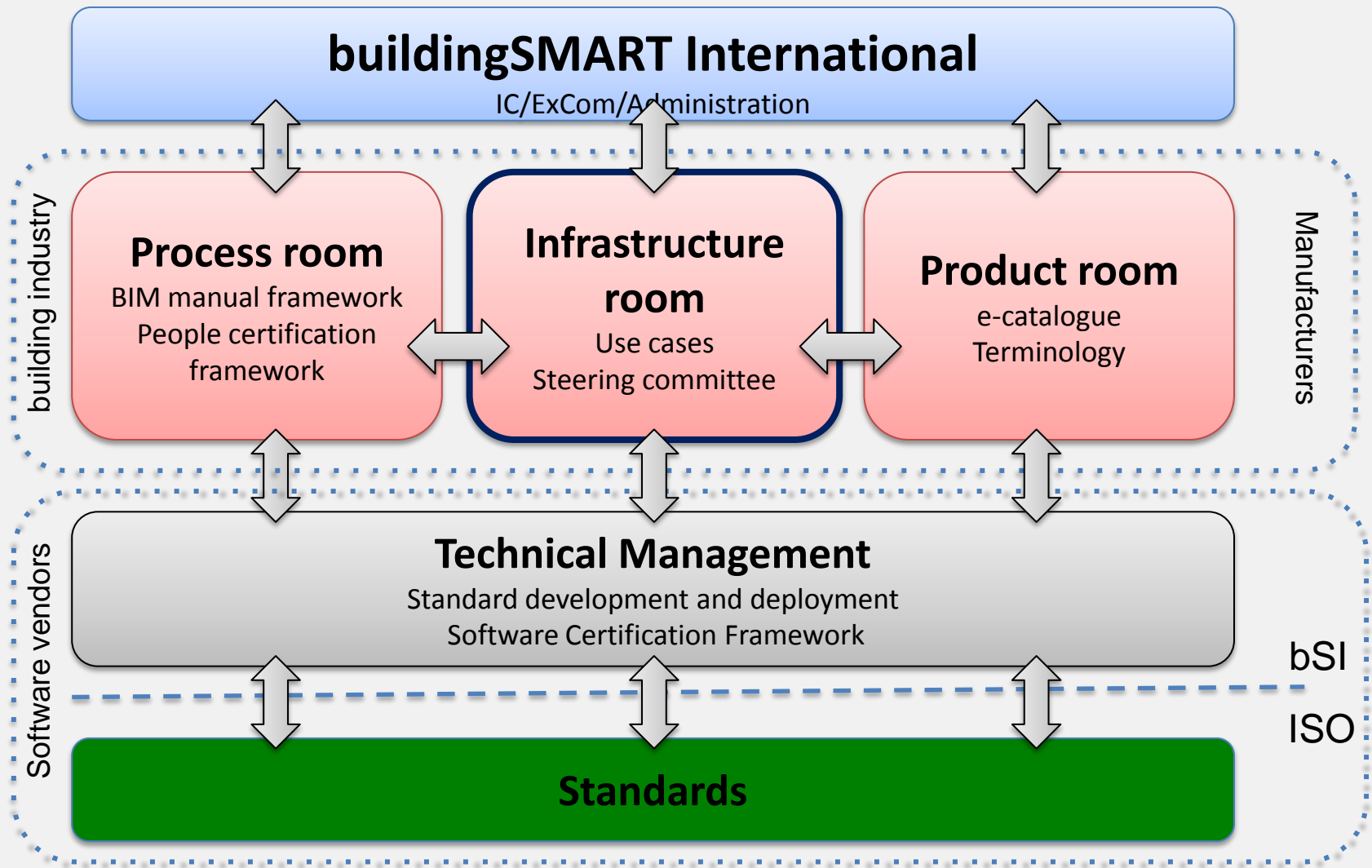
- medium scale
  - geospatial, projected
  - surfacic & volumetric
  - alignment
  - element structure
- 
- bSI (59) & OGC (211)
  - **IFC and LandXML?**



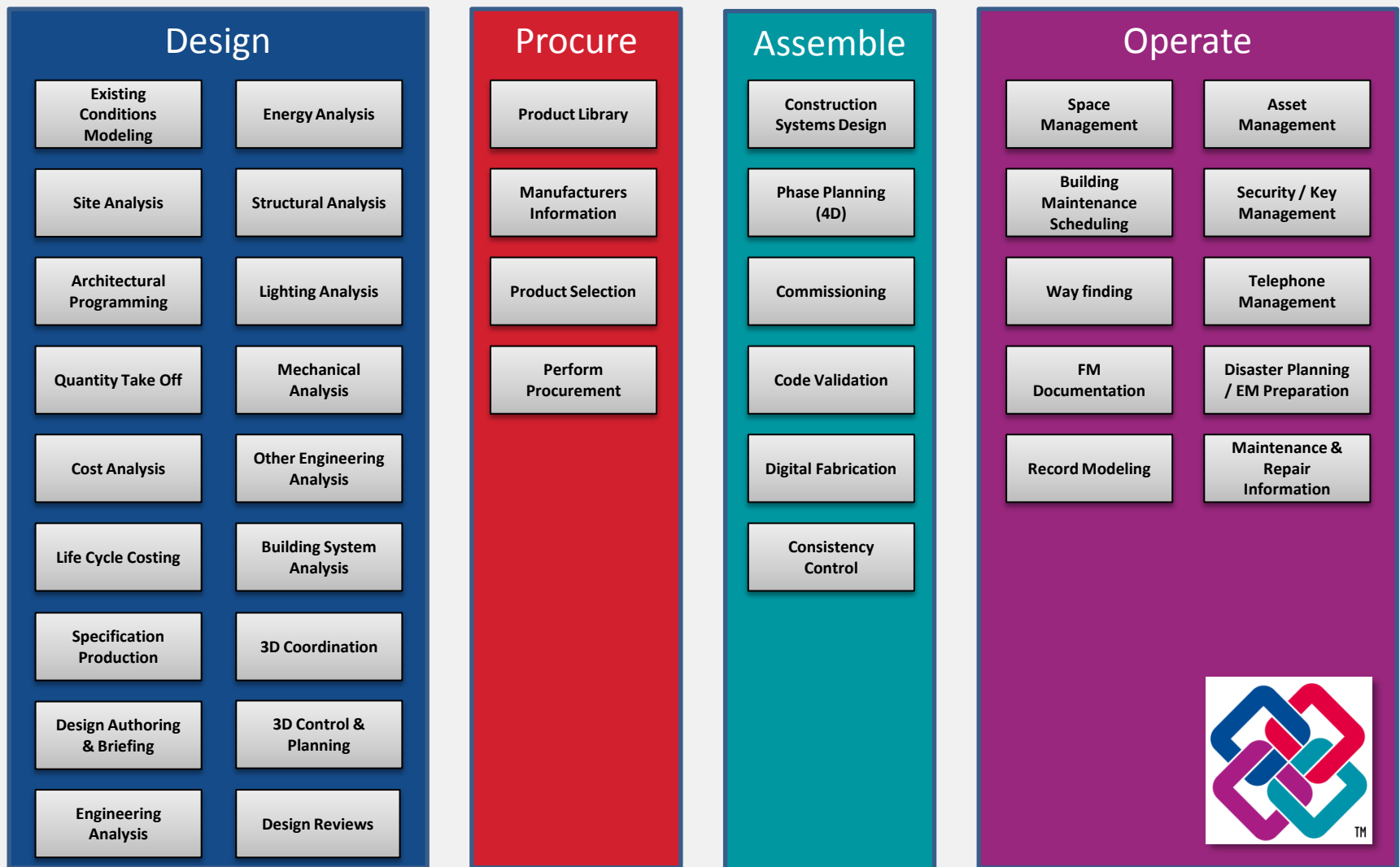
# MAIN AREAS FOR IFC FOR INFRASTRUCTURE

Road and Rail Construction, Bridges, Tunnels, Geological, Utilities  
Defining major use cases for infrastructure

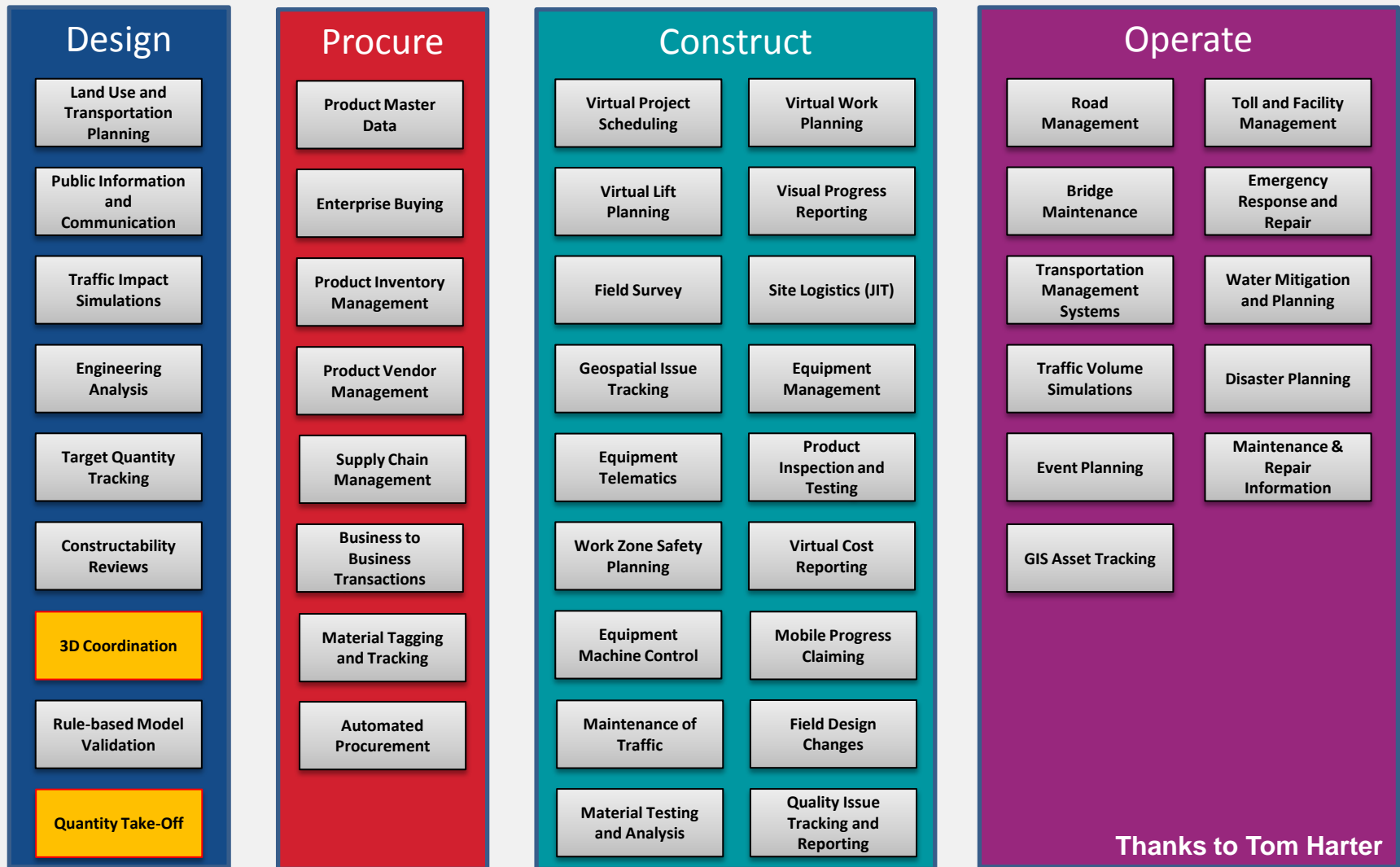
# buildingSMART organization update



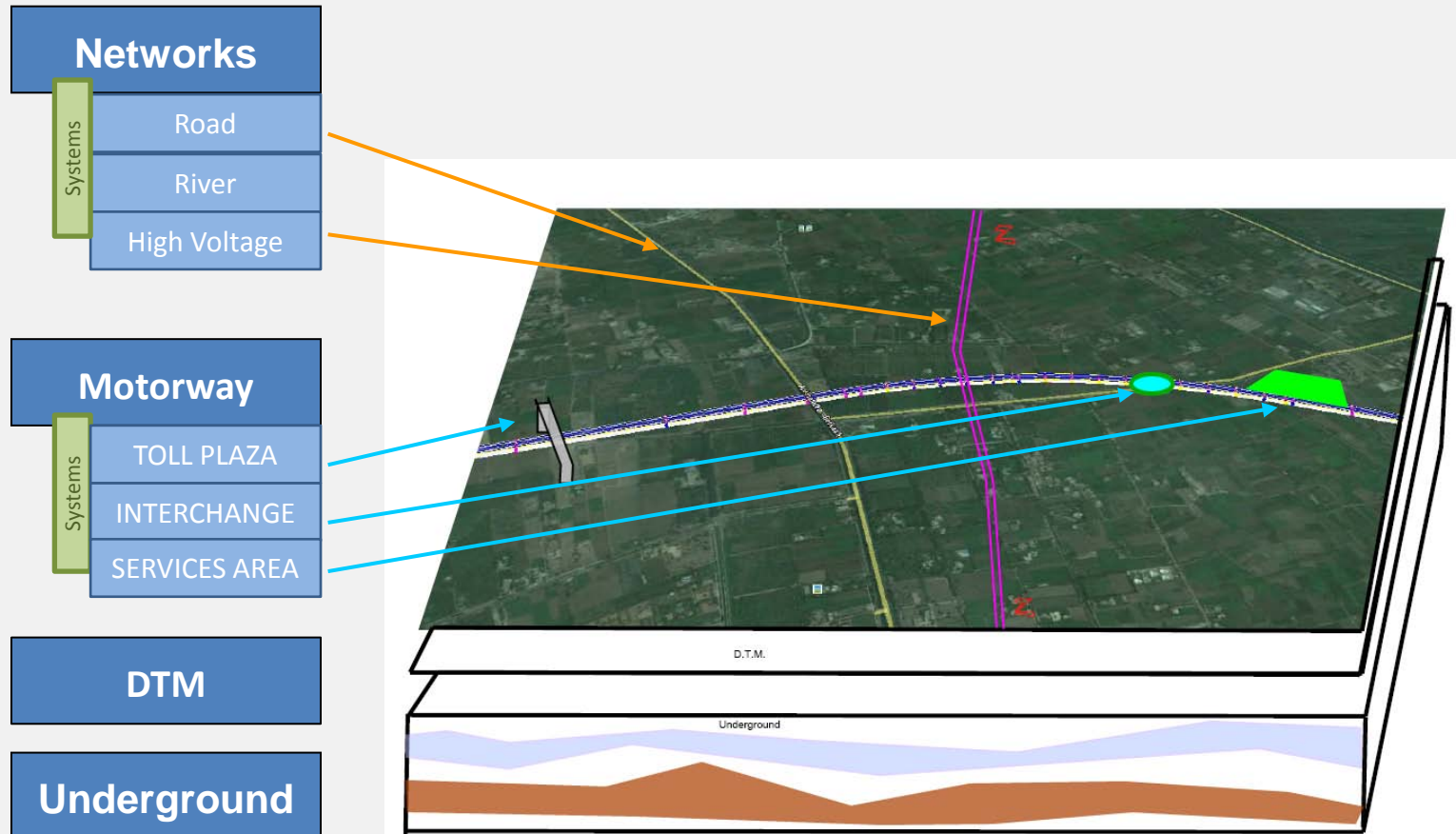
# Identified use cases in building construction



# Potential use cases in infrastructure



# Multi-disciplinary nature of infrastructure projects





# Development baseline

## 1. Common baseline – alignment, linear referencing

- P6: Infrastructure Alignment & Spatial Reference System
- In cooperation with OGC's DWG "Land and Infrastructure"
- Using experience from landXML and others

## 2. First infrastructure domain – shared elements and domain ext.

- P5: IFC for Bridges

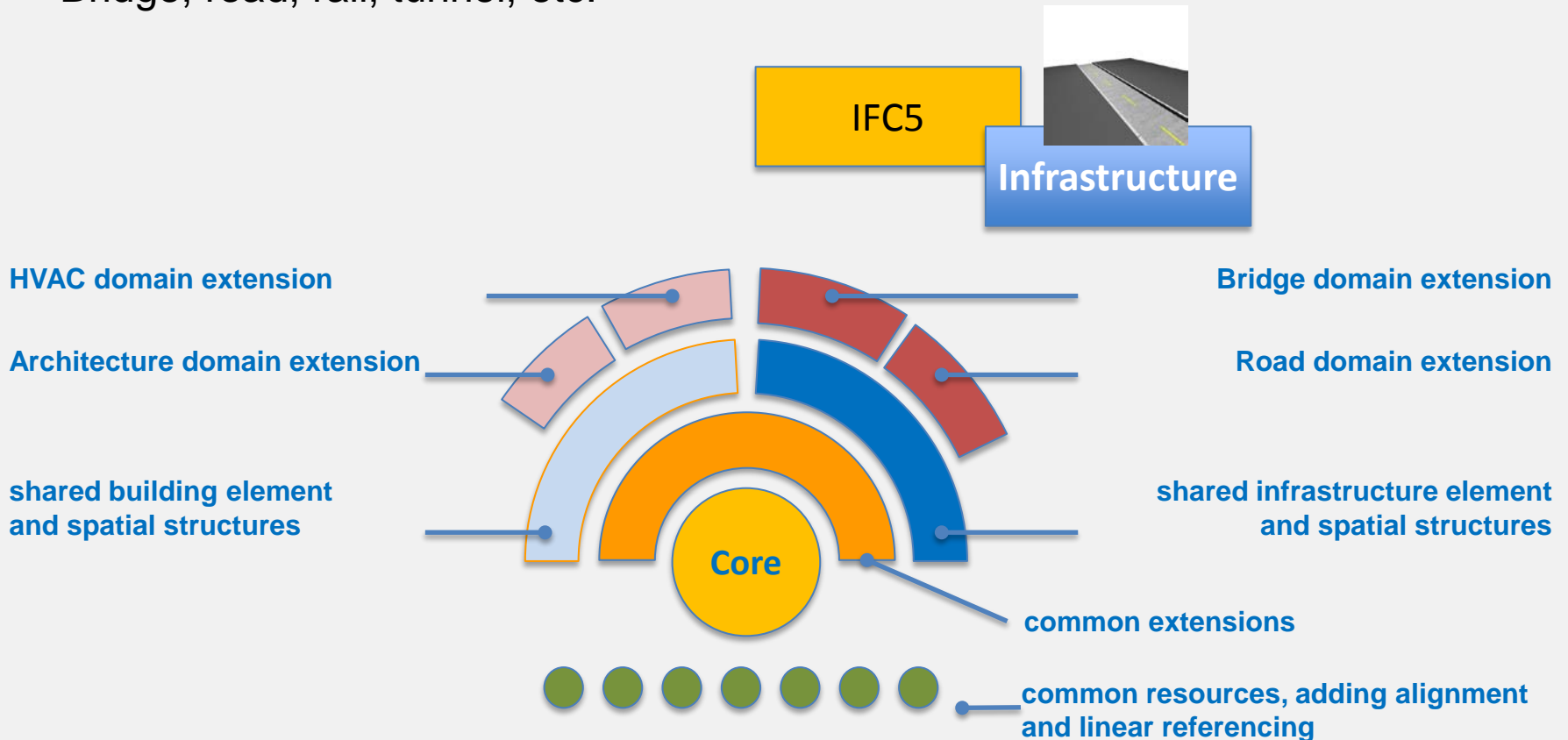
## 3. Expand to other domains – based on experience of 1. and 2.

- Other Infrastructure project proposals

# IFC5 – scope of new extensions

## Gradual development of sector specific IFC for Infra extensions

- Common resources (alignment, geotechnical, earthwork, etc.)
- Bridge, road, rail, tunnel, etc.





# IFC4 – providing the stub for infrastructure

## Supported definitions

- Mapping to GIS coordinate systems
  - Division between site and terrain
- Non-building related spatial elements
- Geographic features (posts, signs, etc.)
  - Civil engineering related elements
    - Non-planar surfaces
    - ...
  - Decision and RFI tracking
- XML based transactions downstream

## New classes in IFC4

- *IfcProjectedCRS, IfcMapConversion*
- *IfcSite (updated)*
- *IfcSpatialZone*
- *IfcGeographicElement*
- *IfcCivilElement (stub)*
- *IfcAdvancedBrep*
- ...
- *BCF 2.0 (already available today)*
- *Simple ifcXML4*

# HOW TO START TODAY?

Some use cases can already be supported today (IFC2x3 / IFC4)

# High value use cases can be dealt with today

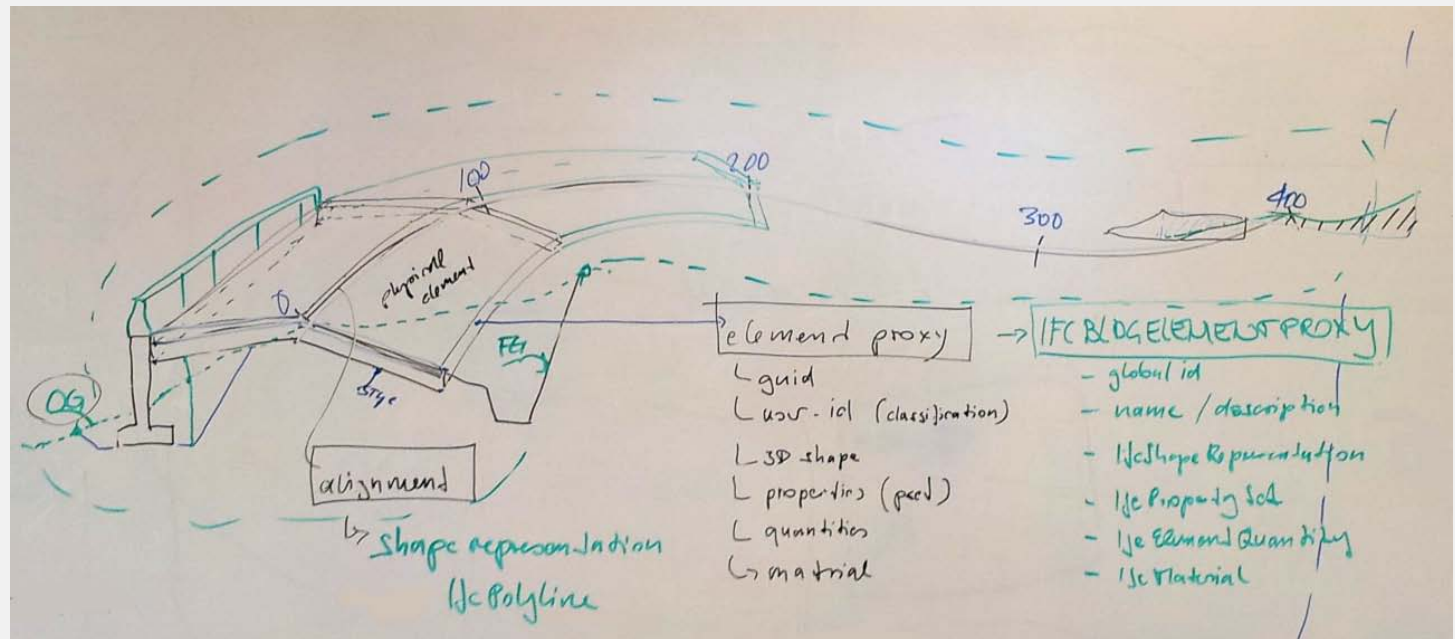
Design

## Information Delivery Manual

- Minimum exchange requirements for identified use case

3D Coordination

Quantity Take-Off



# IFC2x3 CivilProxyView (with properties and quantities)

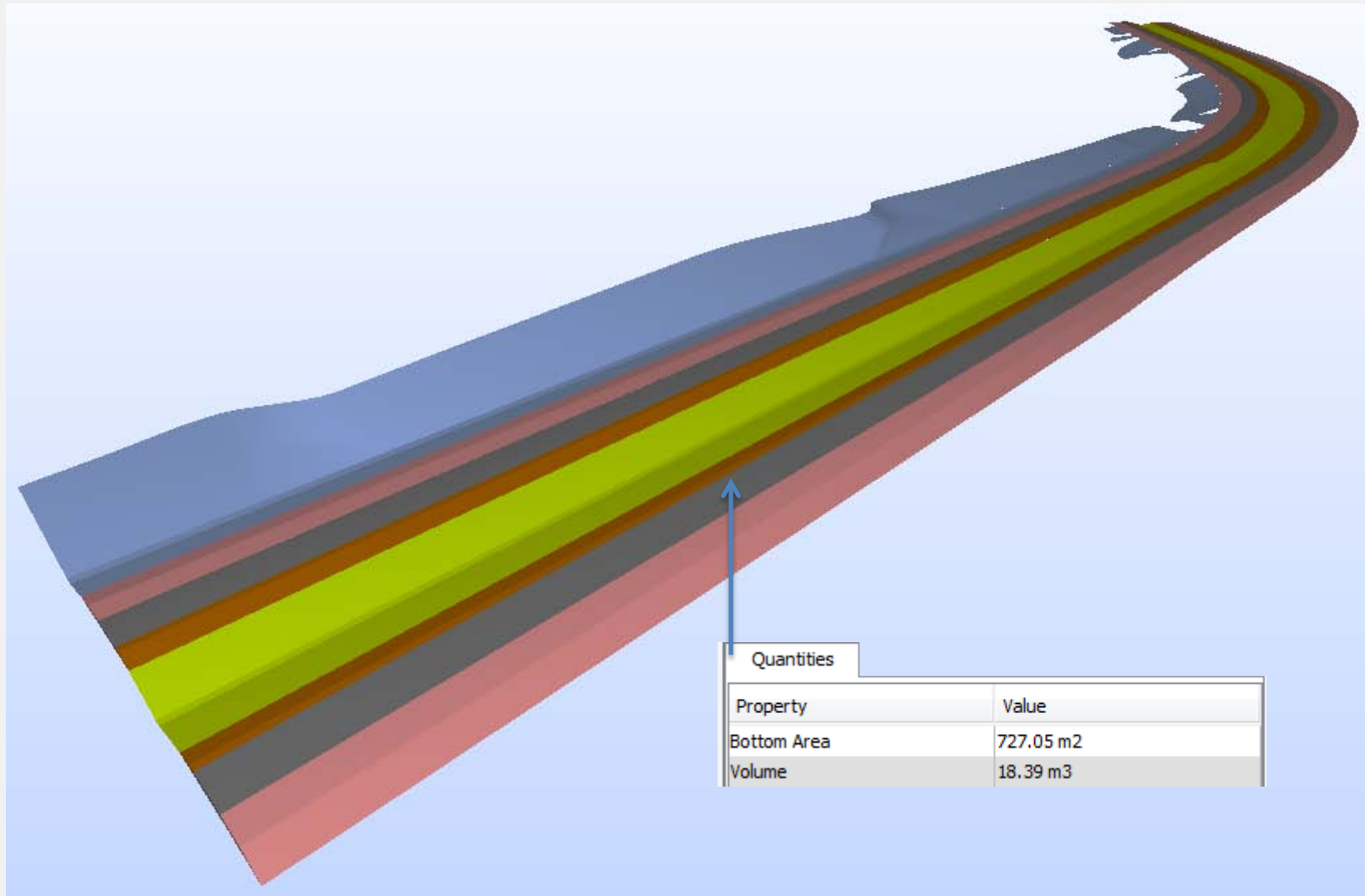
## Minimum exchange requirement for road models (phase 1) exported to IFC (proxy view)

### Road physical components

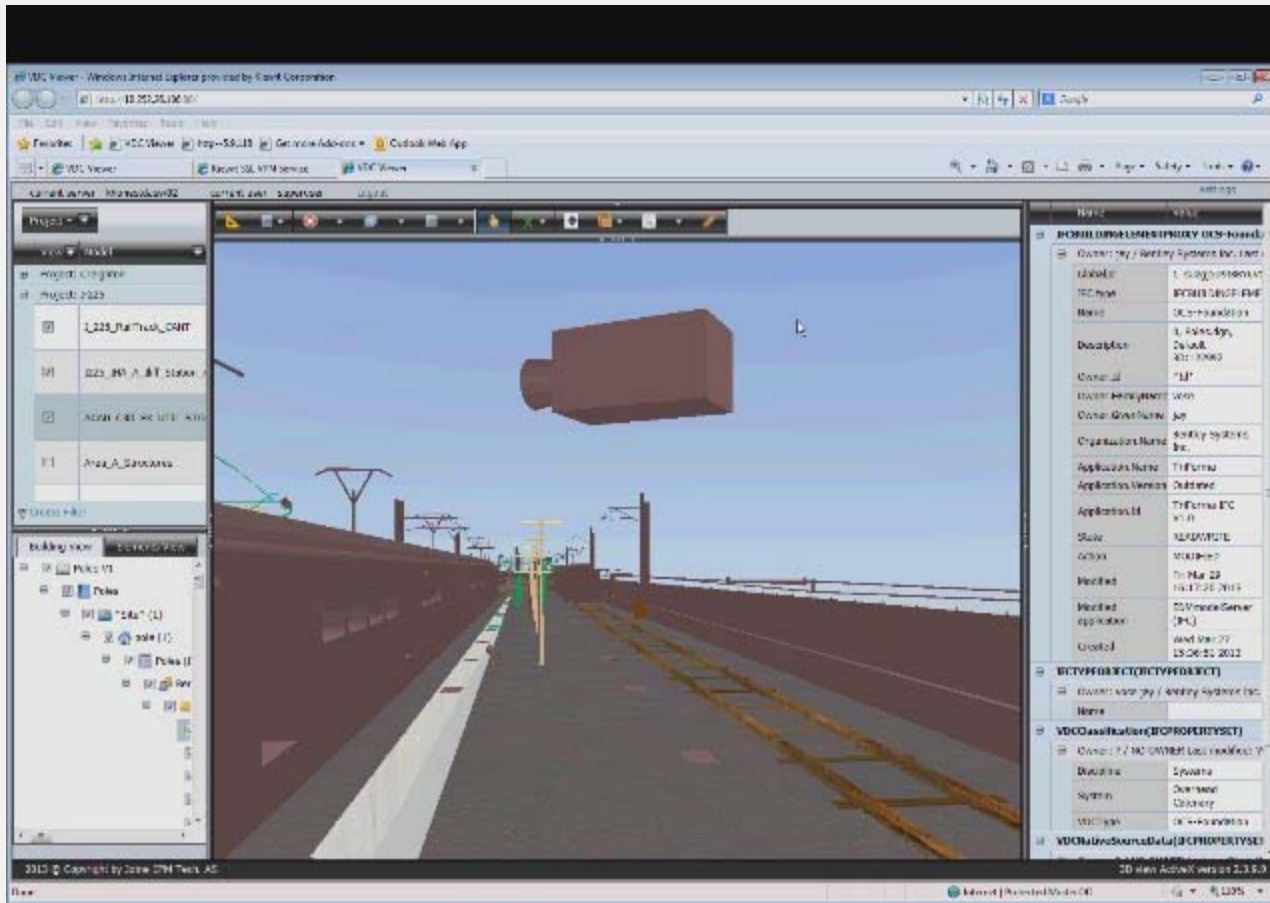
#### identifiable elements with 3D shape and meta data

IFC representation	IfcBuildingElementProxy		
consistent software id	(IfcRoot).GlobalID	id	MAND
name tag	(IfcRoot).Name	string	MAND
description	(IfcRoot).Description	string	OPT
3D shape	link to IfcShapeRepresentation		
- 3D solid	- geometry type = IfcFacetedBrep	geometry	MAND
3D presentation	link to IfcStyledItem		
- surface color	- type IfcSurfaceStyle	color	MAND
- line style	- type IfcCurveStyle	color / line type	OPT
layer	link to IfcPresentationLayerAssignment		
	- IfcPresentationLayer.name	string	MAND
material property	link to IfcMaterial		
	- IfcMaterial.Name	string	MAND
quantities	link to IfcElementQuantity		
- volume	- IfcQuantityVolume	real	MAND
- top surface	- IfcQuantityArea	real	MAND
- perimeter	- IfcQuantityLength	real	MAND
- length	- IfcQuantityLength	real	MAND
properties	link to IfcPropertySet		
- any property associated	- IfcPropertySingleValue	string/real	MAND

# IFC2x3 SimpleProxyView (early example)



# Starting point – IFC “work around” for Infrastructure



# SUMMARY – INFRASTRUCTURE NEXT STEP !

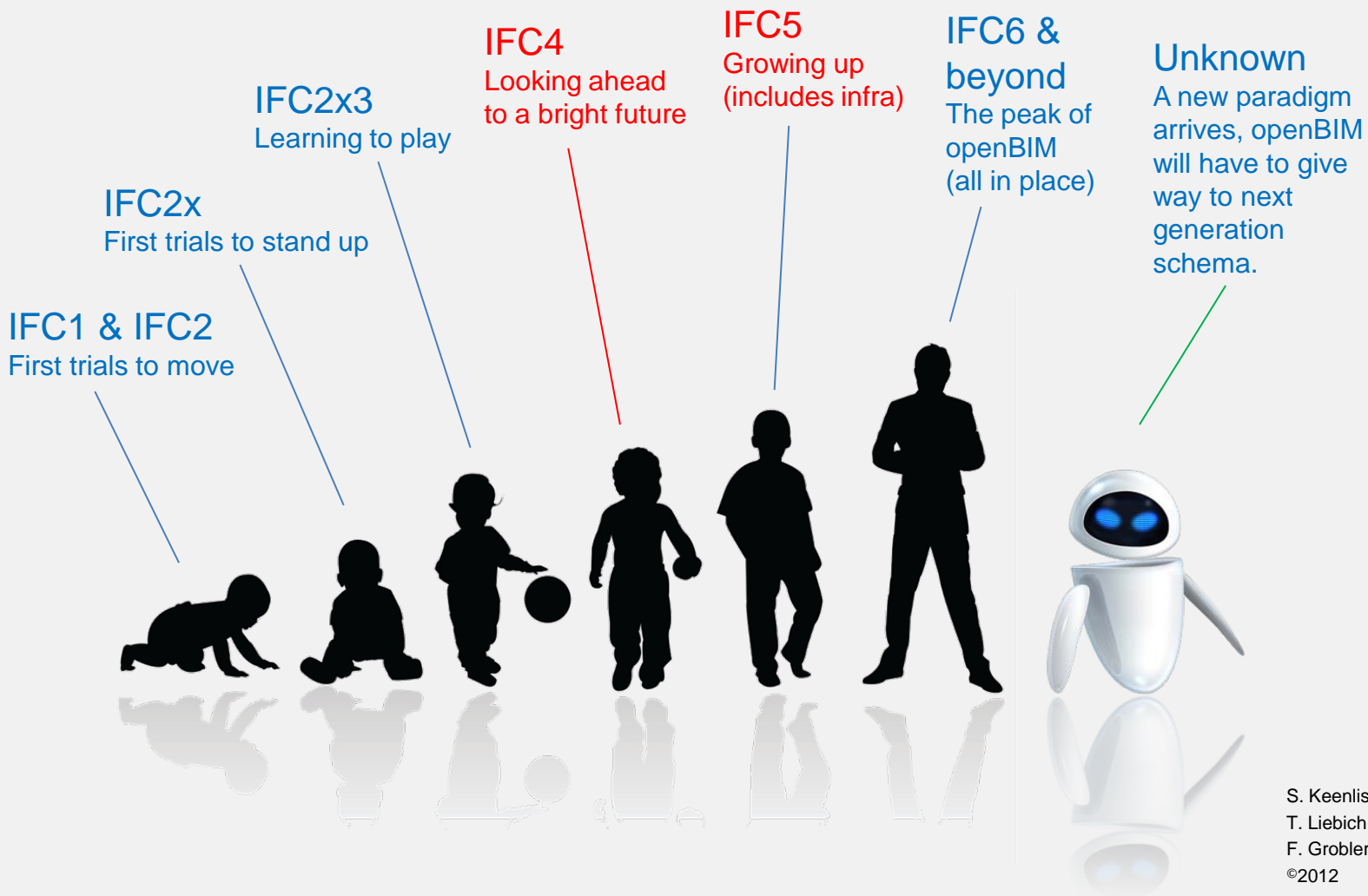
IFC5 / ISO16739 2<sup>nd</sup> Ed. will focus on infrastructure

# IFC5 – going into infrastructure

but not alone – in collaboration with other groups







S. Keenlside  
 T. Liebich  
 F. Grobler  
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