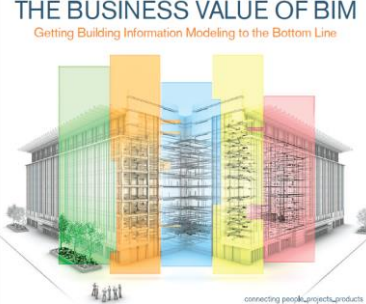
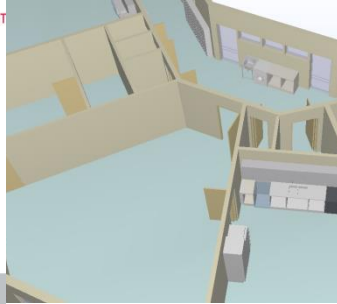
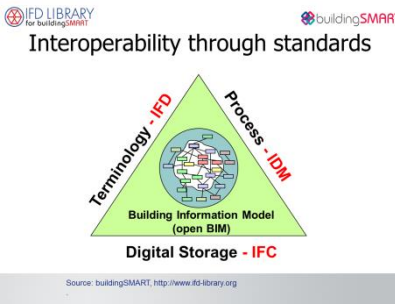
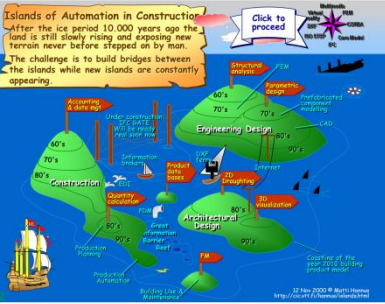
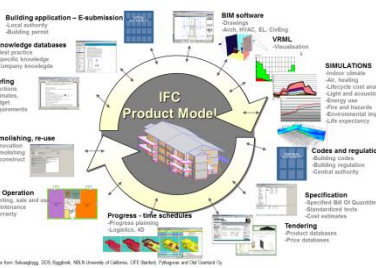


IFC is about exchange and sharing of information



Sustainable Urban Collaboration Hub - SUCH

- For the built environment

Dr Väino Tarandi
 Professor, KTH, Royal Institute of Technology, Stockholm

Oslo 2014-04-24

Short Introduction

KTH – BIM Collaboration Lab

Sustainable buildings and cities require continuous information

- **BIM repositories and BIM servers** will become a necessity
- Manage information on **object level**
- Consolidation and synchronization
- **Heterogeneous applications and data models**
- **Expanding the scope** from individual buildings to groups of buildings, infrastructure and civil works – **City Management**

Through Life Support is needed

- Many standards do not support **versioning and changes**
- **PLM systems are already in use** in the manufacturing industry, and now also in construction

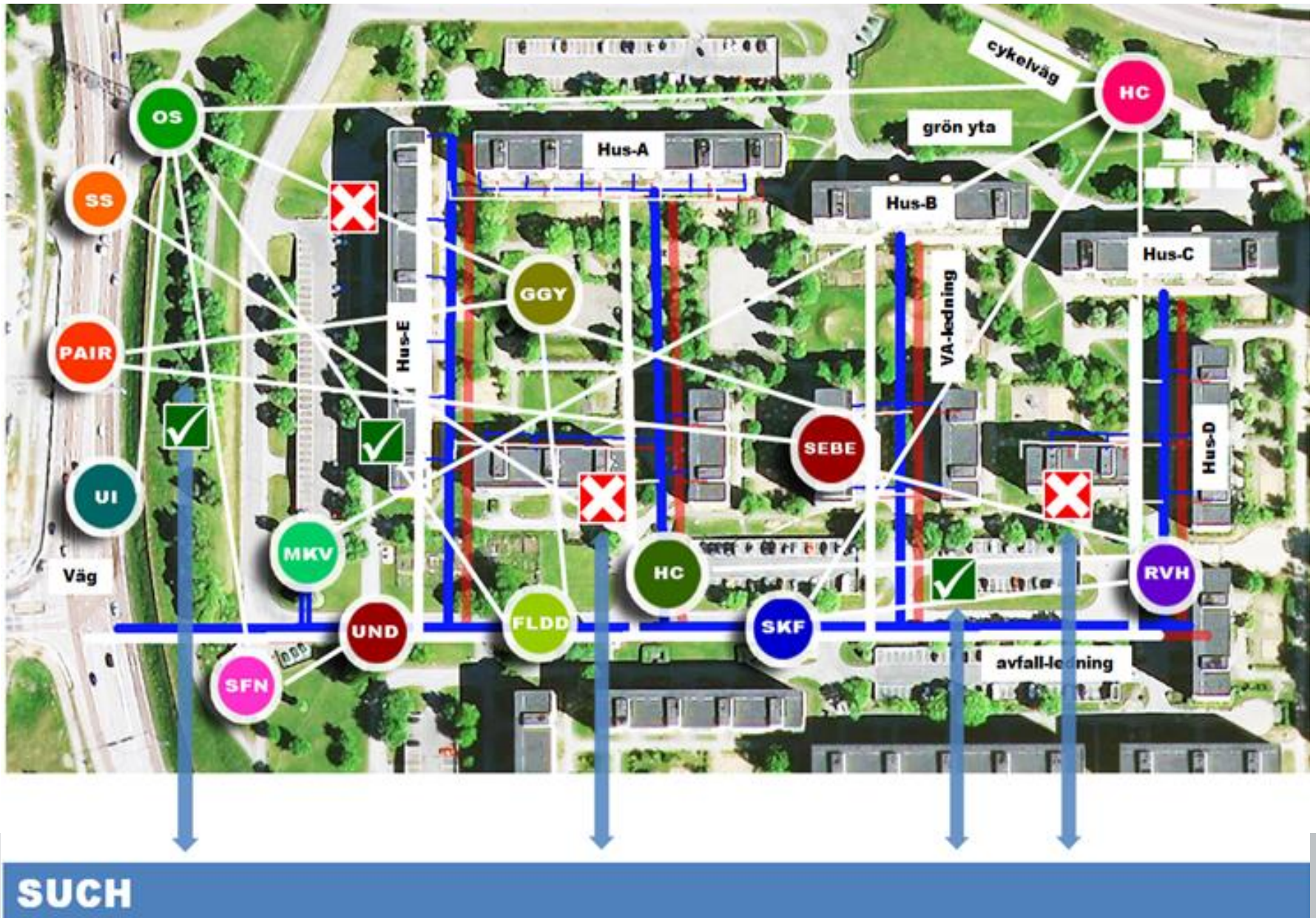
The Sustainable Urban Collaboration Hub – SUCH

- Based on the BIM Collaboration Hub, developed 2010 in the EU project Inpro
- The PLCS standard, ISO 10303-239 is the framework for the complete lifecycle

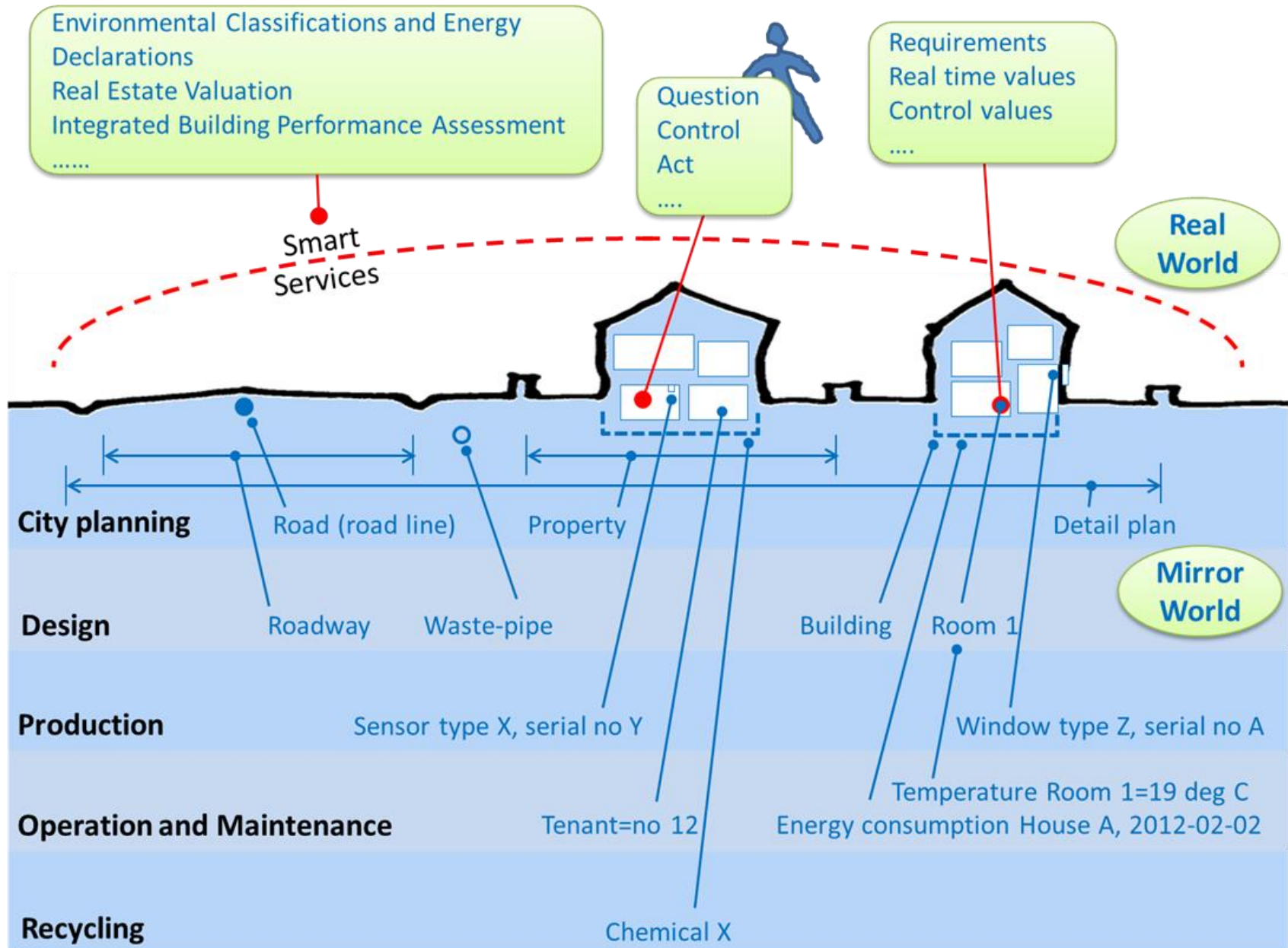
Sustainable Urban Collaboration Hub - SUCH



Multiple Systems – Integration?



The extended scope for the BIM Collaboration Hub



Requirements on a BIM repository

- User access control
- Representation of **users associated** with a project
- Read, store, and write native data models
- **Read, store, and write open standard model data**
- **Manage object instances and read, write and delete them**
- Support **product libraries** for incorporating product instances
- Support storing **product specifications** and maintenance/service information
- Store **e-business data**, for costs, suppliers, etc.
- Provide model **exchange capabilities for remote users**, e.g. web access
- Manage unstructured forms of communication
- **The complete object model**
- **Aggregating models** provided by different disciplines
- Exporting and importing **partial models**
- Managing **workflows and changes**
- Exchanging information with the hub using a **neutral exchange format**, e.g. IFC

Challenges for a BIM Collaboration Hub?

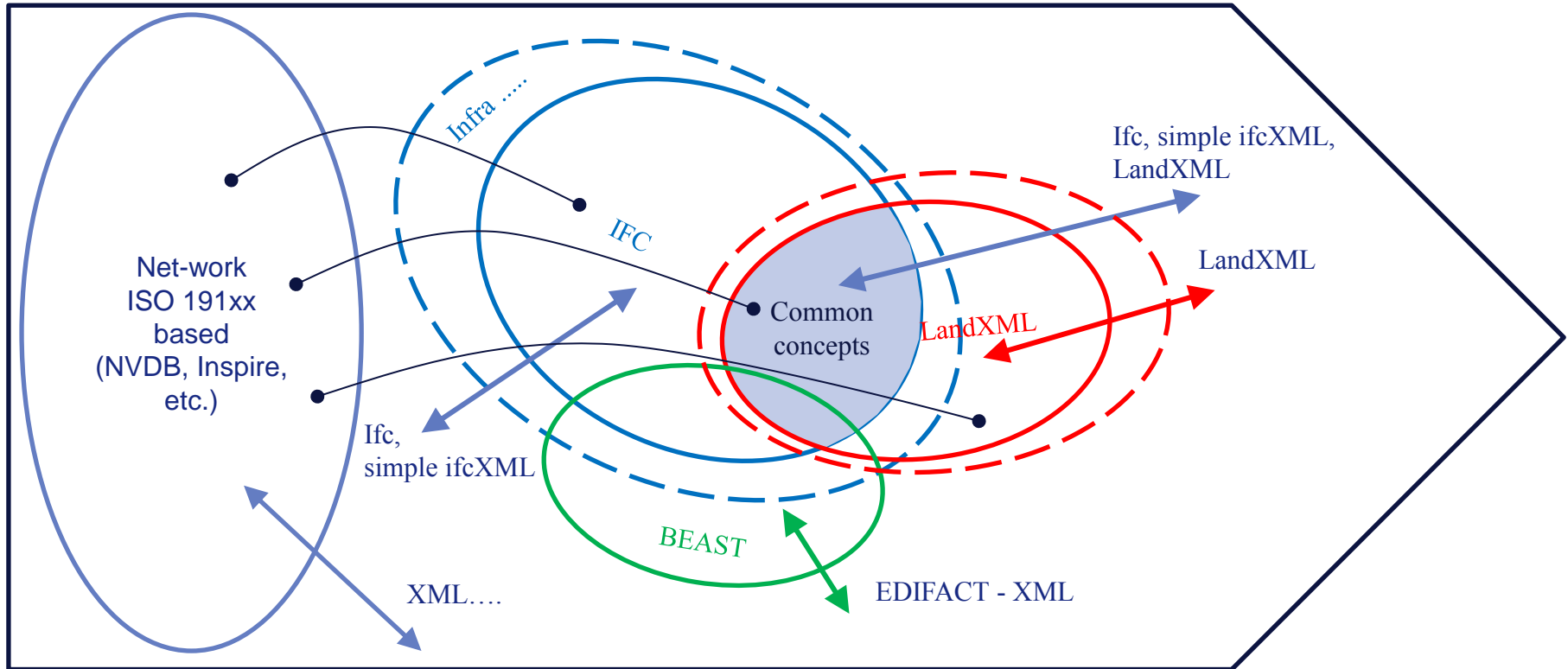
The evolutionary change within the industry **“from managing files to the managing of information objects has only begun to take place”** according to Eastman et al. (BIM Handbook). When object level information management is required, there will be a need for support by a building model repository, also known as e.g. BIM repository.

Challenges – findings, vision of IDDS

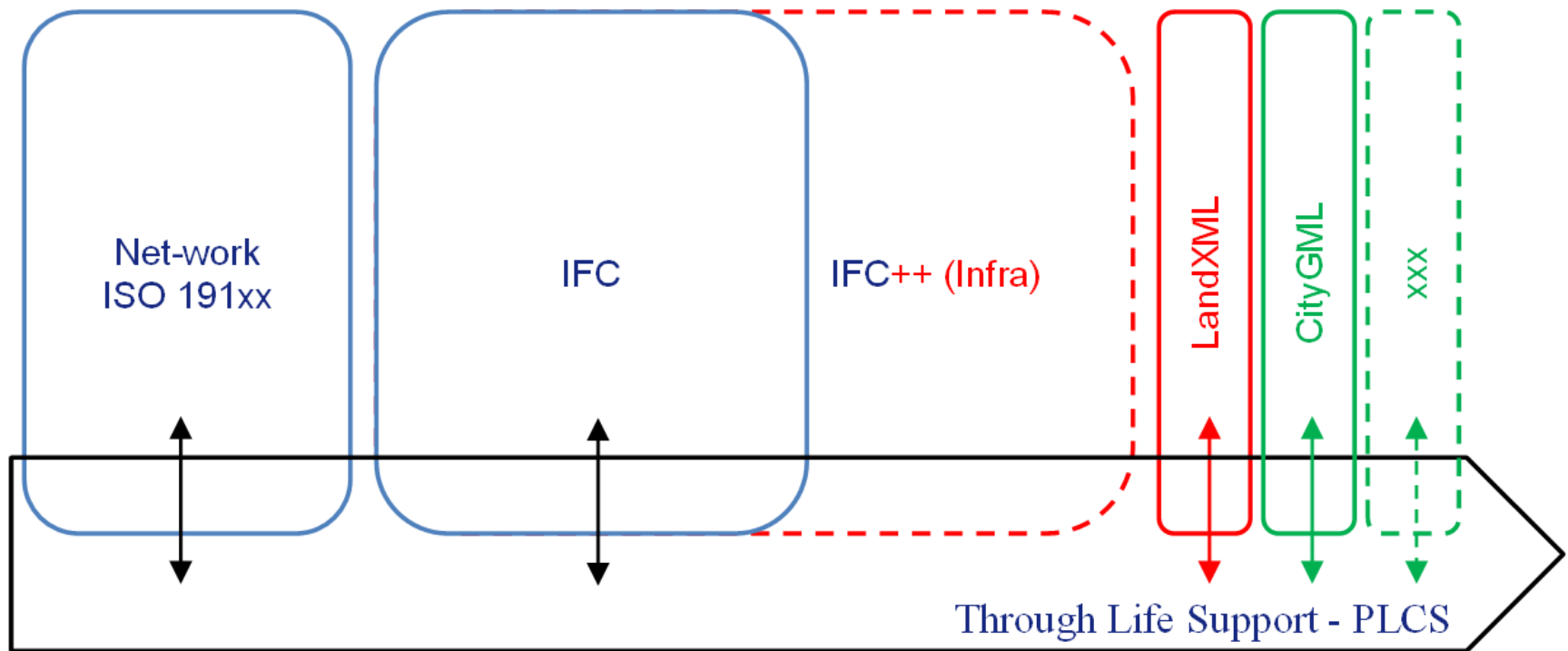
- » Digitally modeled, simulated, controlled and maintained
- » System and service integration throughout the whole lifecycle
- » Performance requirements from owners
- » Multi-criteria focus on the complete life cycle
- » Integration of all parts in the project design and construction
- » Automated design analysis and approval
- » Functional design in response to user requirements and needs
- » Definition of customer needs together with professional designers
- » An effective supply-chain by utilizing shared information and optimized processes

Integration of standards for buildings and infrastructure

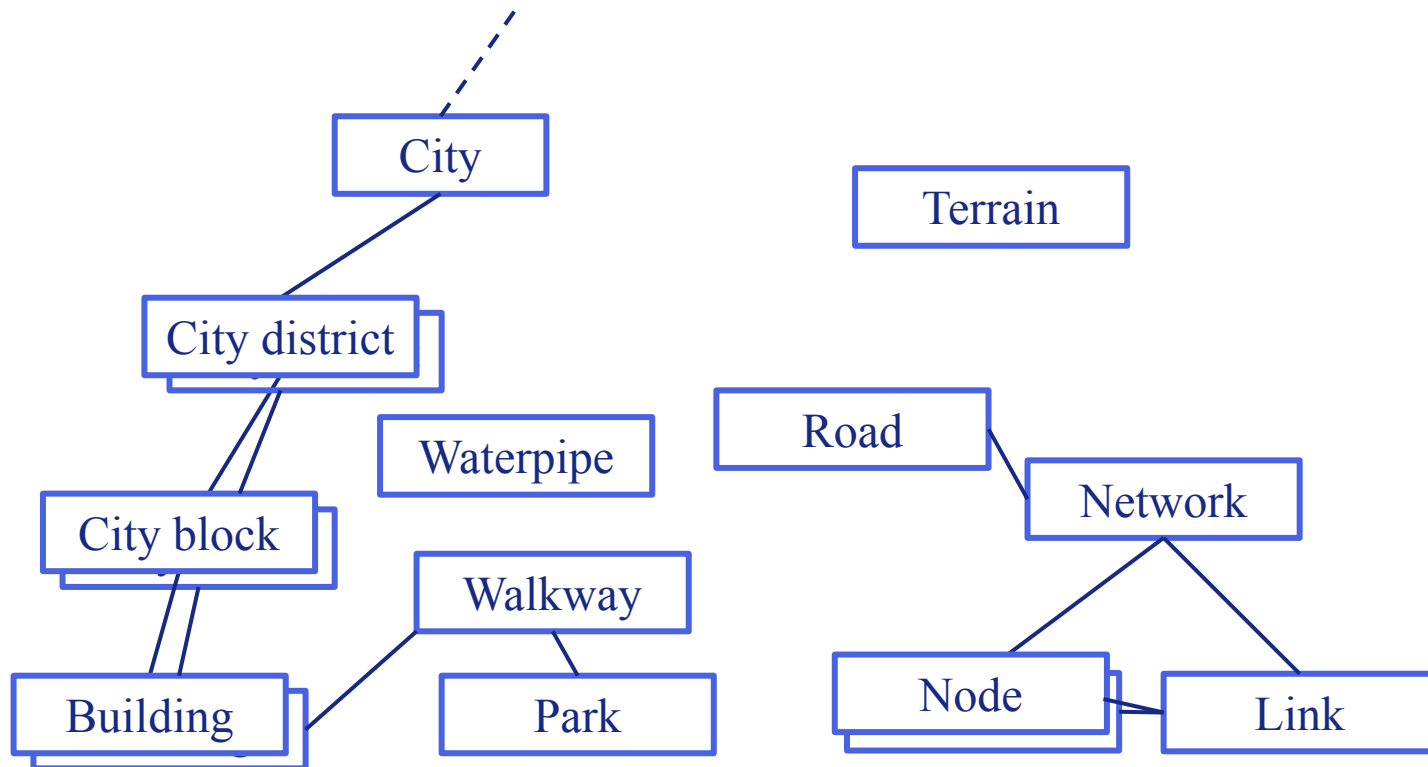
Through Life Support - PLCS



Heterogeneous data models mapped to PLCS



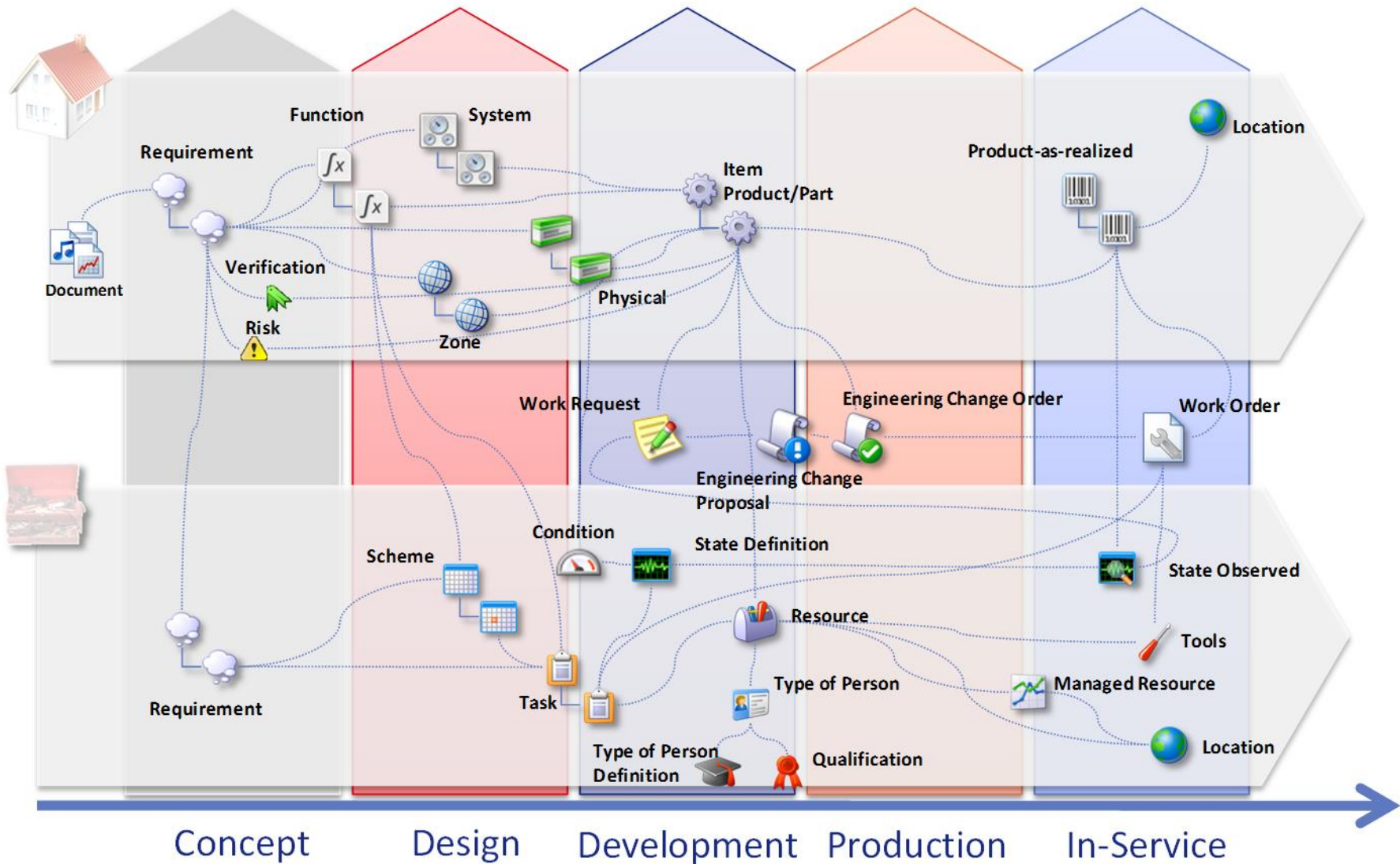
A conceptual model for the built environment is missing...



The PLCS high level model

Product

Support System



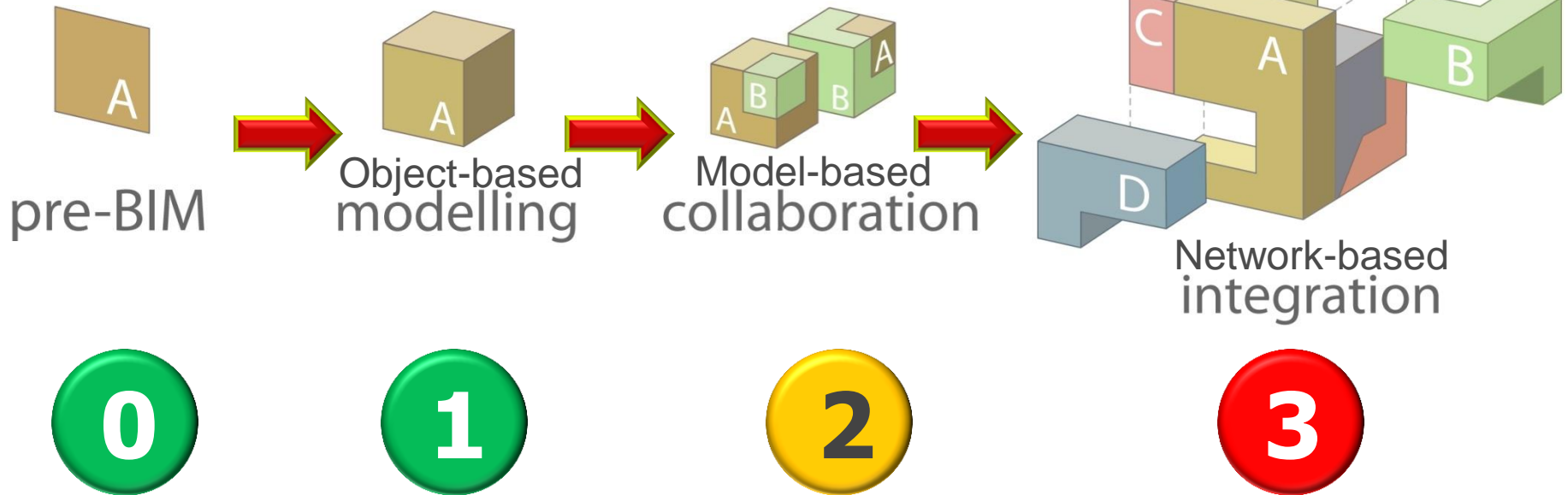
Building Information Modelling



**Data
creation**

**Data
exchange**

**Data
management**



Source: Bilal SUCCAR, Building Information Modelling Framework

BIM Collaboration Hub

Business processes

Information systems

Portal

System A

System B

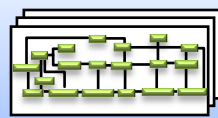
System C

System D

System E

System X

Information models

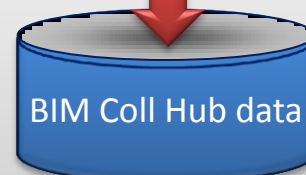


Standardized interfaces

Information



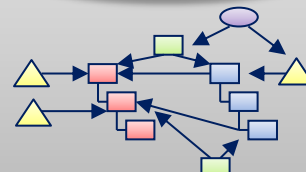
Document Mgmt System



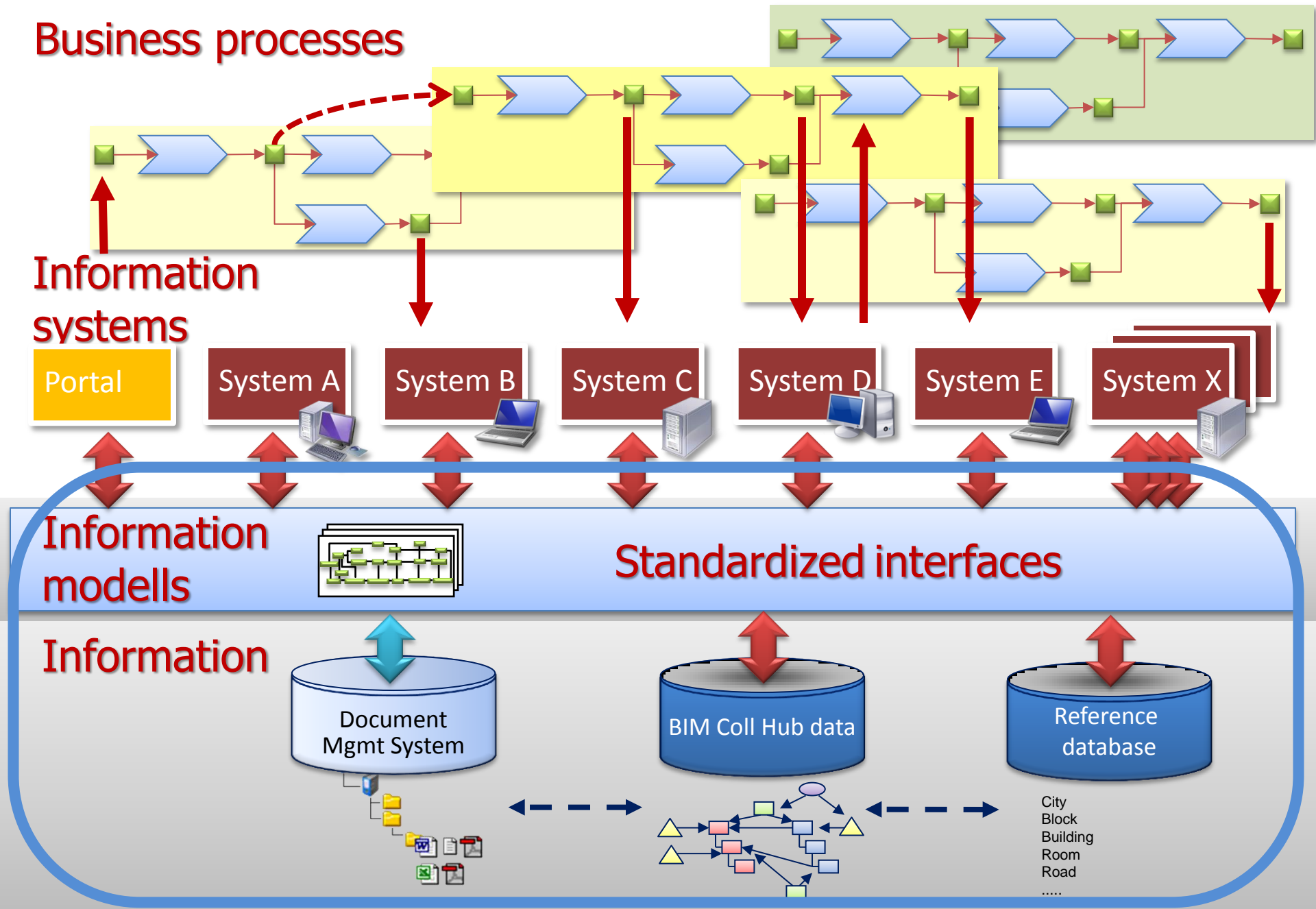
BIM Coll Hub data



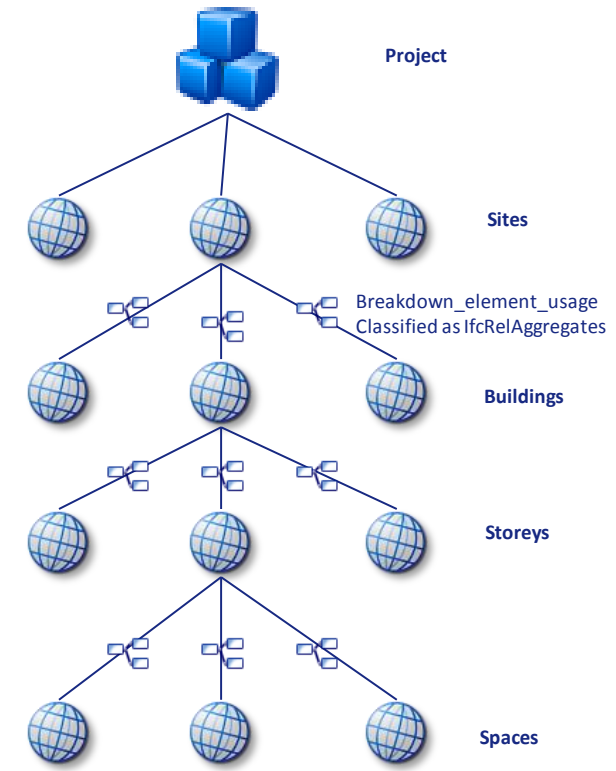
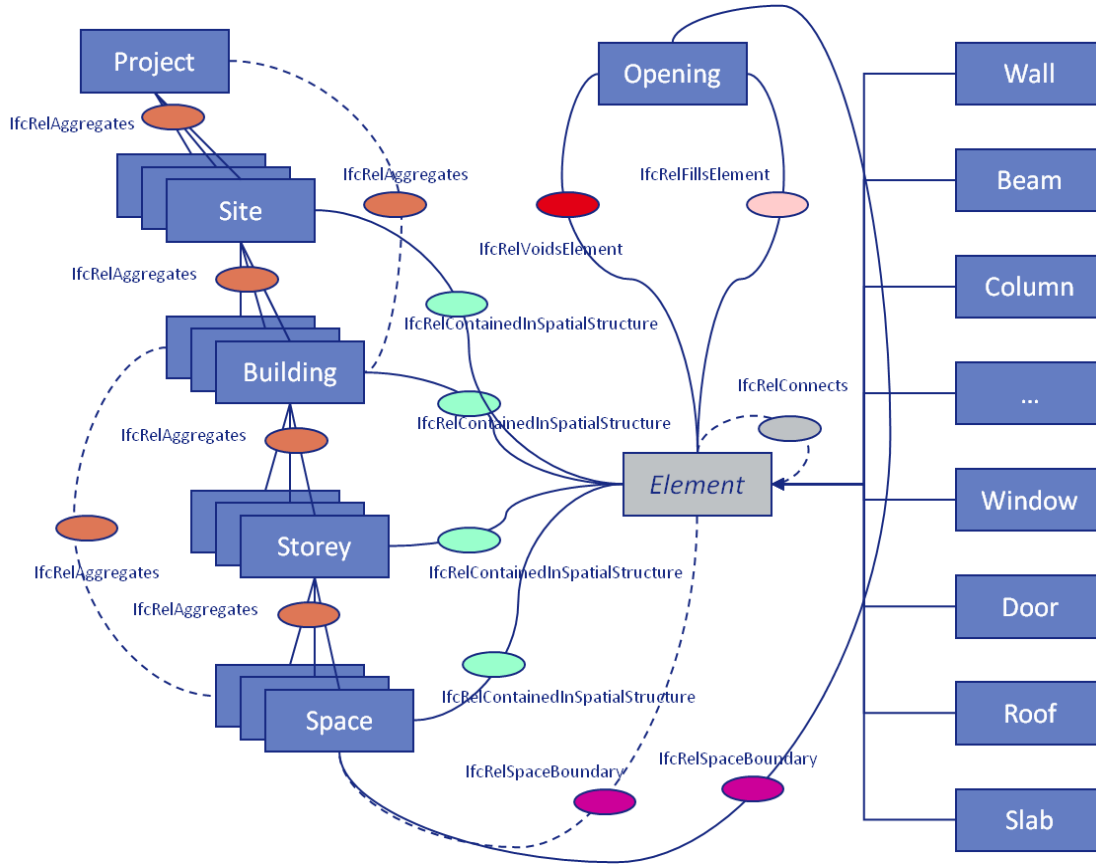
Reference database



City
Block
Building
Room
Road
.....



Typical IFC data exchange file structure and high level structure mapping



High level mapping from IFC to PLCS/SAs



IfcProject



Breakdown classified as IfcProject

IfcSite

IfcBuilding

IfcBuildingStorey

IfcSpace



Zonal_breakdown_element respectively classified as IfcSite, IfcBuilding, IfcBuildingStorey, IfcSpace

IfcElement



Product_as_realized and Physical_element respectively classified as IfcWall, IfcDoor, IfcWindow, IfcSlab, ...

IfcOpening



Product_as_realized and Physical_element classified as IfcOpening

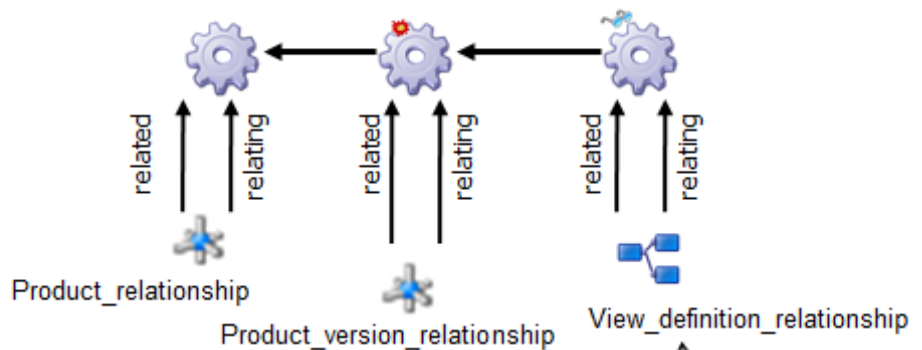
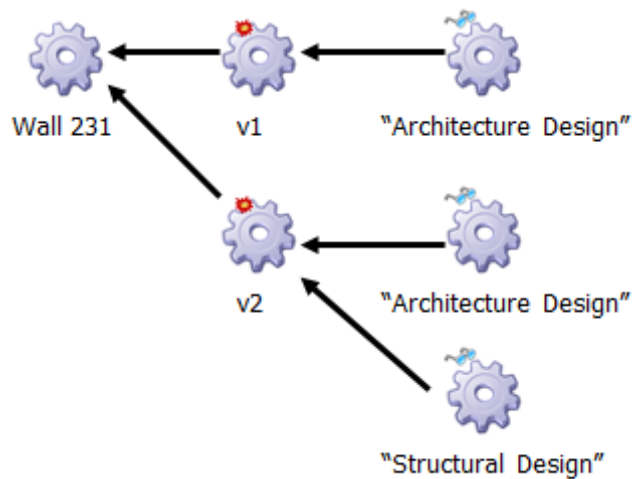
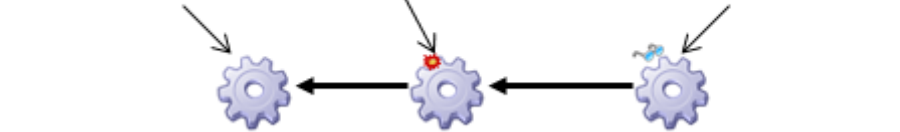
IfcTypeObject



Item respectively classified as IfcDoorStyle, IfcWindowStyle, IfcWallType, etc ...

Products – product/version/view and relationships

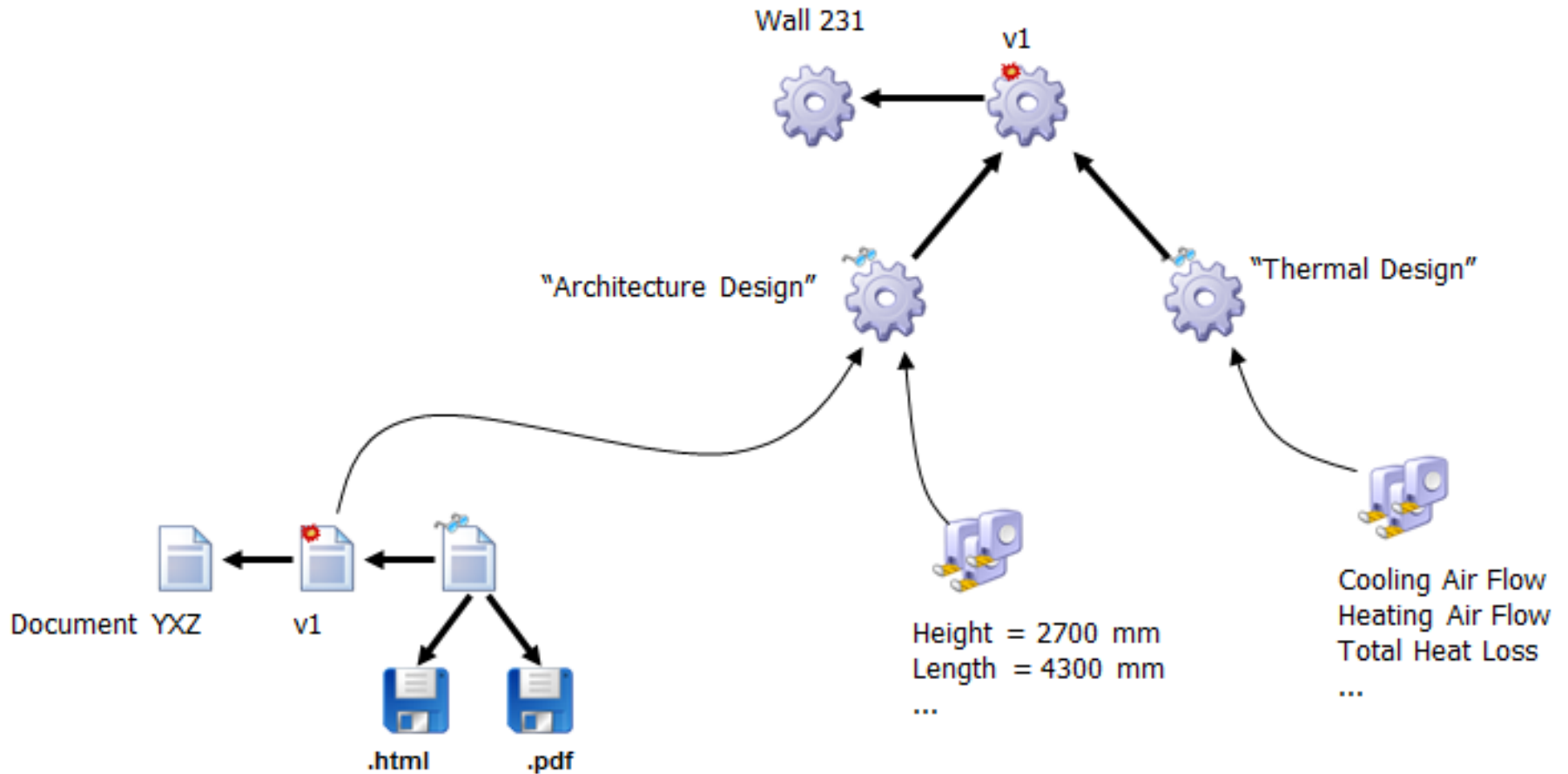
The Product i.e. the thing to manage Its version(s) The context/view (disipline + life cycle stage)



Ex: version relationship: sequence, dependency, alternate, derivation, etc ...

Ex: view definition relationship: assembly, containment, nesting, filling, etc ...

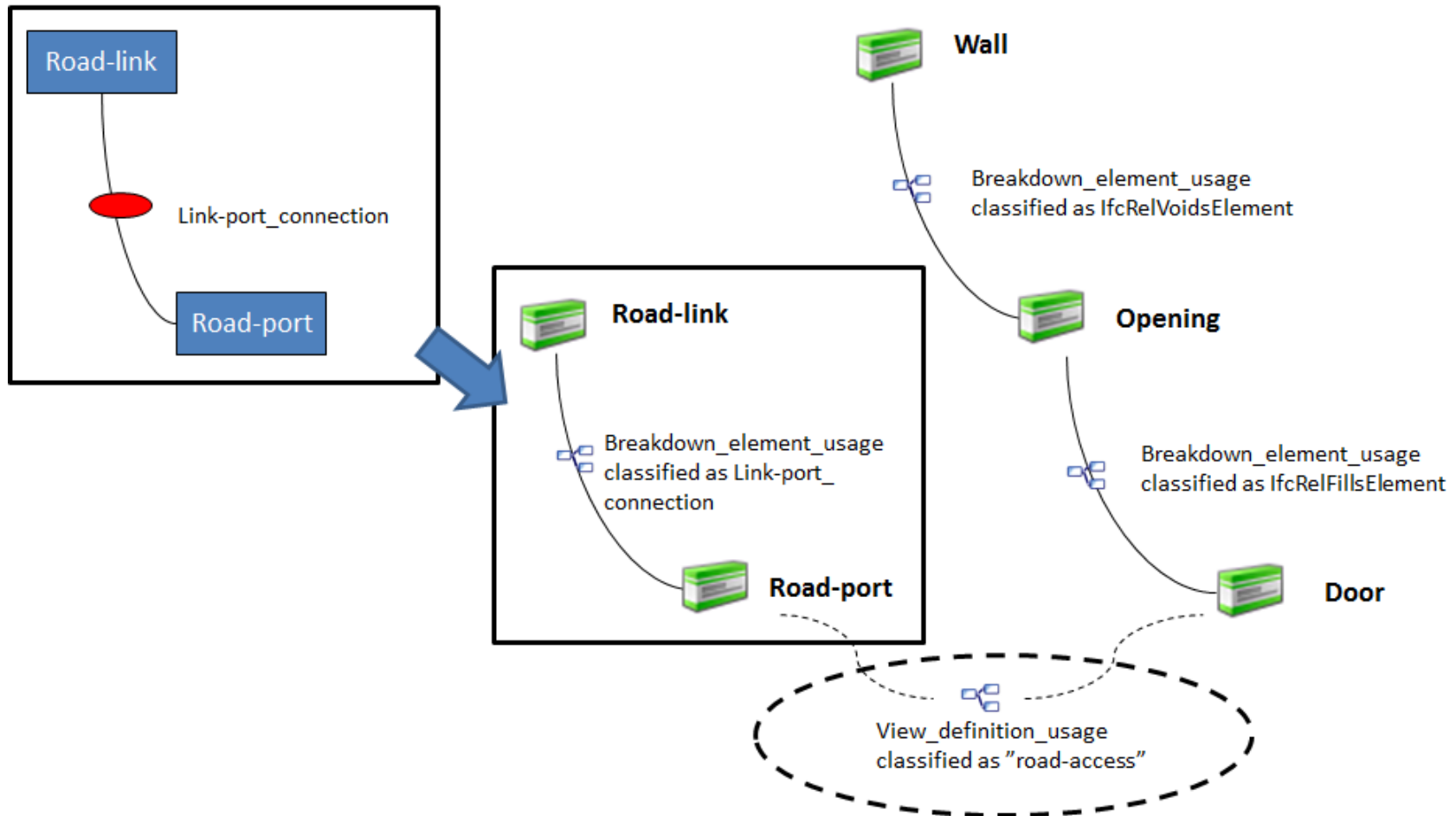
Products – properties, documents



Mapping of instances of data model X to PLCS and linking them to existing structure

Data model X Concepts

PLCS Concepts



To demonstrate by SUCH

General functionality for a BIM Collaboration Hub

- **Read, store, and write open standard model data**
- **Manage object instances and read, write and delete them**
- **Aggregating models** provided by different disciplines
- Exporting and importing **partial models**
- Managing **workflows and changes**
- Exchanging information with the hub using a **neutral exchange format**, e.g. IFC
- Supporting **heterogeneous data models**

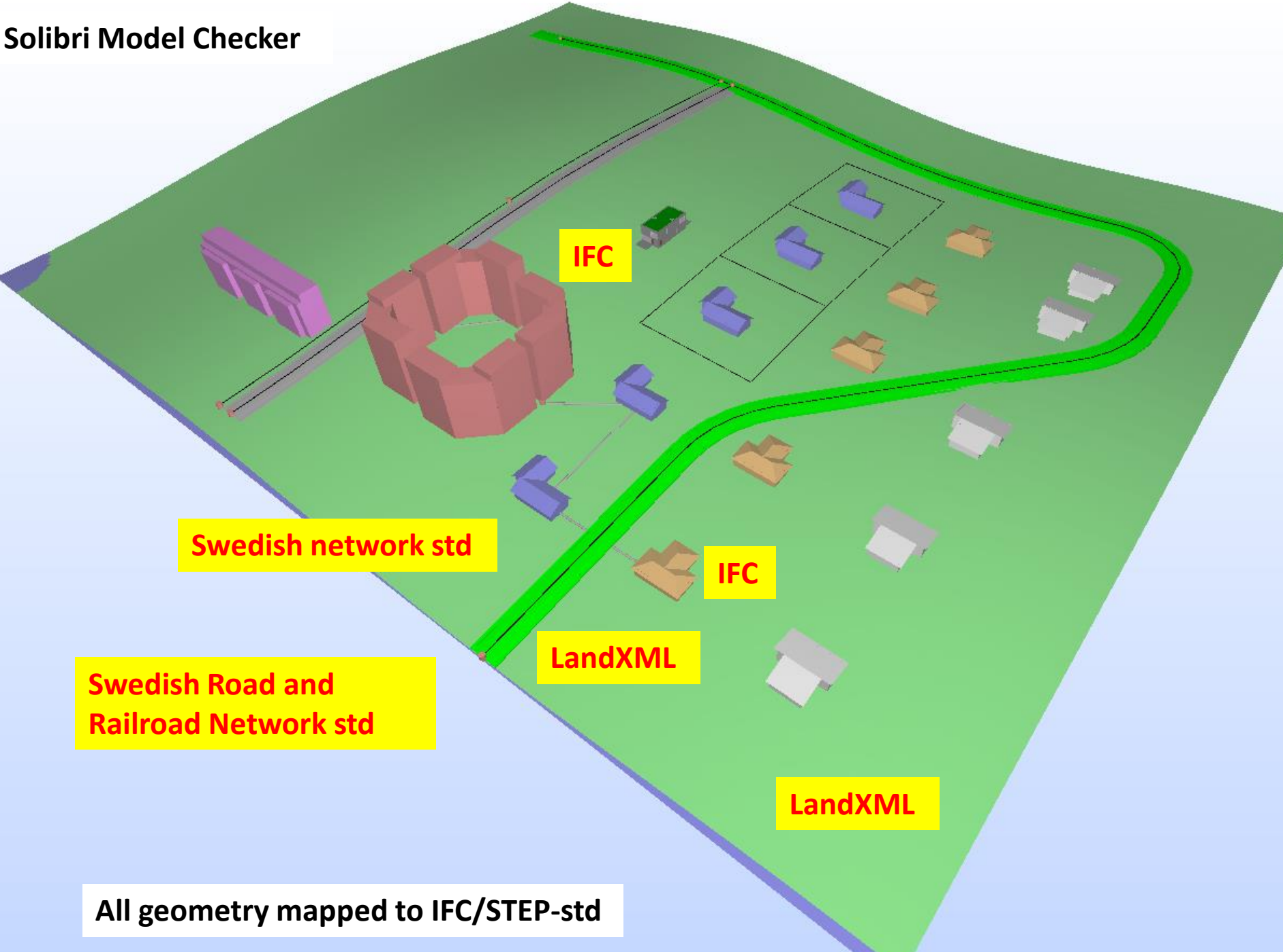
Life cycle management – on object level

- Requirements, Functions, Systems, Versions, Validations, Changes, Phases, Planned,

Sustainability

- History, Versions, Environmental Properties,

Solibri Model Checker



Swedish network std

IFC

IFC

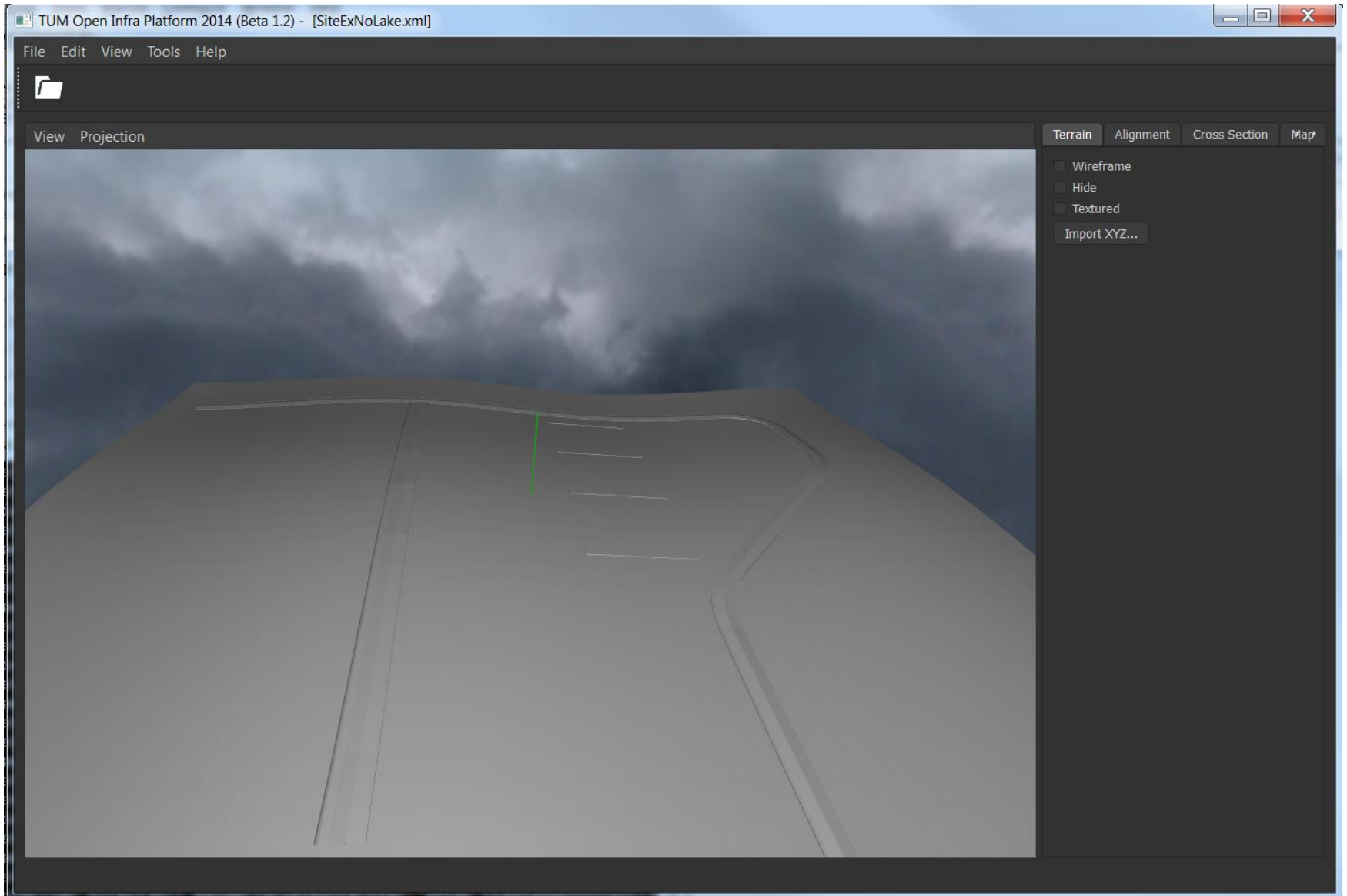
Swedish Road and Railroad Network std

LandXML

LandXML

All geometry mapped to IFC/STEP-std

LandXML file viewed in TUM Open Infra Platform



LandXML mapped to IFC

The screenshot displays the Solibri Model Checker interface for a project named "SiteExNoLake". The software is running in a 3D view mode, showing a site plan with a road and terrain. The road is represented by a thick grey line, and the terrain is shown as a blue and orange mesh. A dashed black rectangle highlights a specific area of the terrain. The interface includes a Model Tree on the left, an Info panel at the bottom left, and a 3D view area on the right.

Model Tree

- SiteExNoLake
 - InfraModel
 - Water
 - Links
 - Nodes
 - Default
 - Default
 - Borders
 - Link Objects
 - Roads
 - Road
 - Object
 - Wastewater
 - Links
 - Nodes
 - Terrain
 - Land Objects
 - Object

Info Panel

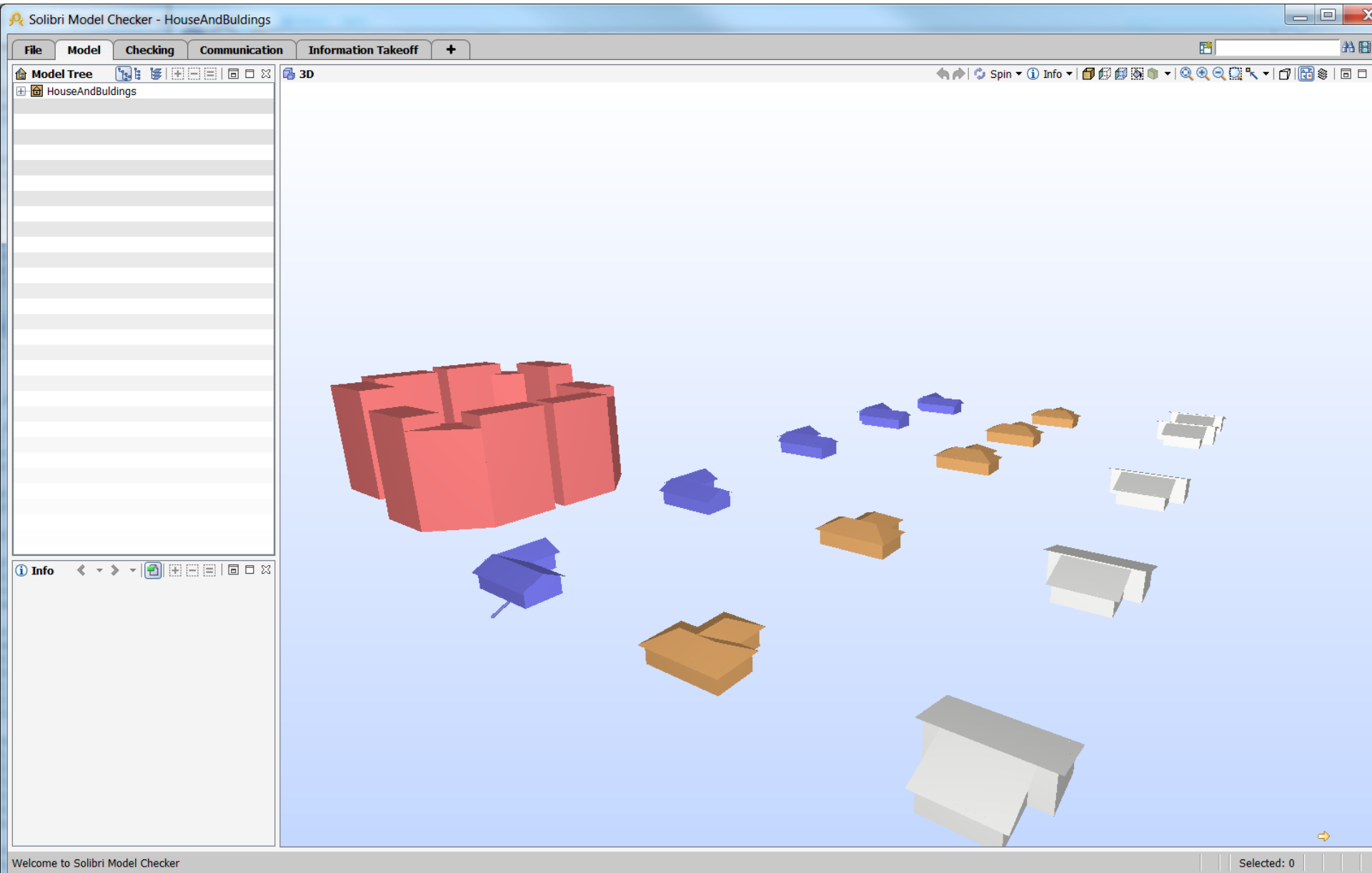
Object.2.1

Classification	Hyperlinks	IM_coding	
Identification	Location	Quantities	Relations
Property	Value		
Model	SiteExNoLake		
Discipline	Architectural		
Name	Terrain		
Type	Terrain		
Material			
Layer			
Geometry	Boundary Representation		
GUID	3a3R9ues5CRxxOLJvdM...		
BATID			

Welcome to Solibri Model Checker

Selected: 0

..and some buildings



Roads and pipes

The screenshot displays a software interface for a 3D model checker. The main window shows a 3D rendering of a road and pipe system. The interface includes a menu bar, a toolbar, and a status bar. A table of elements is visible on the left, and a properties panel is on the right.

Id	Start Date	Id	Name	Version
-	2013-08-09 09:51:22	1Z_VhDL7zCtPclwX75gaPL	Road 66	1
-	2013-08-09 09:51:22	2fPCVfCDAH@pUMq5j3s	Road 66 cl	1

Properties Panel:

Property	Value
Model	2312cc7f-e30d-43ae-8fec-d55ad7a2ef00535254447043920023
Discipline	Architecture
Name	100001
Type	Undefined
Layer	Road level2
System	
Geometry	Extrusion
GUID	02cAfFsaPDcRR8uWjZbmS, 1
BATID	





- Physical Element Version
- Versions
- Documents
- Identifiers
- Classifications
- Used In
- Properties

0qu0fSSNrAxc91\$exRq5h5, 1, Ground

Owner Architect Office (Id1001)
Creation date 2013-04-30 10:45:29

- Westland Version ID: 1
 - Borders Version ID: 1
 - House 32 Version ID: 1
 - House 21 Version ID: 1
 - Built Environment Version ID: 1
 - Pipes Version ID: 1
 - FlowSegment 02:2 Version ID: 1
 - FlowSegment 02:1 Version ID: 1
 - Roads Version ID: 1
 - Road 66 Version ID: 1
 - Road 67 Version ID: 1
 - Link Objects Version ID: 1
 - Node Objects Version ID: 1
 - House 35 Version ID: 1
 - House 42 Version ID: 1
 - Default Version ID: 1
 - House 22 Version ID: 1
 - House 34 Version ID: 1
 - Building 01 Version ID: 1





vaino.tarandi@abe.kth.se (WORLD)

Id Context: WORLD, World
Effectivity: 2013-05-05 14:52:38 : Actual

Application Context: Architecture/BuildingDesign -
Ownership Filter: Disabled

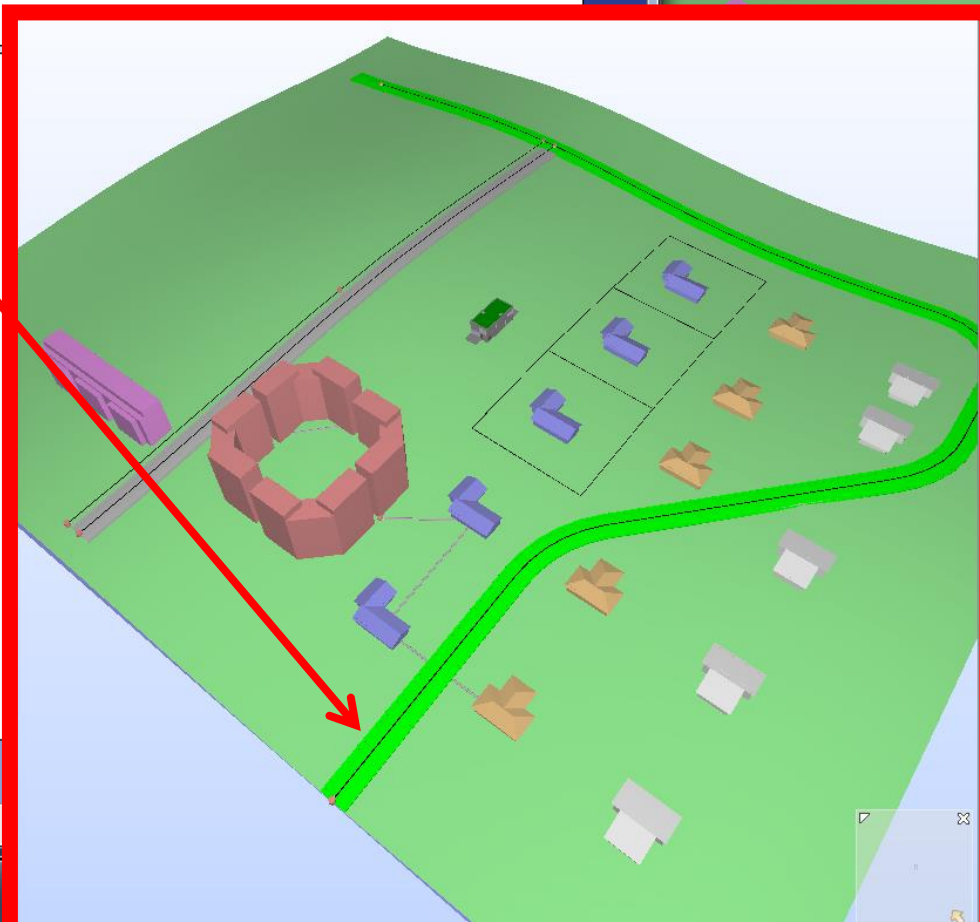
Physical Element Version Versions Documents Identifiers Classifications **Used In** Properties

0i1FCjGE5C2RFpMcrDZ3wu, 1, Road 66

Id	Start Date	Id	Name	Version
-	2013-04-30 12:45:24	26Nq5c6arAkubNlptd9qKy	Roads	1
-	2013-04-30 12:45:24	2jBQ910b97QvAQ_tX2LI39	100002	1
-	2013-04-30 12:45:24	3VcoKMO9X0uf3bUbReccR2	100001	1



- Built Environment Version ID: 1
 - Pipes Version ID: 1
 - FlowSegment 02:2 Version ID: 1
 - FlowSegment 02:1 Version ID: 1
 - Roads Version ID: 1
 - Road 66 Version ID: 1**
 - Road 67 Version ID: 1**
 - Link Objects Version ID: 1
 - Link 1001 Version ID: 1
 - Road 66 cl Version ID: 1
 - Link 1004 Version ID: 1
 - Link 1003 Version ID: 1
 - Link 1002 Version ID: 1
 - FlowSegment 01 Version ID: 1
 - Road 66 cl Version ID: 1
 - Link 1005 Version ID: 1





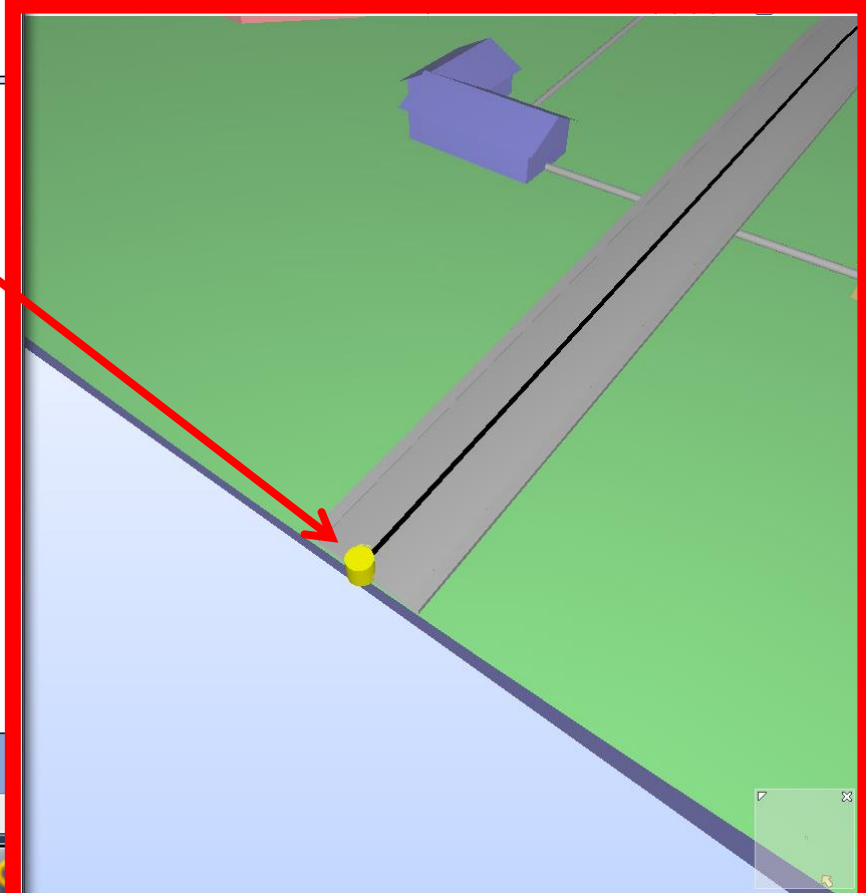
vaino.tarandi@abe.kth.se (WORLD)
Id Context: WORLD, World
Effectivity: 2013-05-05 14:52:38 : Actual
Application Context: Architecture/BuildingDesign -
Ownership Filter: Disabled

Physical Element Version Versions Documents Identifiers Classifications Used In Uses Properties

3VcoKMO9X0uf3bUbReccR2, 1, 100001

Id	Start Date	Id	Name	Version
-	2013-04-30 12:45:24	0i1FCjGE5C2RFpMcrDZ3wu	Road 66	1
-	2013-04-30 12:45:24	3AzWX7MRP0yu1XhRSFBQXh	Road 66 cl	1

- Link 1002 Version ID: 1
- FlowSegment 01 Version ID: 1
- Road 66 cl Version ID: 1
 - Link 1005 Version ID: 1
- Road 67 cl Version ID: 1
- Link 1005 Version ID: 1
- Node Objects Version ID: 1
 - 100004 Version ID: 1
 - 100031 Version ID: 1
 - 100024 Version ID: 1
 - 100045 Version ID: 1
 - 100013 Version ID: 1
 - 100001 Version ID: 1
 - Road 66 Version ID: 1
 - Road 66 cl Version ID: 1
 - 100021 Version ID: 1



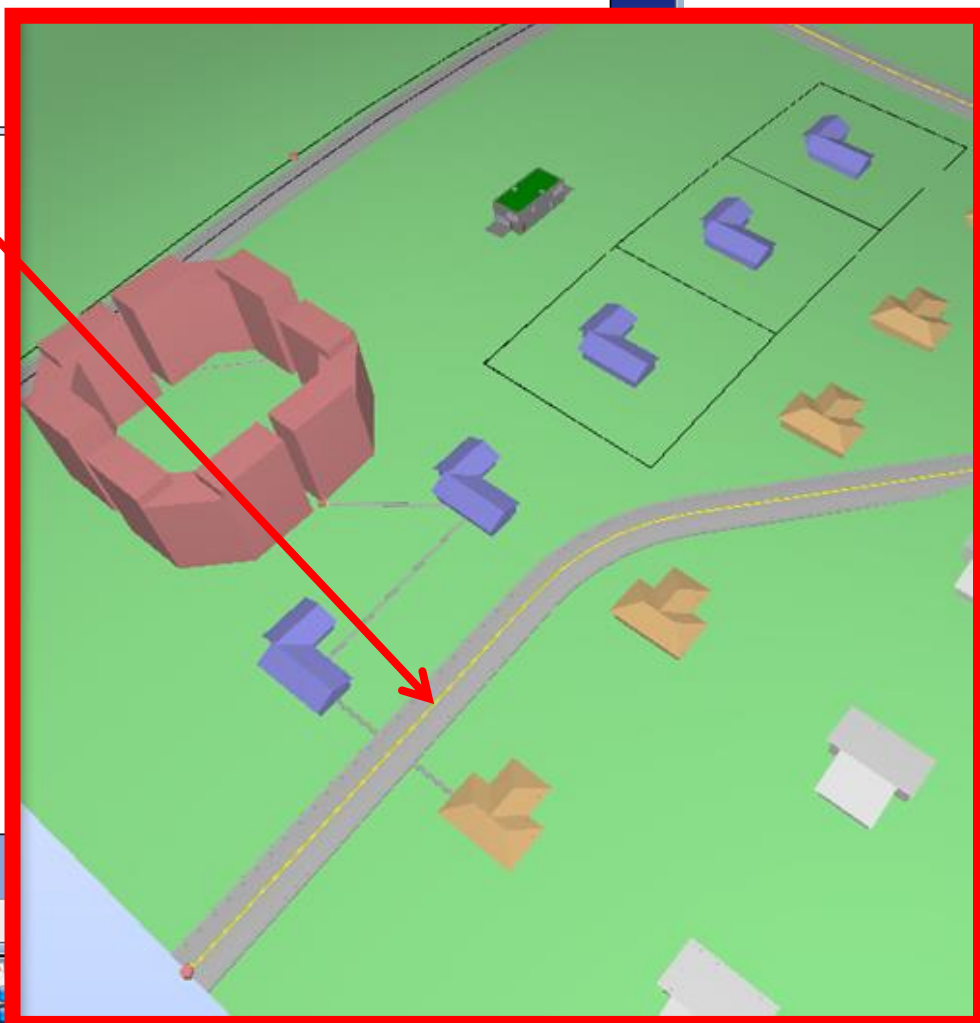


Physical Element Version Versions Documents Identifiers Classifications Used Uses Properties

3AzWX7MRP0yu1XhRSFBQXh, 1, Road 66 cl

Id	Start Date	Id	Name	Version
water link	2013-05-05 05:14:00	1I\$X74xqT1pxxM99\$HmC2k	Link 1005	1

- + Link 1002 Version ID: 1
- + FlowSegment 01 Version ID: 1
- **Link 1005 Version ID: 1**
 - + **Link 1005 Version ID: 1**
- + Road 67 cl Version ID: 1
- + Link 1005 Version ID: 1
- Node Objects Version ID: 1
 - + 100004 Version ID: 1
 - + 100031 Version ID: 1
 - + 100024 Version ID: 1
 - + 100045 Version ID: 1
 - + 100013 Version ID: 1
 - 100001 Version ID: 1
 - + Road 66 Version ID: 1
 - + Road 66 cl Version ID: 1
 - + 100021 Version ID: 1





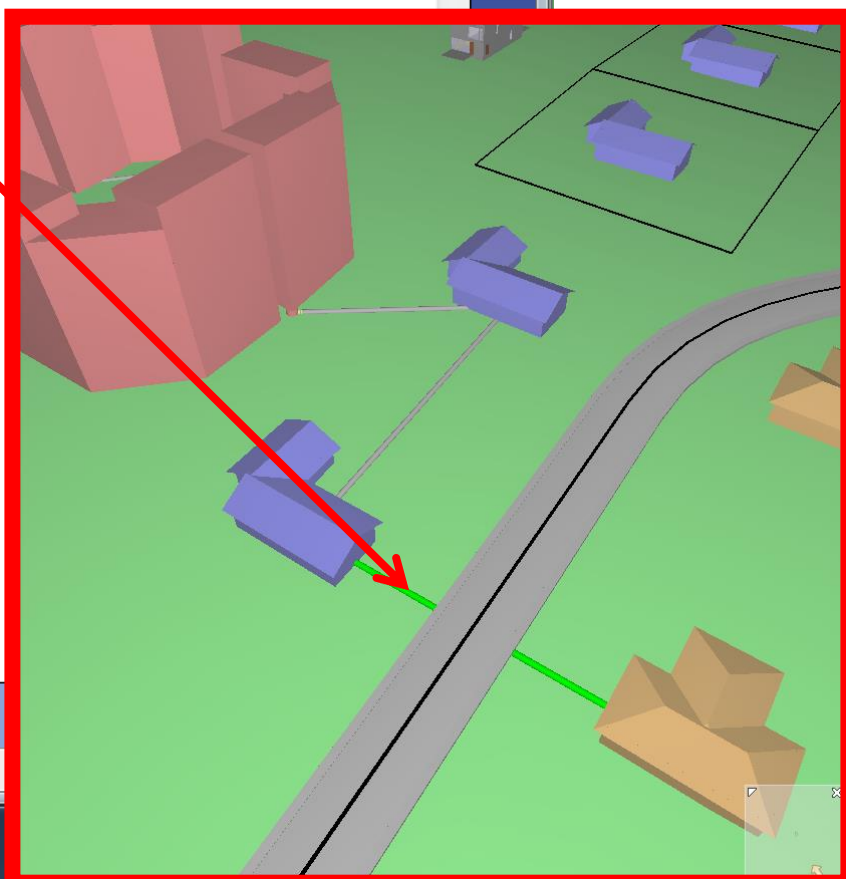
Physical Element Version Versions Documents Identifiers Classifications Used In Properties

1l\$X74xqT1pxxM99\$HmC2k, 1, Link 1005

Id	Start Date	Id	Name	Version
-	2013-04-30 12:45:24	0\$tNgKoLf0PQL5dDeZSmHM	Link Obie	1
-	2013-04-30 12:45:24	1tCL0s6MH5_ebJ7DWLcWOK	100031	1
-	2013-04-30 12:45:24	2ujwMm2NP2fg\$ITANB2LZk	100021	1
-	2013-05-05 05:14:00	3A2WX7MRP0yu1XhRSFBQXh	Road 66 cl	1



- Link 1002 Version ID: 1
- FlowSegment 01 Version ID: 1
- Road 66 cl Version ID: 1
 - Link 1005 Version ID: 1
- Road 67 cl Version ID: 1
- Link 1005 Version ID: 1
- Node Objects Version ID: 1
 - 100004 Version ID: 1
 - 100031 Version ID: 1
 - 100024 Version ID: 1
 - 100045 Version ID: 1
 - 100013 Version ID: 1
 - 100001 Version ID: 1
 - Road 66 Version ID: 1
 - Road 66 cl Version ID: 1
 - 100021 Version ID: 1





vaino.tarandi@abe.kth.se (WORLD)

Id Context: WORLD, World

Application Context: Architecture/BuildingDesign -

Effectivity: 2013-05-05 14:52:38 : Actual

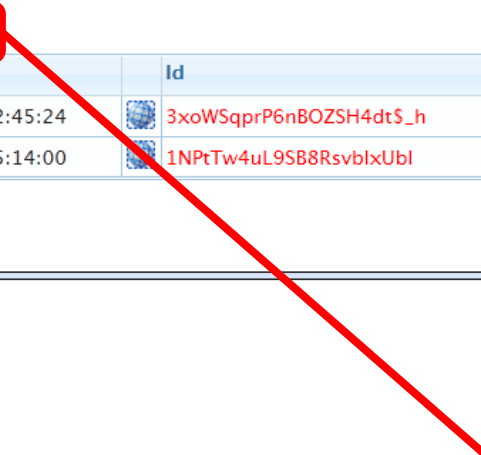
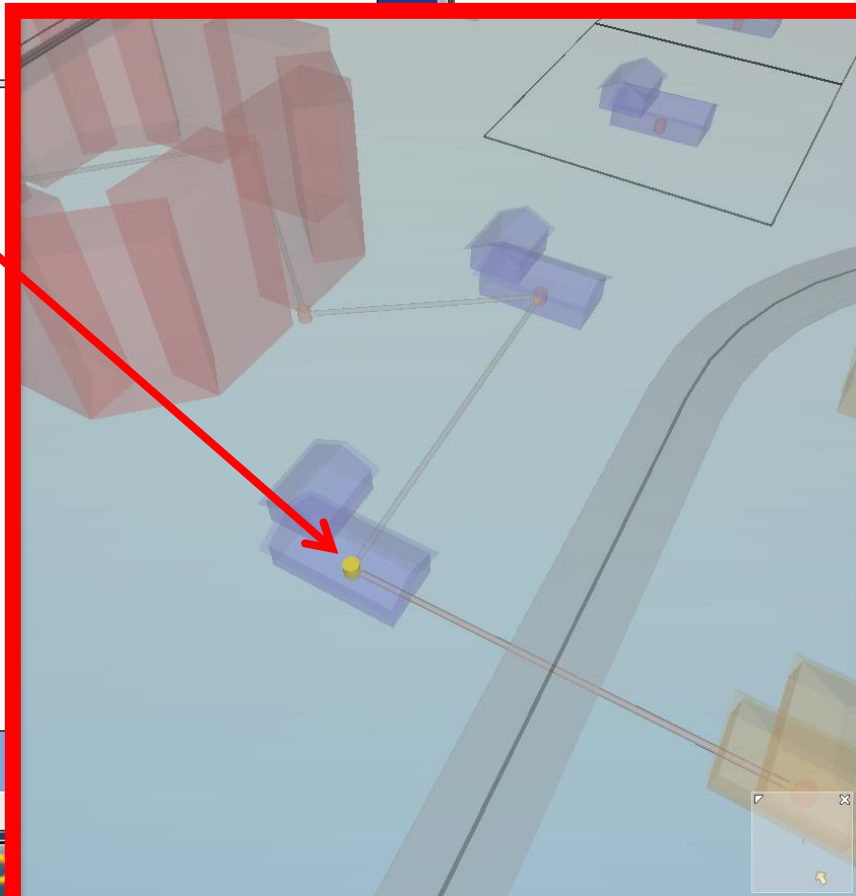
Ownership Filter: Disabled

Physical Element Version Versions Documents Identifiers Classifications Used In Uses Properties

2ujwMm2NP2fg\$ITANB2LZk, 1, 100021

Id	Start Date	Id	Name	Version
-	2013-04-30 12:45:24	3xoWSqprP6nBOZSH4dt\$h	Node Obj	1
water link	2013-05-05 05:14:00	1NPtTw4uL9SB8RsvblxUbl	House 21	1

- + Link 1005 Version ID: 1
- Node Objects Version ID: 1
 - + 100004 Version ID: 1
 - + 100031 Version ID: 1
 - + 100024 Version ID: 1
 - + 100045 Version ID: 1
 - + 100013 Version ID: 1
 - 100001 Version ID: 1
 - + Road 66 Version ID: 1
 - + Road 66 cl Version ID: 1
 - 100021 Version ID: 1
 - + Link 1005 Version ID: 1
 - + Link 1004 Version ID: 1
 - + 100002 Version ID: 1
 - + 100041 Version ID: 1
 - + 100006 Version ID: 1





vaino.tarandi@abe.kth.s
Id Context: WORLD, W
Effectivity: 2013-05-07

Building Versions Documents Identifiers Classifications **Used In** Uses Properties

INPTw4uL9SB8RsvblxUBI, 1, House 21

Id	Start Date	Id	Name
-	2013-04-30 12:45:24	3kJDEunAz2XBqRpm0R4t9S	Westland

Building Versions Documents Identifiers Classifications **Used In** **Uses** Properties

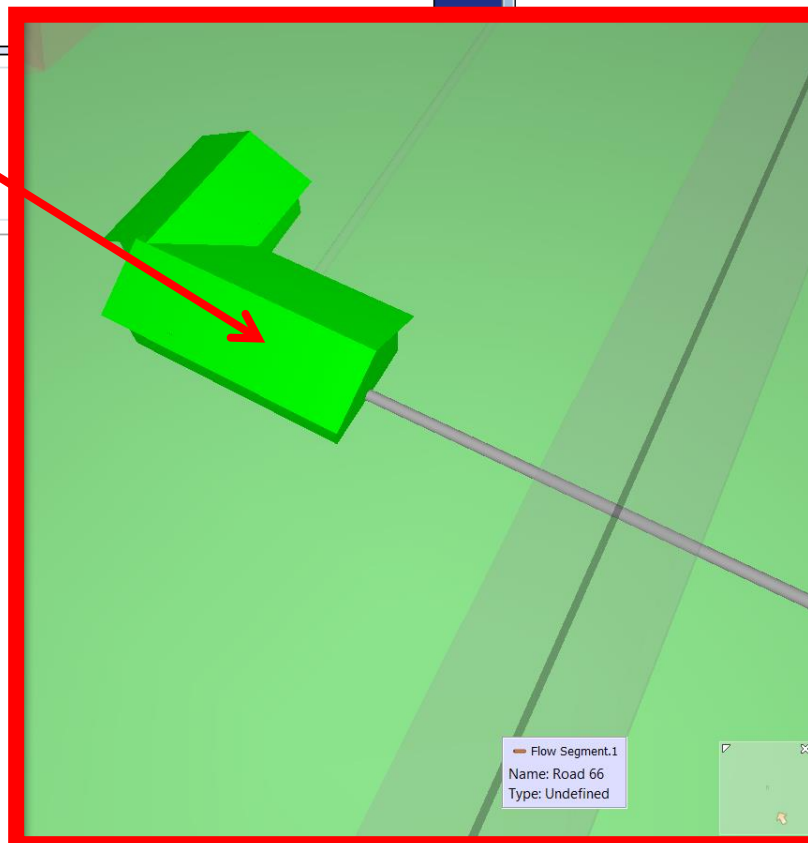
INPTw4uL9SB8RsvblxUBI, 1, House 21

Id	Start Date	Id	Name	Version
water link	2013-05-05 05:14:00	2ujwMm2NP2fg\$ITANB2Lzk	100021	1

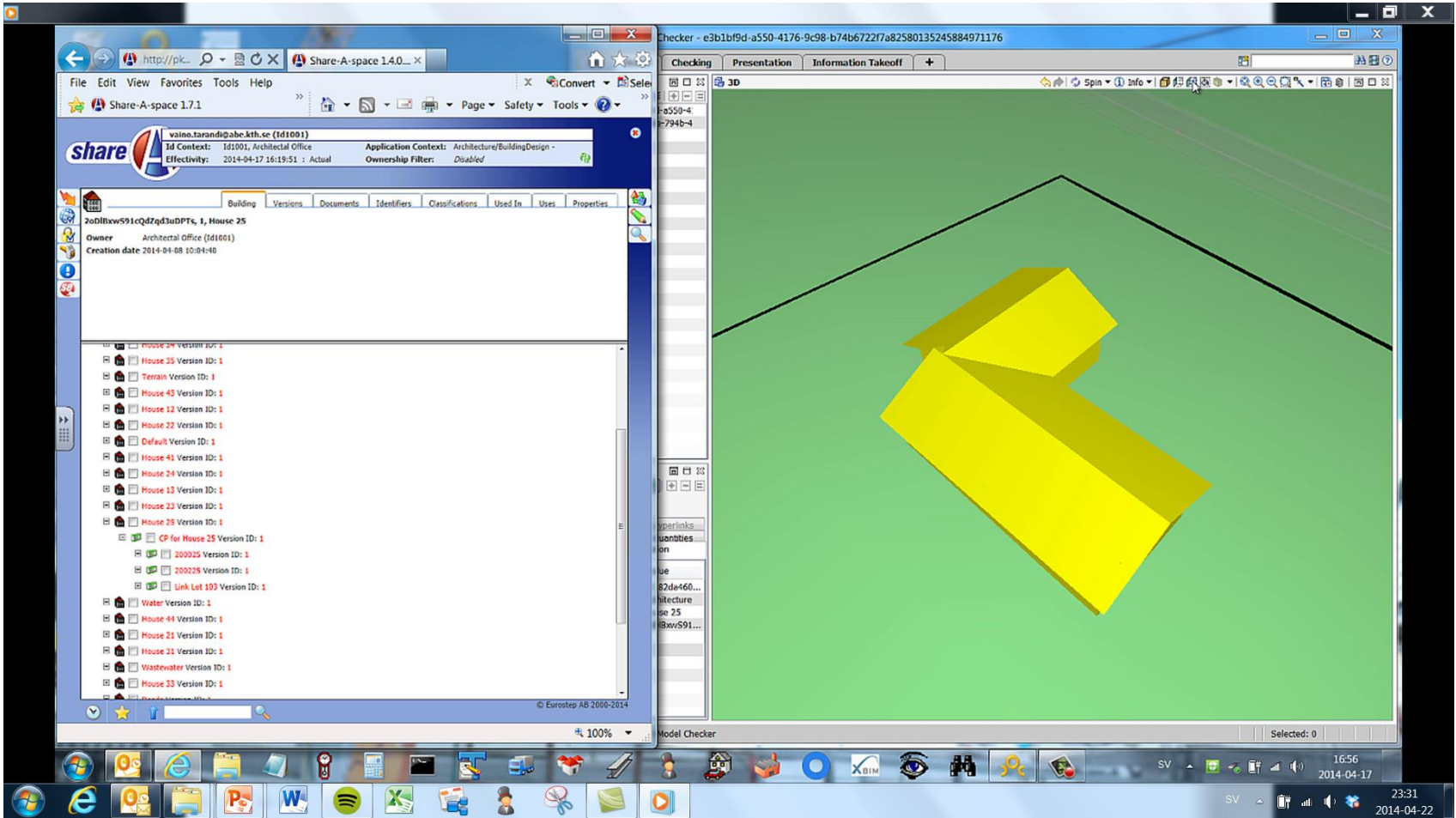
IFC File Generation Options

- All selected Recursive from selected
 - Use Cached File if Existing
-

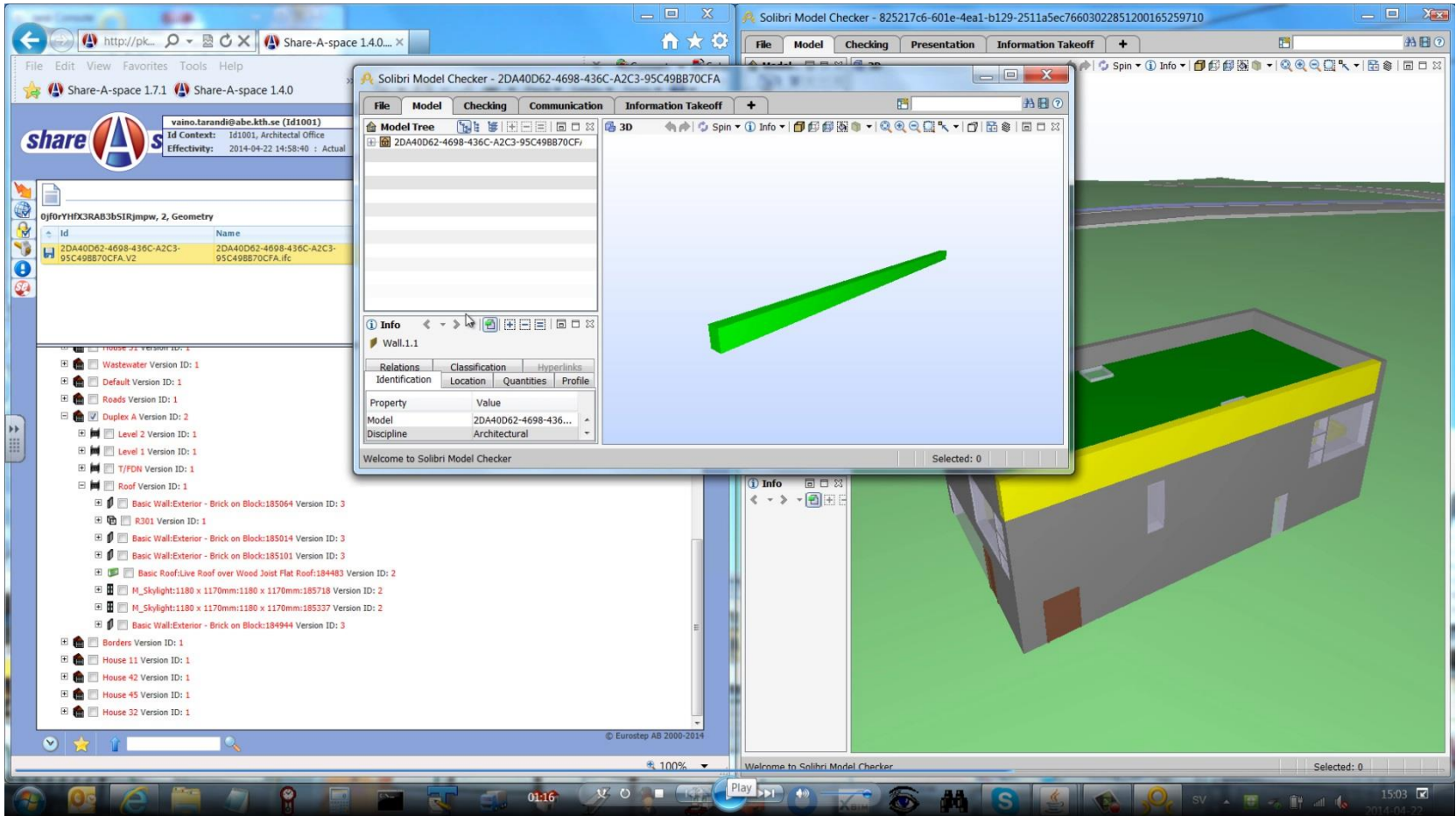
- Westland Version ID: 1
 - Borders Version ID: 1
 - House 32 Version ID: 1
 - House 21 Version ID: 1**
 - 100021 Version ID: 1
 - Link 1005 Version ID: 1
 - Link 1004 Version ID: 1
 - Built Environment Version ID: 1
 - Pipes Version ID: 1
 - Roads Version ID: 1
 - Link Objects Version ID: 1
 - Node Objects Version ID: 1
 - 100004 Version ID: 1



Water pipes to House



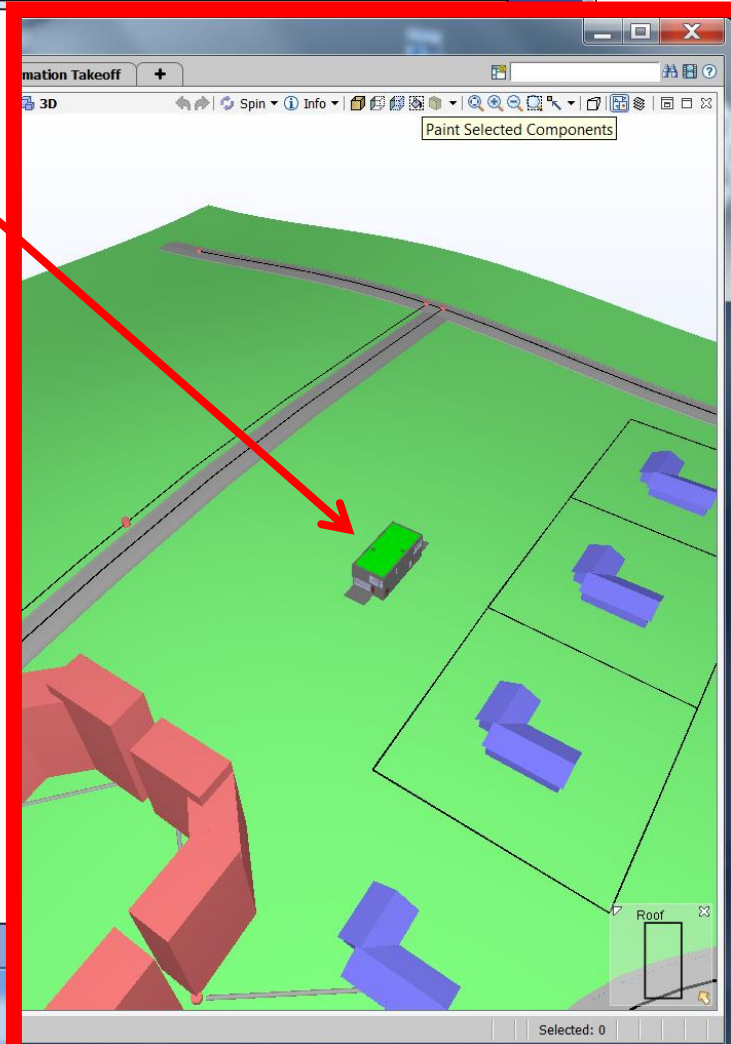
Versions



1xS3Bck291UvhgP2a6eflK, 1, Duplex A

Id	Start Date	Id	Name	Version
-	2013-04-30 12:49:14	1xS3Bck291UvhgP2dvNMKI	Level 1	1
-	2013-04-30 12:49:14	1xS3Bck291UvhgP2dvNMQJ	Level 2	1
-	2013-04-30 12:49:14	1xS3Bck291UvhgP2dvNsgp	T/FDN	1
-	2013-04-30 12:49:14	1xS3Bck291UvhgP2dvNtSE	Roof	1

- Land Objects Version ID: 1
 - Ground Version ID: 1
 - Lake Version ID: 1
- House 24 Version ID: 1
- House 25 Version ID: 1
- House 13 Version ID: 1
- House 23 Version ID: 1
- House 11 Version ID: 1
- House 45 Version ID: 1
- House 41 Version ID: 1
- House 31 Version ID: 1
- House 44 Version ID: 1
- Duplex A Version ID: 1
 - Roof Version ID: 1
 - Level 2 Version ID: 1
 - T/FDN Version ID: 1
 - Level 1 Version ID: 1
- House 43 Version ID: 1





vaino.tarandi@abe.kth.se (WORLD)

Id Context: WORLD, World **Application Context:** Architecture/BuildingDesign -

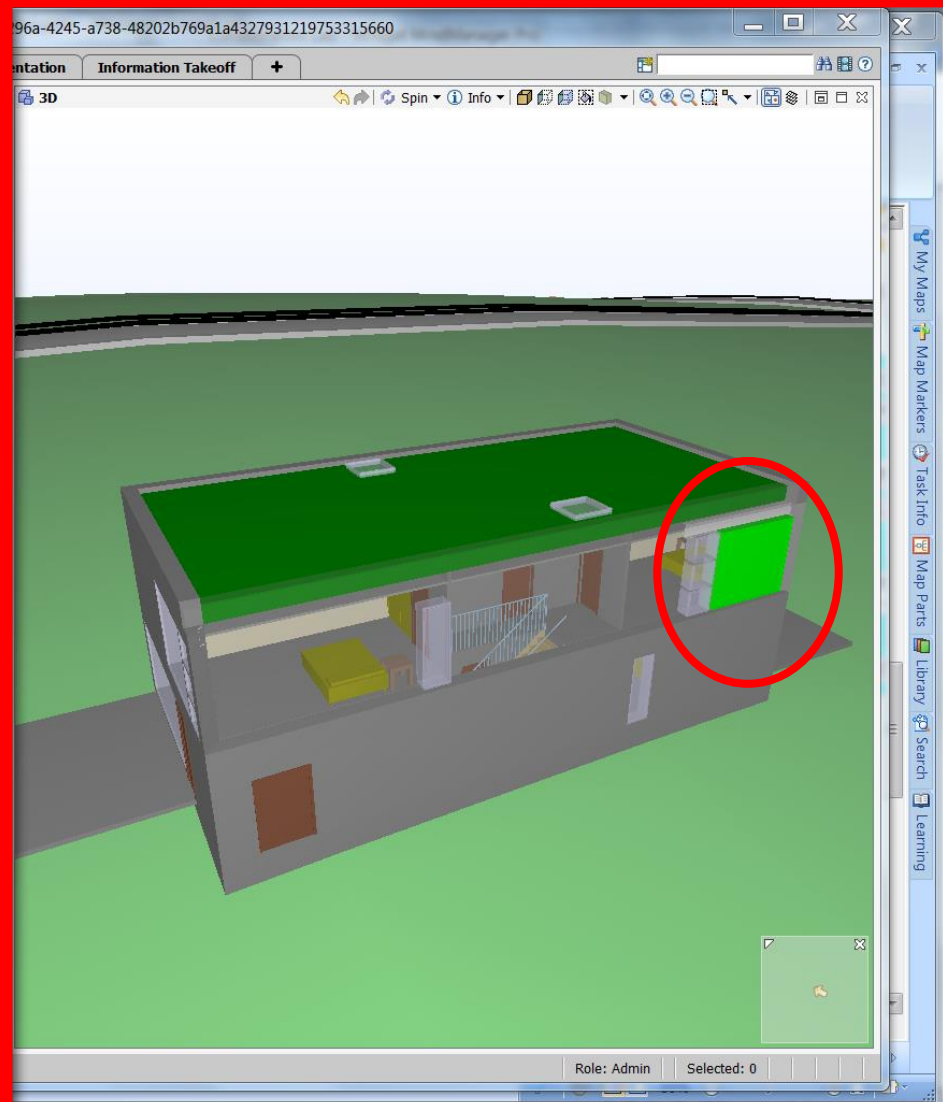
Effectivity: 2013-05-07 18:17:52 : Actual **Ownership Filter:** Dis

110GAJtrTFv8\$zmKJOH4pU, 1, M_Fixed:2800mm x 2410mm:2800mm x 2410mm:181096

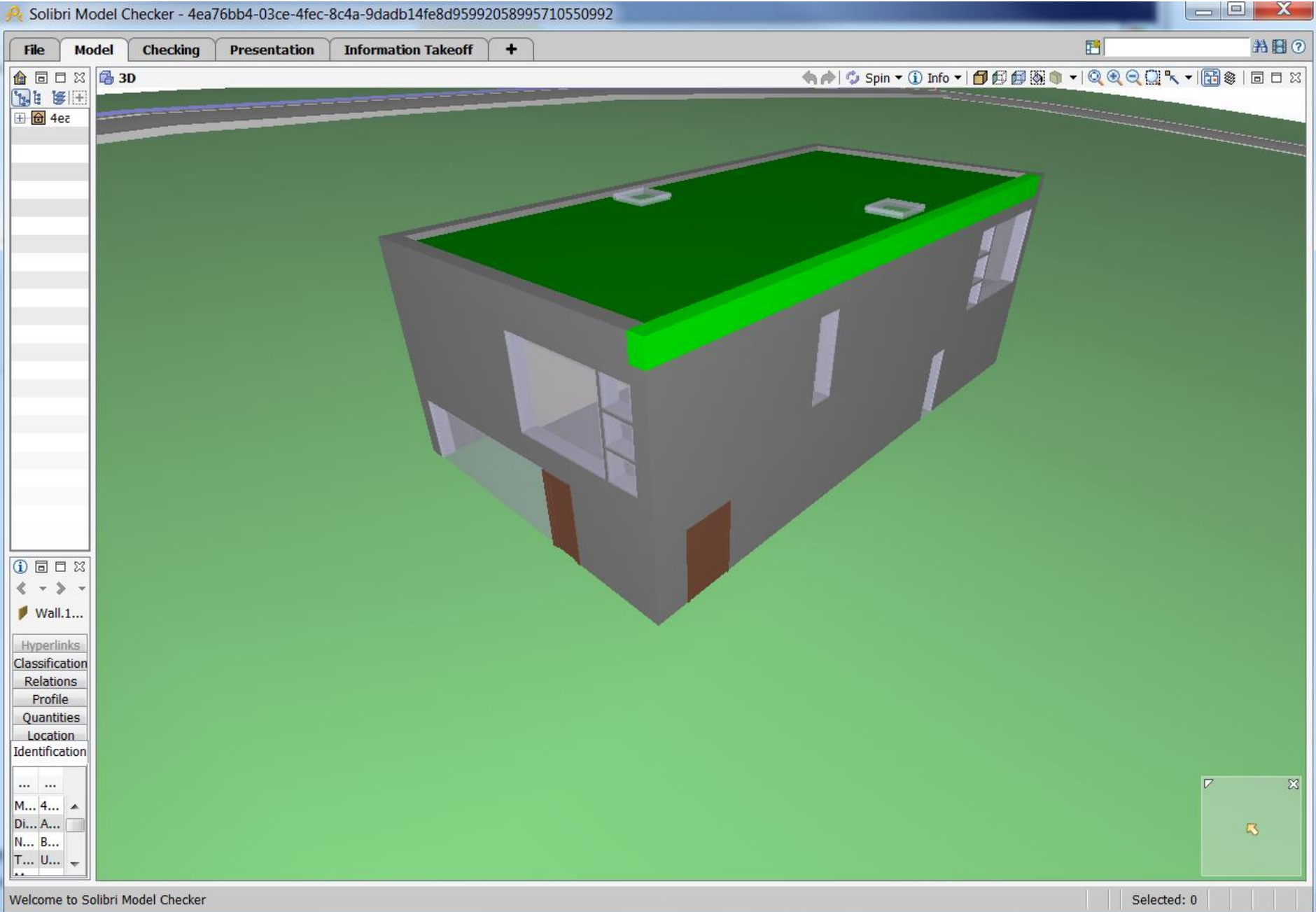
Owner Architect Office (Id1001)

Creation date 2013-04-30 10:50:12

- ⊕ Floor:Finish Floor - Wood:169093 Version ID: 1
- ⊕ M_W-Wide Flange:W410X60:W410X60:209166 Version ID: 1
- ⊕ M_Casement:819mm x 759mm:819mm x 759mm:149736 Version ID: 1
- ⊕ Floor:Residential - Wood Joist with Subflooring:144872 Version ID: 1
- ⊕ Basic Wall:Exterior - Brick on Block:143478 Version ID: 1
 - ⊖ Opening Version ID: 1
 - ⊕ M_Casement:819mm x 759mm:819mm x 759mm:181548 Version ID: 1
 - ⊖ Opening Version ID: 1
 - ⊕ M_Fixed:819mm x 759mm:819mm x 759mm:181583 Version ID: 1
 - ⊖ Opening Version ID: 1
 - ⊕ M_Fixed:2800mm x 2410mm:2800mm x 2410mm:181096 Version ID: 1
 - ⊖ Opening Version ID: 1
 - ⊖ Opening Version ID: 1
- ⊕ Basic Wall:Interior - Furring (38 mm Stud):217578 Version ID: 1
- ⊕ M_Fixed:2800mm x 2410mm:2800mm x 2410mm:181096 Version ID: 1



Detailed Designed Building Roof Version 1

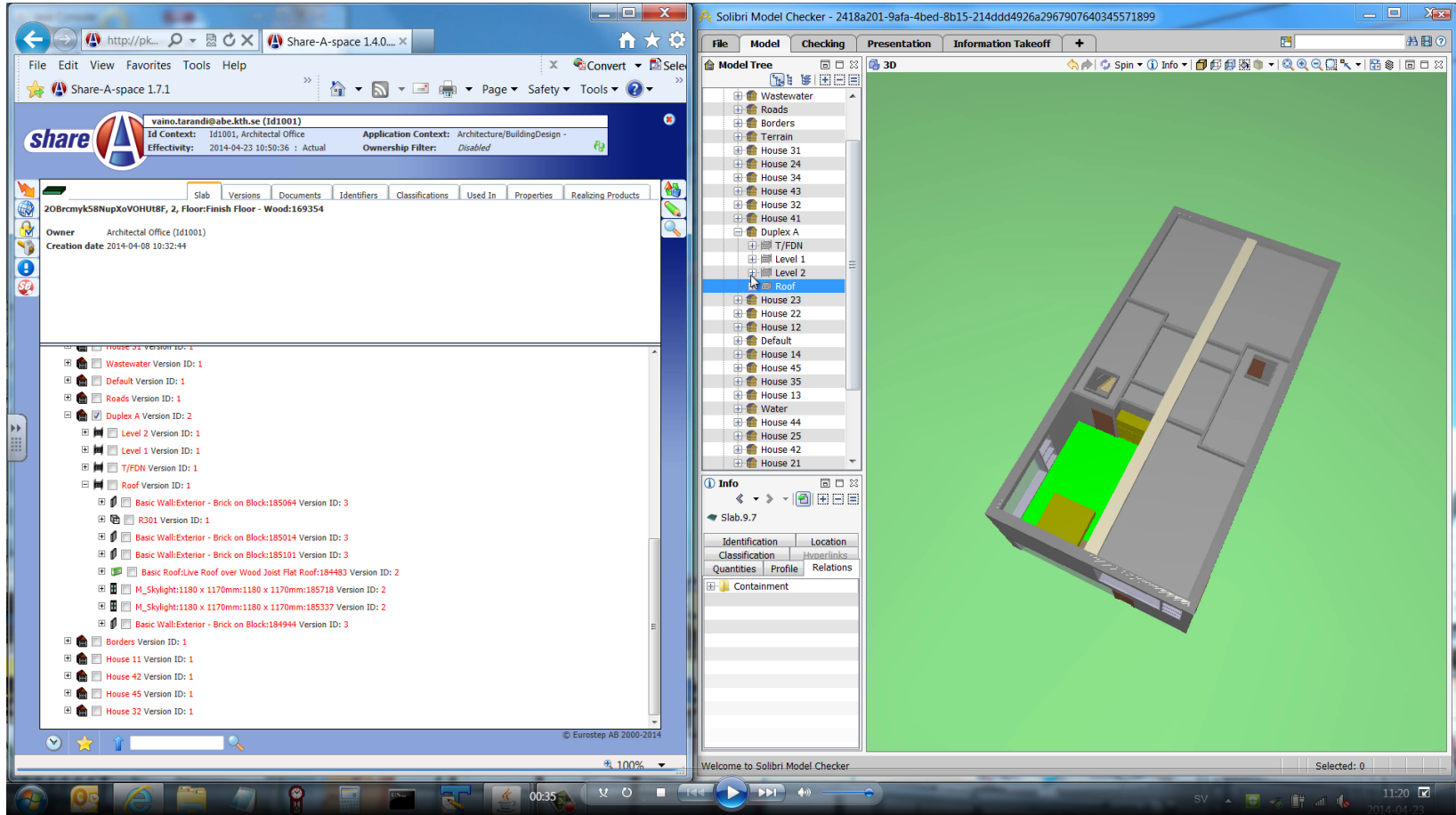


Detailed Designed Building Roof Version 2

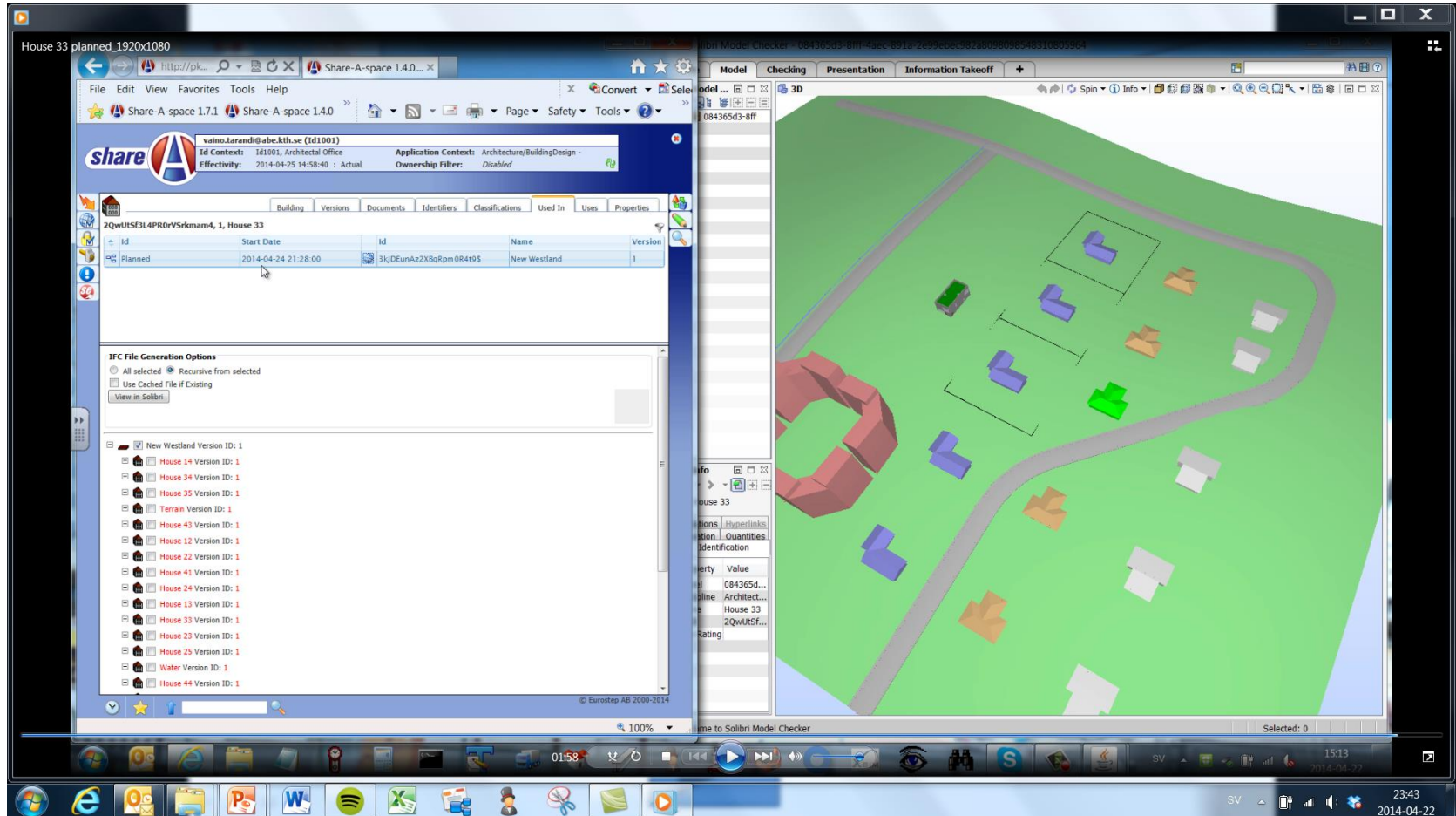
The screenshot displays a web-based interface for a BIM model. At the top, a browser window shows the URL `orjan.falk@eurostep.com (Id1001)` and various application contexts. Below the browser, the **share A space** logo is visible. The main interface is divided into several sections:

- Left Panel (Tree View):** A hierarchical tree view of the model. The selected element is **Basic Wall:Exterior - Brick on Block:185014**, which is circled in red. Other elements include Roads, House 11, House 33, House 35, Terrain, House 25, Water, House 41, House 43, Duplex A, Level 1, T/FDN, Roof, Basic Wall:Exterior - Brick on Block:184944 (Version ID: 2), Basic Wall:Exterior - Brick on Block:185014 (Version ID: 2), Basic Roof:Live Roof over Wood Joist Flat Roof:184483 (Version ID: 1), M_Skylight:1180 x 1170mm:1180 x 1170mm:185718 (Version ID: 1), Basic Wall:Exterior - Brick on Block:185101 (Version ID: 2), Basic Wall:Exterior - Brick on Block:185064 (Version ID: 2), M_Skylight:1180 x 1170mm:1180 x 1170mm:185337 (Version ID: 1), R301 (Version ID: 1), Level 2 (Version ID: 1), and House 45 (Version ID: 1).
- Top Panel (Model Checker):** A header for the **Solibri Model Checker** with tabs for File, Model, Checking, Presentation, and Information Takeoff. The 3D view is currently active.
- 3D View:** A 3D perspective view of a building model with a green roof and grey walls. The roof is highlighted in green.
- Right Panel (Properties):** A panel showing properties for the selected element, including Classification, Relations, Profile, Quantities, Location, and Identification.

Properties - added



Planned construction



Thank you!