SMART SURVEYORS FOR LAND AND WATER MANAGEMENT

CHALLENGES IN A NEW REALITY

FIG NL THE NETHERLANDS

e WORKING WEEK 2021

20-25 JUNE

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Basics on BIM for Surveyors

24.06.2021, 09:00-10:00 CET

ORGANISED BY FIG GIN Geo-Informatie Nederland kadaster ITC UNIVERSITY OF TWENTE

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What is **B**uilding **I**nformation **M**odeling?

Definition

“Building Information Modeling refers to a cooperative **methodology** that uses **digital models of a building** as the basis for the information and data relevant to the **life cycle** of the building.
The information and data relevant to the building's life cycle is consistently recorded, managed and exchanged between the parties involved or transferred for further processing.”

"The core of the method is the creation of digital three-dimensional building models.“

Building – build environment, not buildings only

Information - The **I** makes the difference ! No Drawings

Modeling, **M**odel, **M**anagement...

Translated definition according to BMVI, 2016

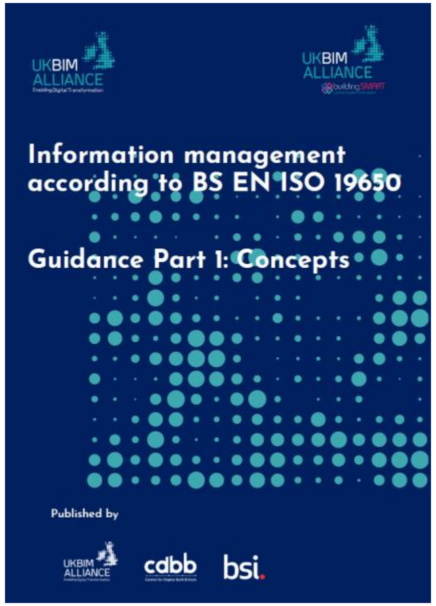
ISO19650: ”building information modelling (BIM) … use of a shared digital representation of a built object (including buildings, bridges, roads, process plants, etc.) to facilitate design, construction and operation processes to form a reliable basis for decisions” (from ISO 29481-1:2016)

Clear definitions for the information needed by the project client or asset owner, and for the standards, methods, processes, deadlines and protocols that will govern its production and review.

The quantity and quality of information produced being just sufficient to satisfy the defined information needs, whilst not compromising health and safety or security. Too much information represents wasted effort by the supply chain and too little means clients/owners take uninformed decisions about their projects/assets.

Efficient and effective transfer of information between those involved in each part of the life cycle – particularly within projects and between project delivery and asset operation.

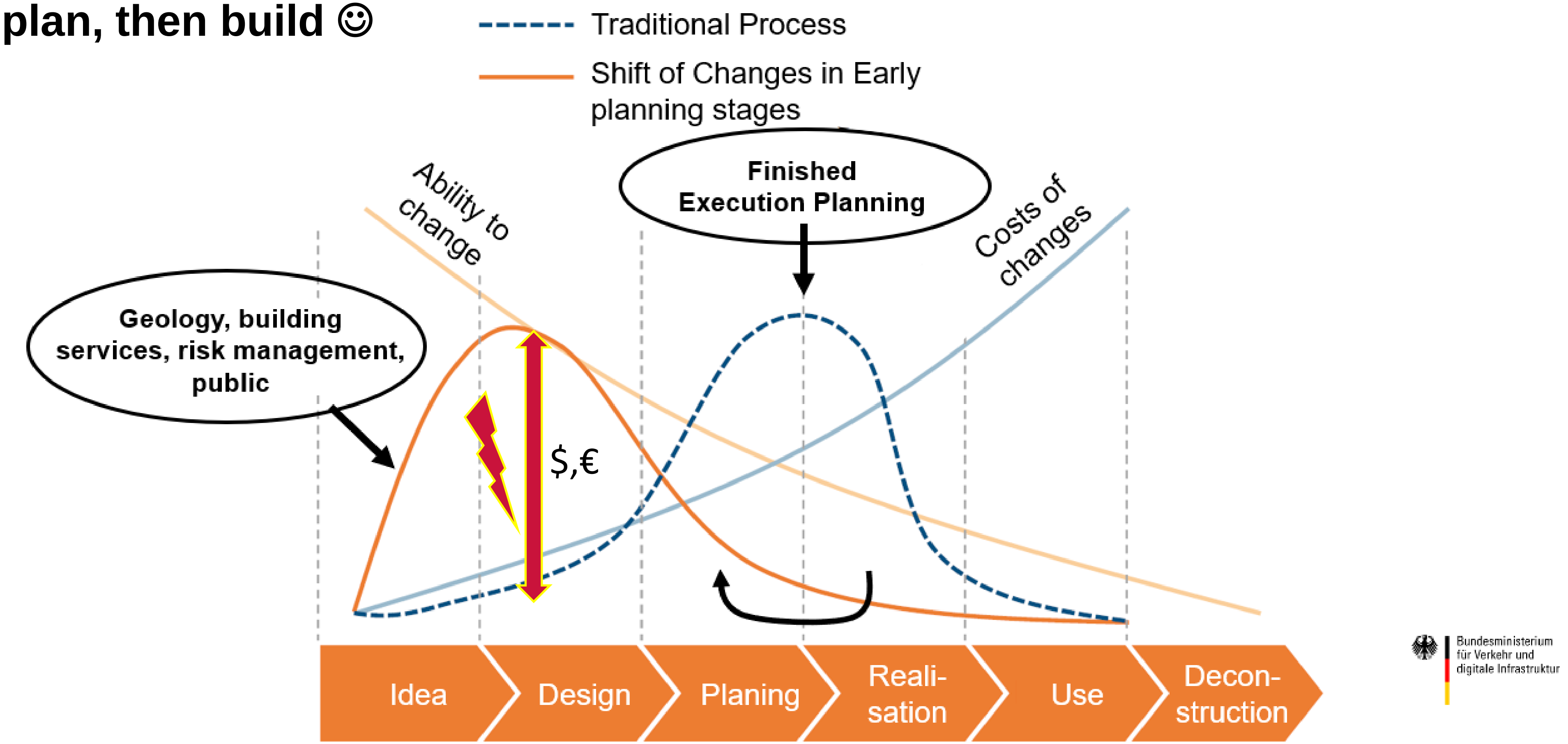
-> **Informed and timely decision making!**



https://www.ukbimframework.org/standards-guidance/

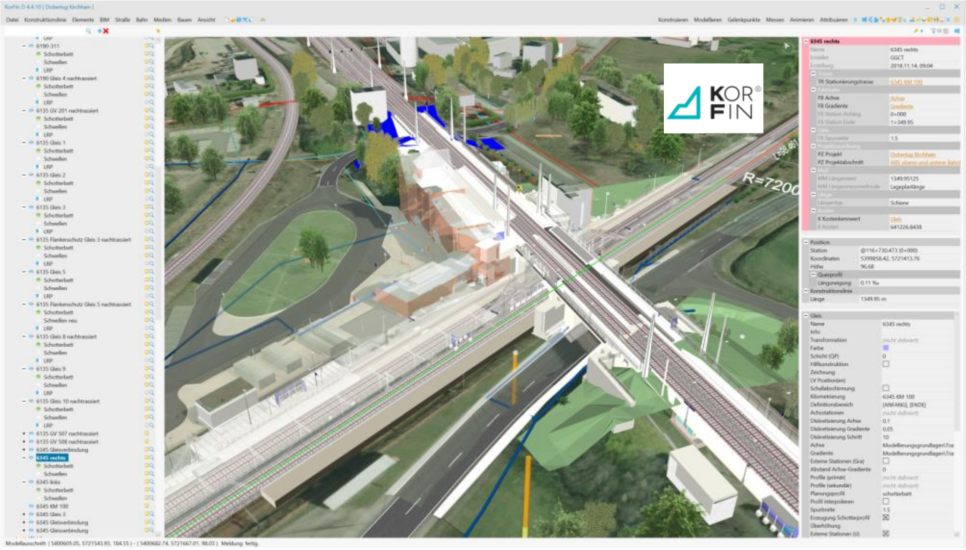
→ **Motivation #1:** Optimization of Costs in the Life Cycle

First plan, then build ☺



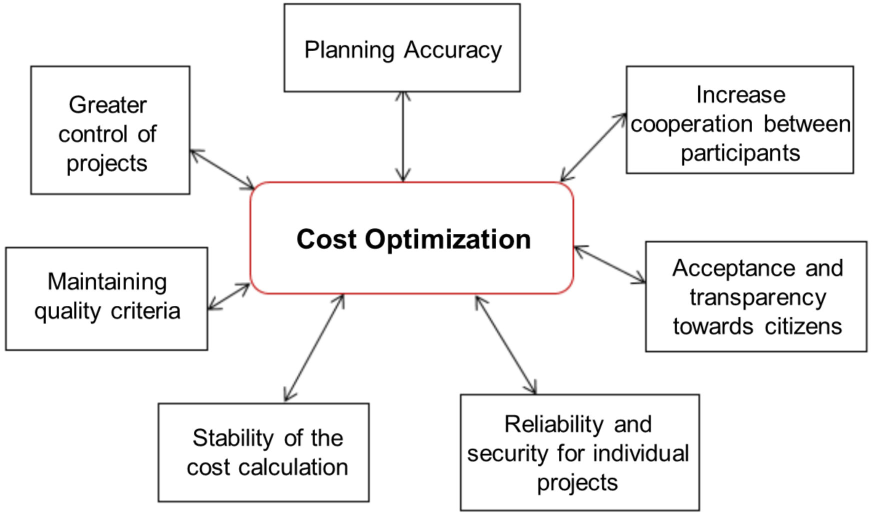
BMVI: Reform Commission Construction of Major Projects - Final Report

technical perspective



https://www.korfin.de

commercial perspective



Eggert, Jacqueline: Erarbeitung einer Fiktivplanung für den Ausbau der B 4 i Geländebestandsmodell, Bachelorarbeit, HTW Dresden, 2017

XOXO BFFE

What is your perspective?

A) Technical
B) Commercial

What are **use-cases for BIM?**

A Use Case defines …

- **who** needs
- which **information**
- at what **time**
- in which **format**
- in which **level of detail**

Result of a Use Case:

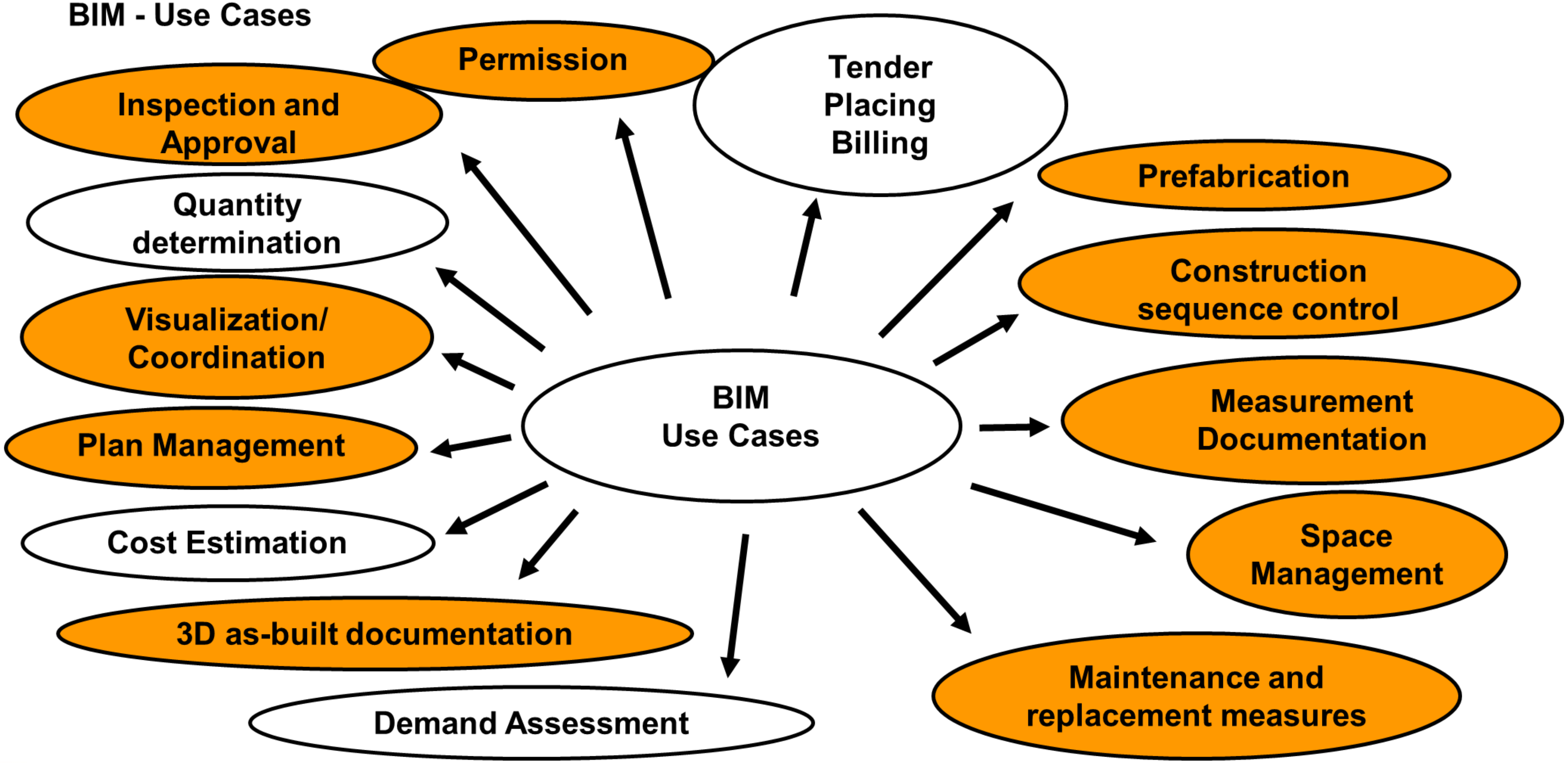
- **common** understanding
- **integrated** processes
- inputs to **EIR** and **BEP**
- mapping to **IFC schema**
- basics for **MVD’s**

UCM ® a service by buildingSMART International

https://ucm.buildingsmart.org/

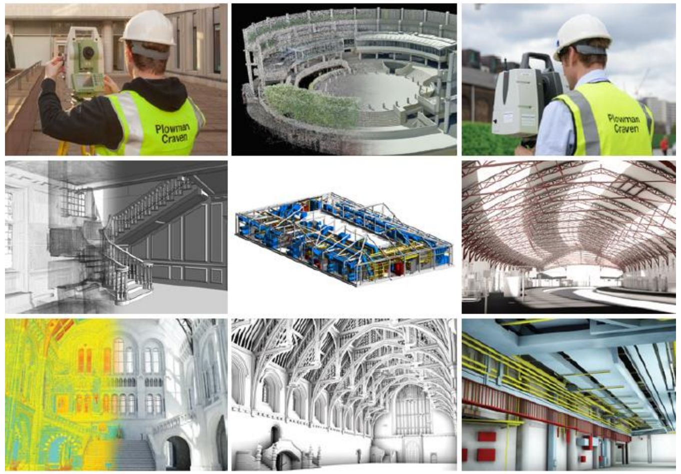
- **Geo-referencing in IFC**
- **Stake out**
- **Retro BIM**
- **…**

BIM - Use Cases



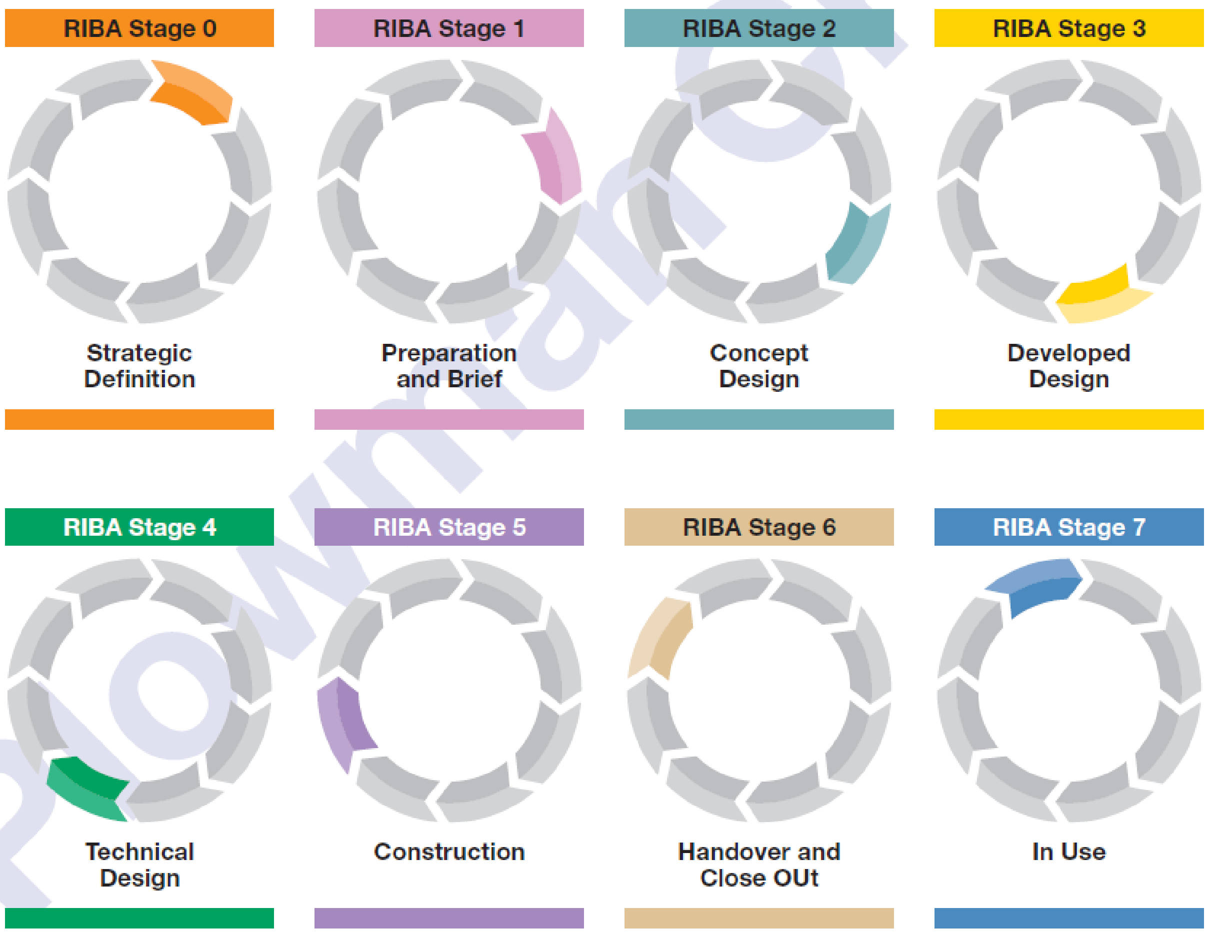
Plowman Craven

BIM SURVEY SPECIFICATION AND REFERENCE GUIDE



plowmancraven.co.uk

the trusted name in measurement



What are the **requirements** for a **BIM ~~Software~~?**

BIM Authoring Tools

6 point benchmark!

Hausknecht, Liebich (2016)

#1 Model element based work with parametric

Model: Semantically structured 3D model

Semantics through classification and attribution

Geometry parameters:

e.g. : Length, Width, Height

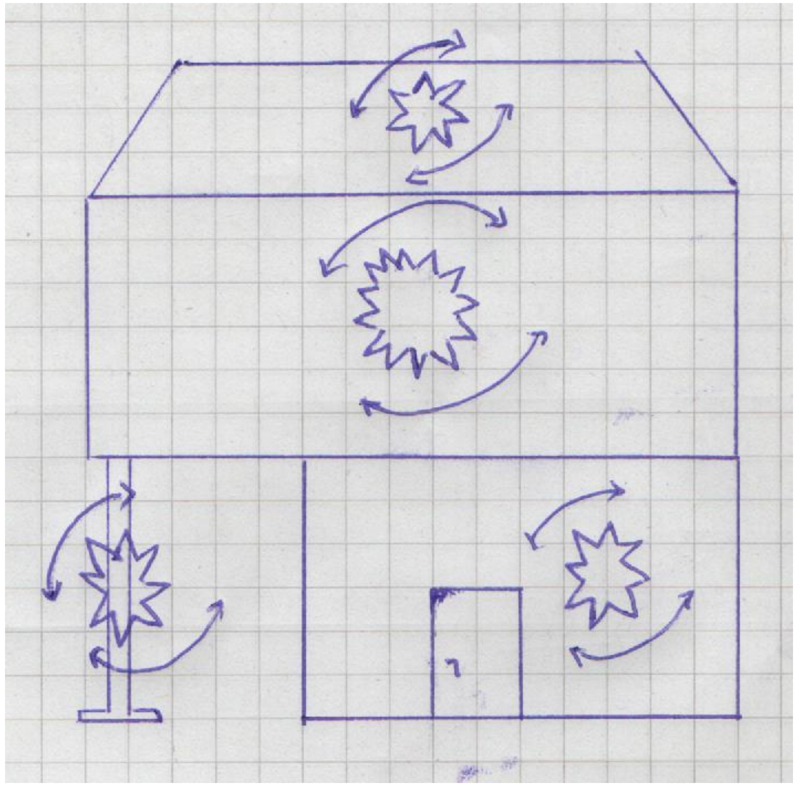
e.g. : Distance to wall axis, parapet height

Conditions/Constraints:

e.g. : "Always horizontal“

Calculations

e.g. wall thickness = sum of the layers



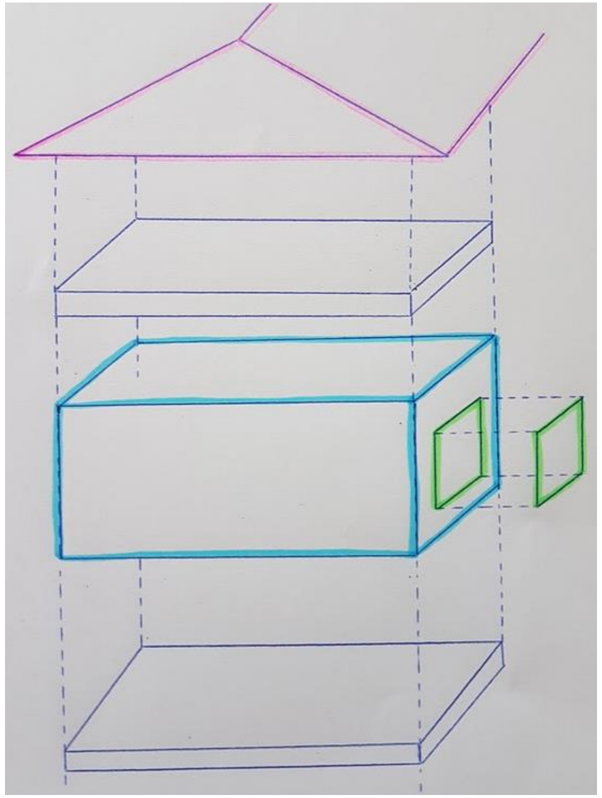
Cmp: Traffic route construction: Linear reference systems / parametric reference to the axis, lane width

#2 Definition of dependencies between model elements

The software can automatically adjust model elements in position and shape (and other properties) **in relation to other elements**.

- Example: wall intersection
- inner/outer wall
- Connecting construction parts to grids/layers

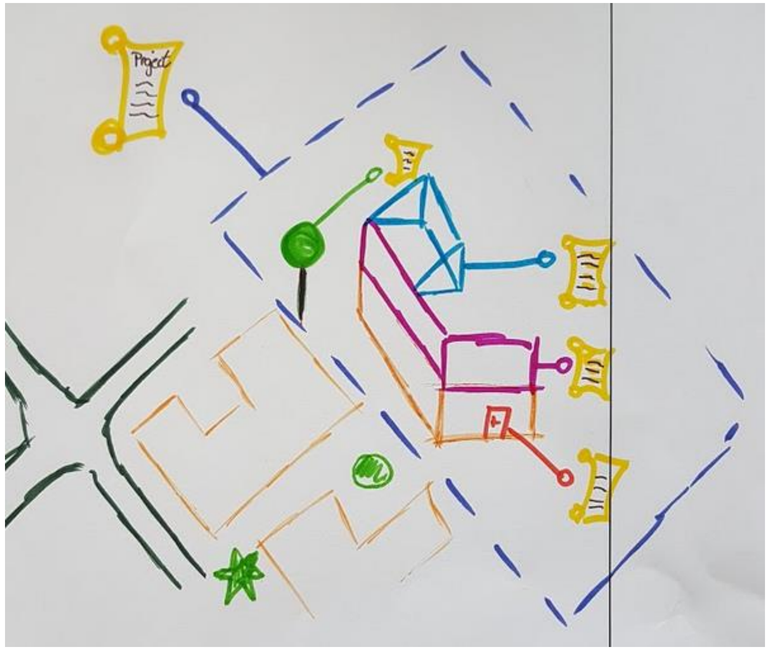
Rule-based modeling: e.g. "Window always in wall”



#3 Logical structural elements in a BIM model

In addition to the geometric outline (3D), the building model contains further "virtual breakdown structures”: **Classification according to spatial aggregation**

- Project
  - Building / building section
    - Storey
      - Zone
        - Room



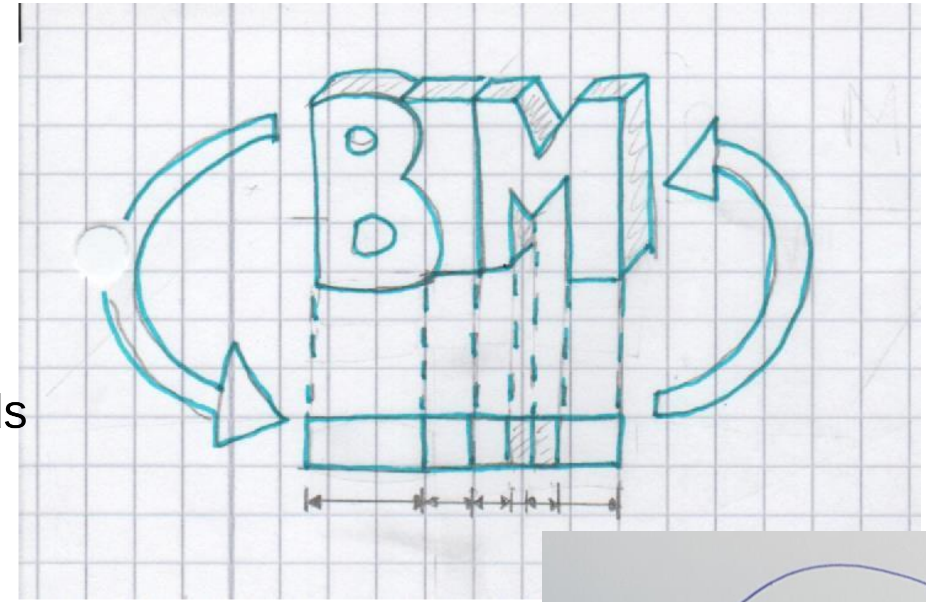
Logical connection with physical model elements (e.g.: space boundary)

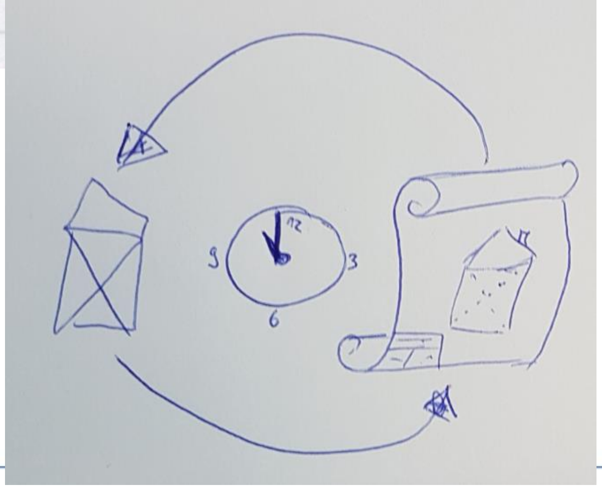
#4 Dynamic plan derivation from the BIM model

Automated updating of 2D floor plans, sections and views

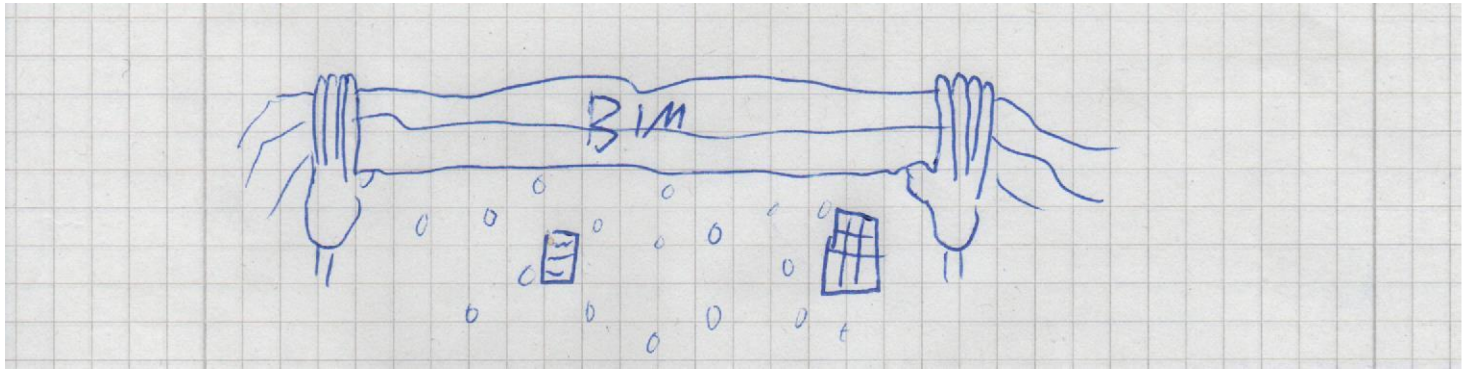
- Standardized representation according to CAD standards
- Uniform format, layout, stamp, labeling

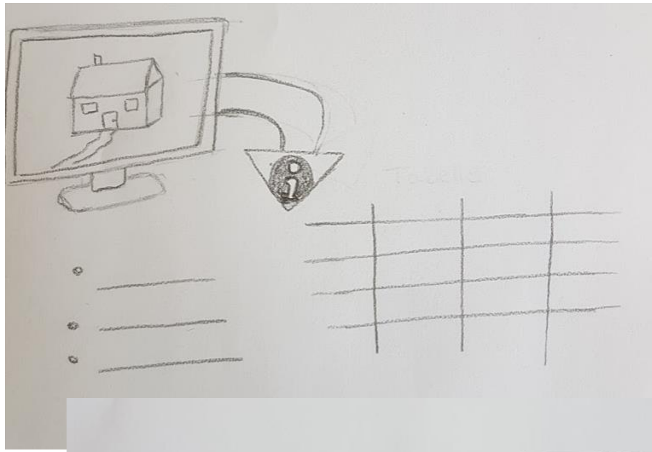
  and dimensioning
- Management of the plan

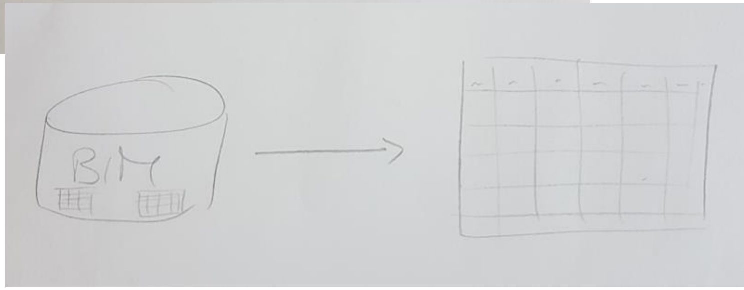




#5 Creation of lists and other evaluations from the BIM model





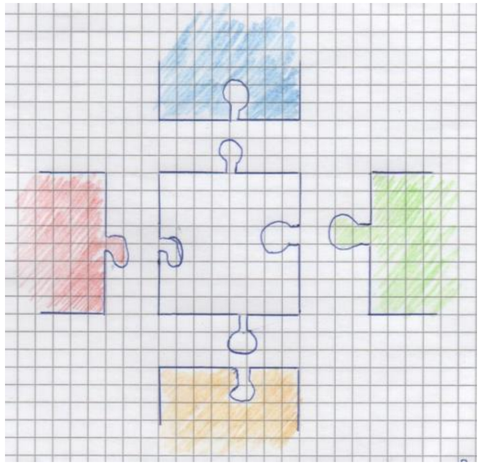


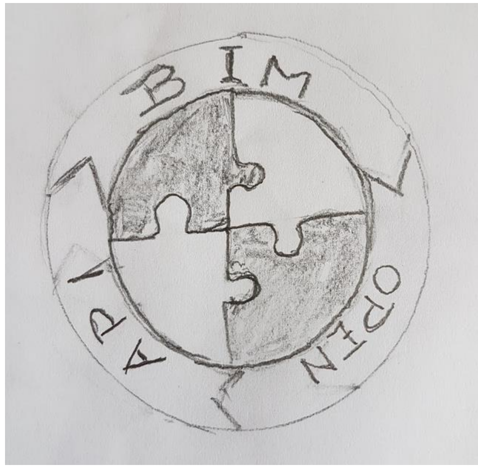
Lists, tables, reports, ...

- Automated updating of attribute data and calculated geometric quantities (length, area, volume)
- Sensible structuring and grouping according to spatial aggregation hierarchy or component classification
- For example: quantity determination, service specifications, maintenance lists, ...

#6 Integration with other BIM-capable software products via open interfaces

- Reuse and consistent use of the model / federated models!
- Vendor-independent data exchange with IFC (bS/ISO16739)
- Careful: This is complex, must be planned and configured!





Are **open** standards essential to BIM

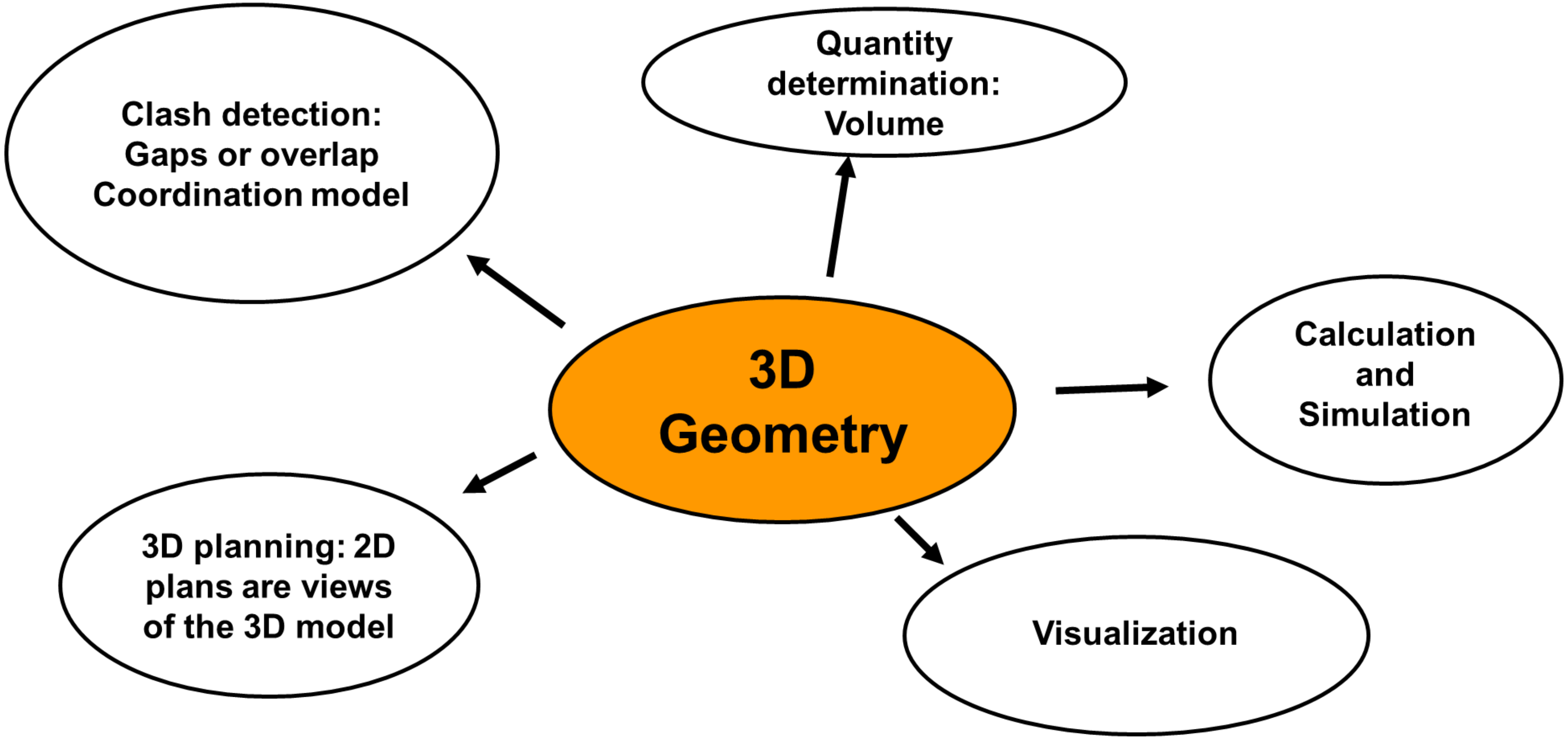
A) Yes

B) No, proprietary formats work much better

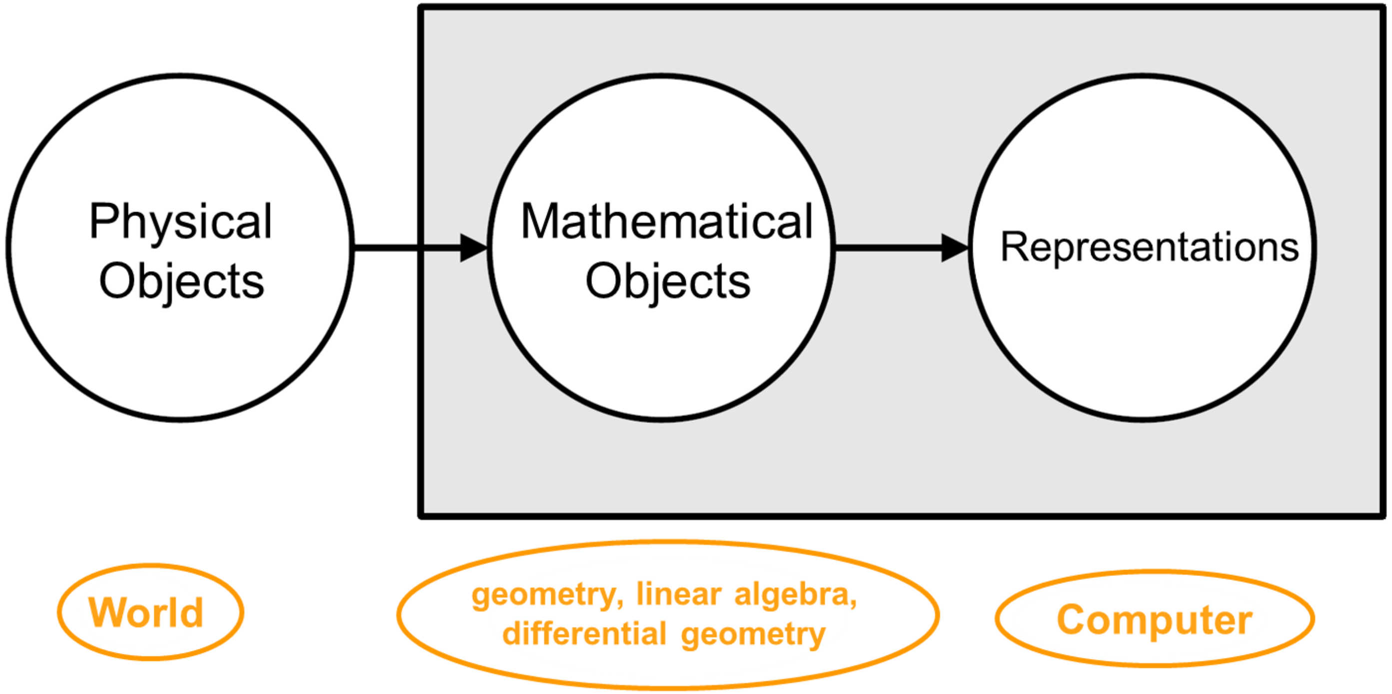
C) Well, it depends

Geometry & Topology in BIM

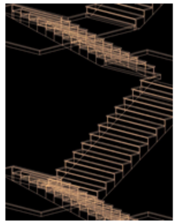
3D – Geometry (Use Cases)



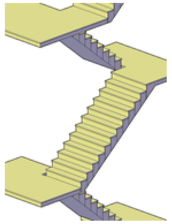
3D-Model


Physical Objects
Mathematical Objects
Representations
World
geometry, linear algebra, differential geometry
Computer

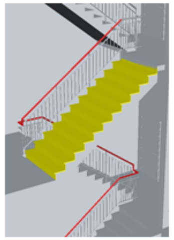
3D == 3D ?????



Wireframe Models



Surface Models



Solid Models

Wireframe Models

- Points and lines
- Outlines of an object
- transparent
- no volumes, no sections
- fast to render

Surface Models

- Quantity of areas in R3
- analytical surfaces (free form surfaces)
- Area curvature (u,v-lines)
- Automotive engineering, product design

Solid Models

- Quantity of volume
- polyhedron, cuboid, cylinder, cone
- Operations between volumes
- architecture, **city model, building model**

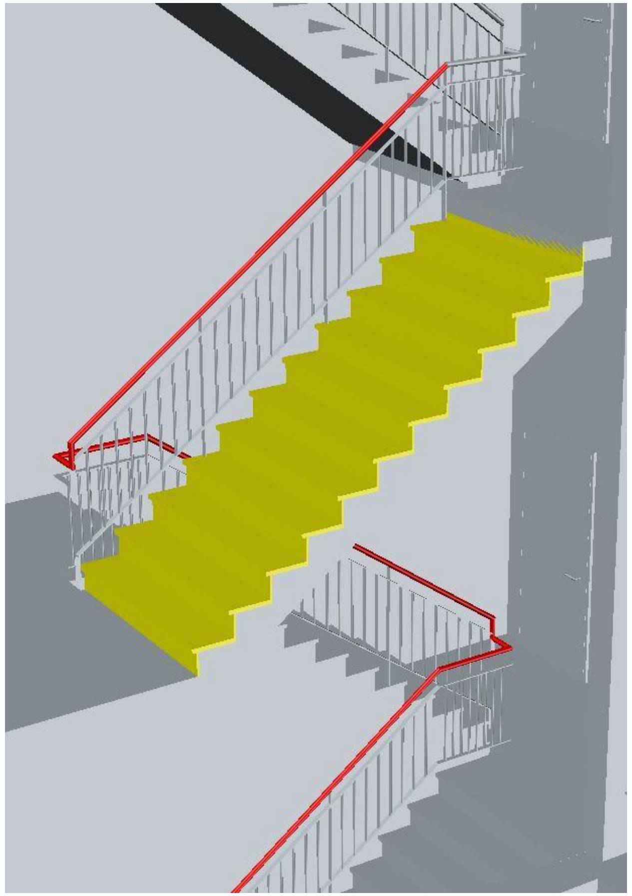
Solid Models

Advantages:

- Calculation of quantities
- Visualization of sections
- Calculation of collisions (clash detection)
- Better performance in CAD/BIM

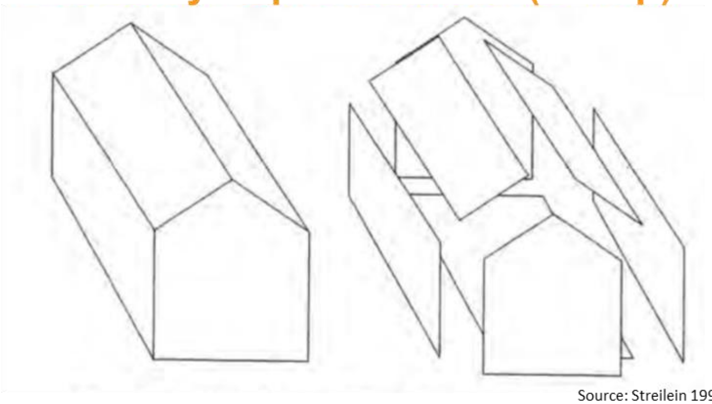
Disadvantages:

- "unfamiliar" for GIS/surveying
- difficult to derive from surveying
- Accuracy, detail, deformation resistance?



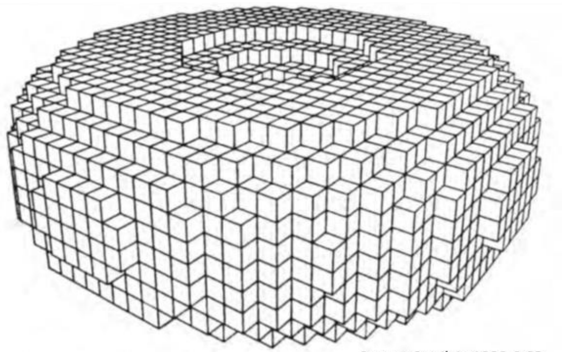
Accumulative Solid Models

Boundary Representation (B-Rep)



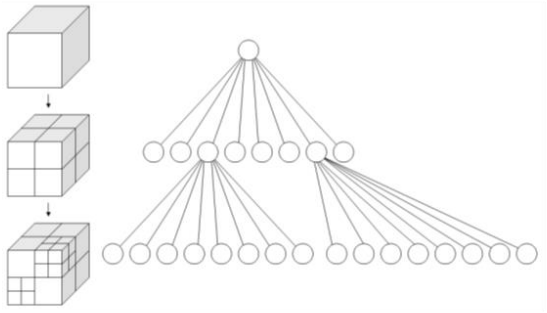
Source: Streilein 1999, S. 70

Voxel



Source: Streilein 1999, S.68

Octree



Source: Wikipedia „Octree“

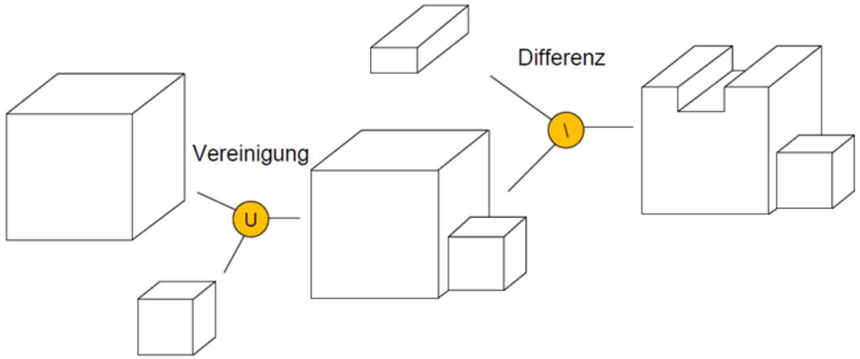
3D models without design specification. The **means of information** (body, surface, edge, point or grid coordinate) can be used directly.

A direct comparison between **measurement result** and **model coordinates** is easily possible for accumulative solid models.

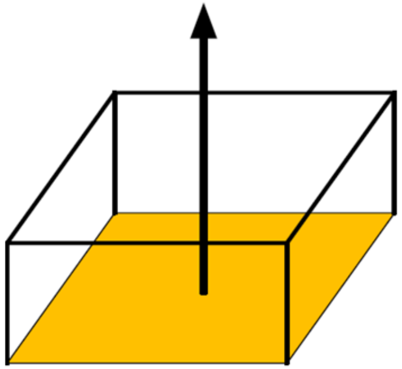
B-Rep models are treated in the field of City Modelling (CityGML).

Generative Solid Models

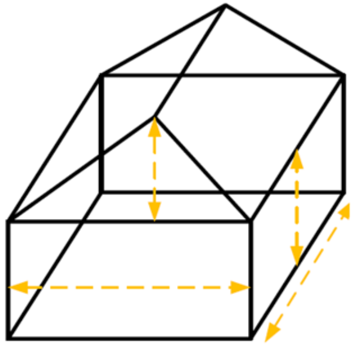
Construktive Solid Geometry (CSG)



Sweep



Parametric modedeling



Means of information are geometric primitives and their combinations, not the result of modeling

The **construction history** is an indispensable component of the model [Cf. Pahl 1990].

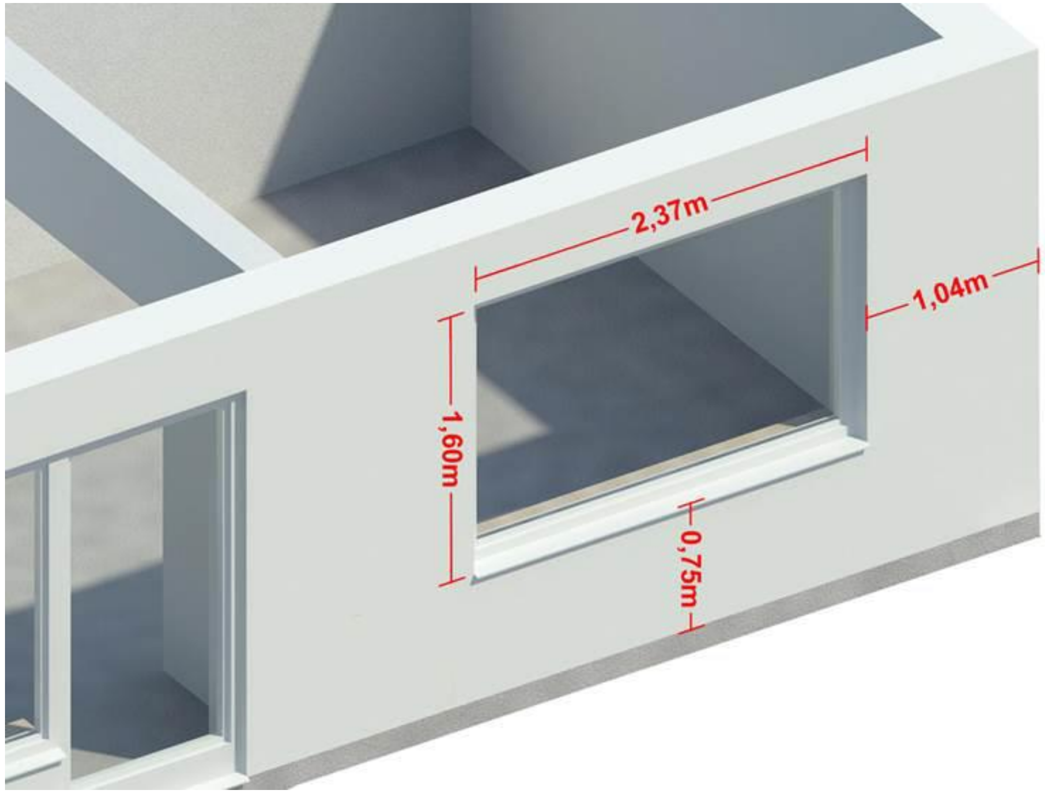
Parametric Modeling:

The most important BIM solid type !!!!

Solid objects with a given, limited set of parameters (length, width, height....)

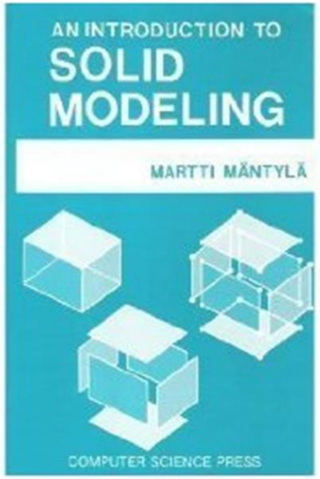
Parameter values refer to the type or the instance

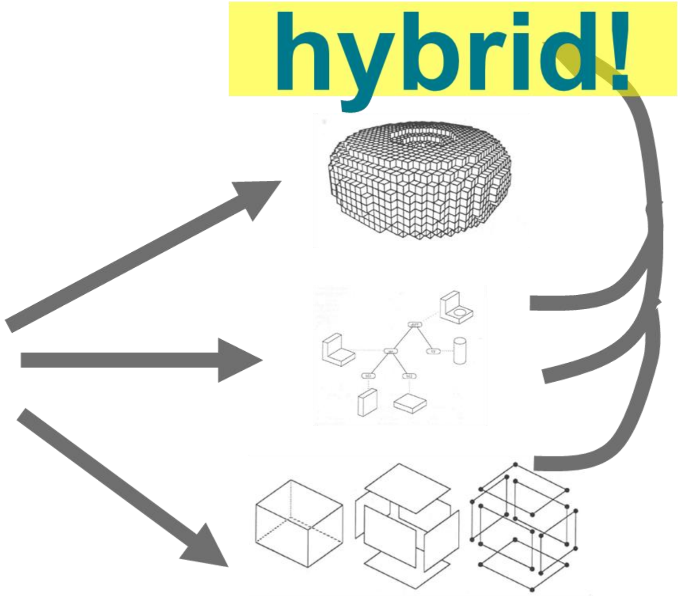
Design and management of parameterized components is a major task in BIM projects.



Parametric Modeling

3D ≠ 3D: Too Many Model Types „Spoil the Broth“





Mäntylä, M: An Introduction to Solid Modeling, Computer Science Press, 1988

A brief look at the Industry Foundation Classes (IFC)

#97 = IFCOPENINGELEMENT('2LcE7', #2, 'xyz','Description of x

#98 = IFCLOCALPLACEMENT(#46, #99); Relativ

#103 = IFCPRODUCTDEFINITION
#109 = IFCRELVOIDSELEM); Sweep
#110 = IFCSHAPER weptSolid', (#111));

#108 = ES('2UEO1', #2, $, $, (#97), #104);

ANTITY('2xwA', #2, 'BaseQuantities', $, $,(#105, #106, #107));
# TYLENGTH('Depth', 'Depth', $, 3.000E-1);
# QUANTITYLENGTH('Height', 'Height', $, 1.400);
#1 = IFCQUANTITYLENGTH('Width', 'Width', $, 7.500E-1); Parameter

Data exchange of 3D geometry in BIM must be configured and tested

Topology

Simple definition: Topology describes the **spatial relationships** that are invariant to geometric transformations such as shifting, rotating and scaling.

Typical topological relations are

- "is contained in",
- "is the boundary of" or
- "touches"

Topological relations are either

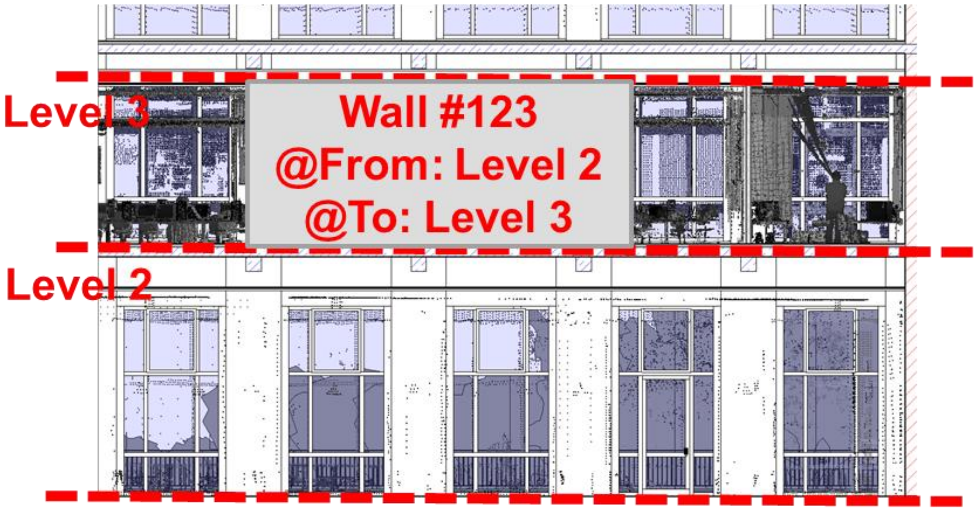
- **implicit** (can be calculated from geometry in BIM if required)

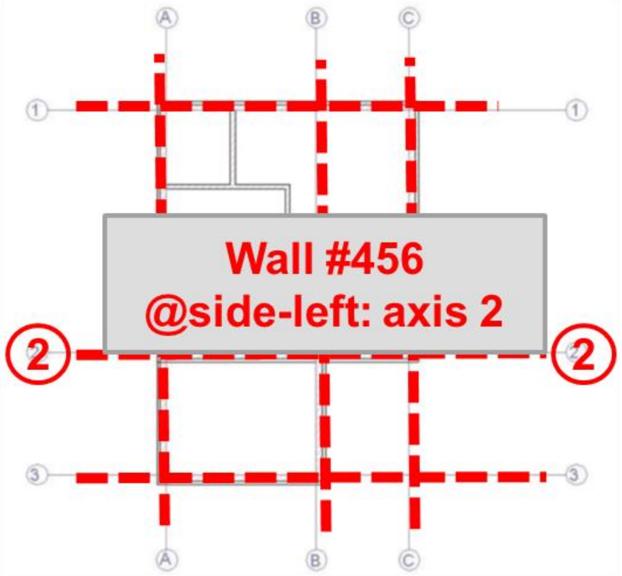
or

- **explicit** (relations are stored in the model)

Topology of the components among themselves

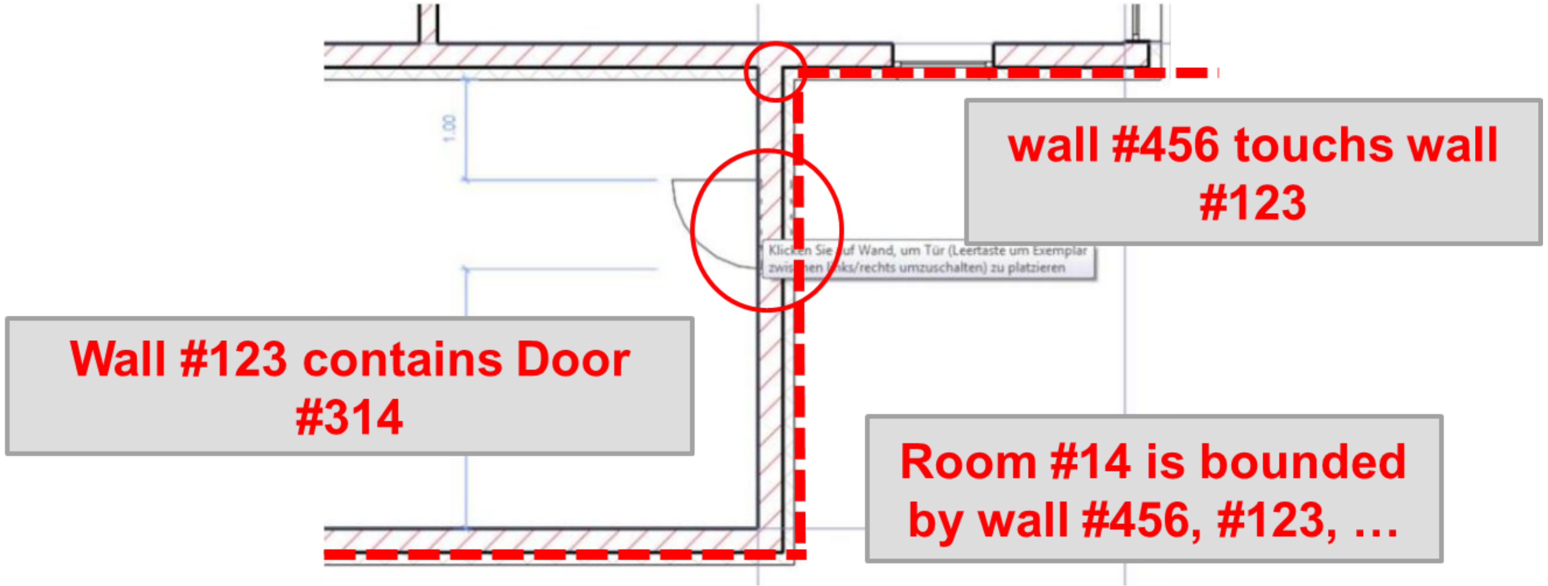
Indirect topology with reference elements
- Vertical reference with horizontal planes
- Components refer to axes



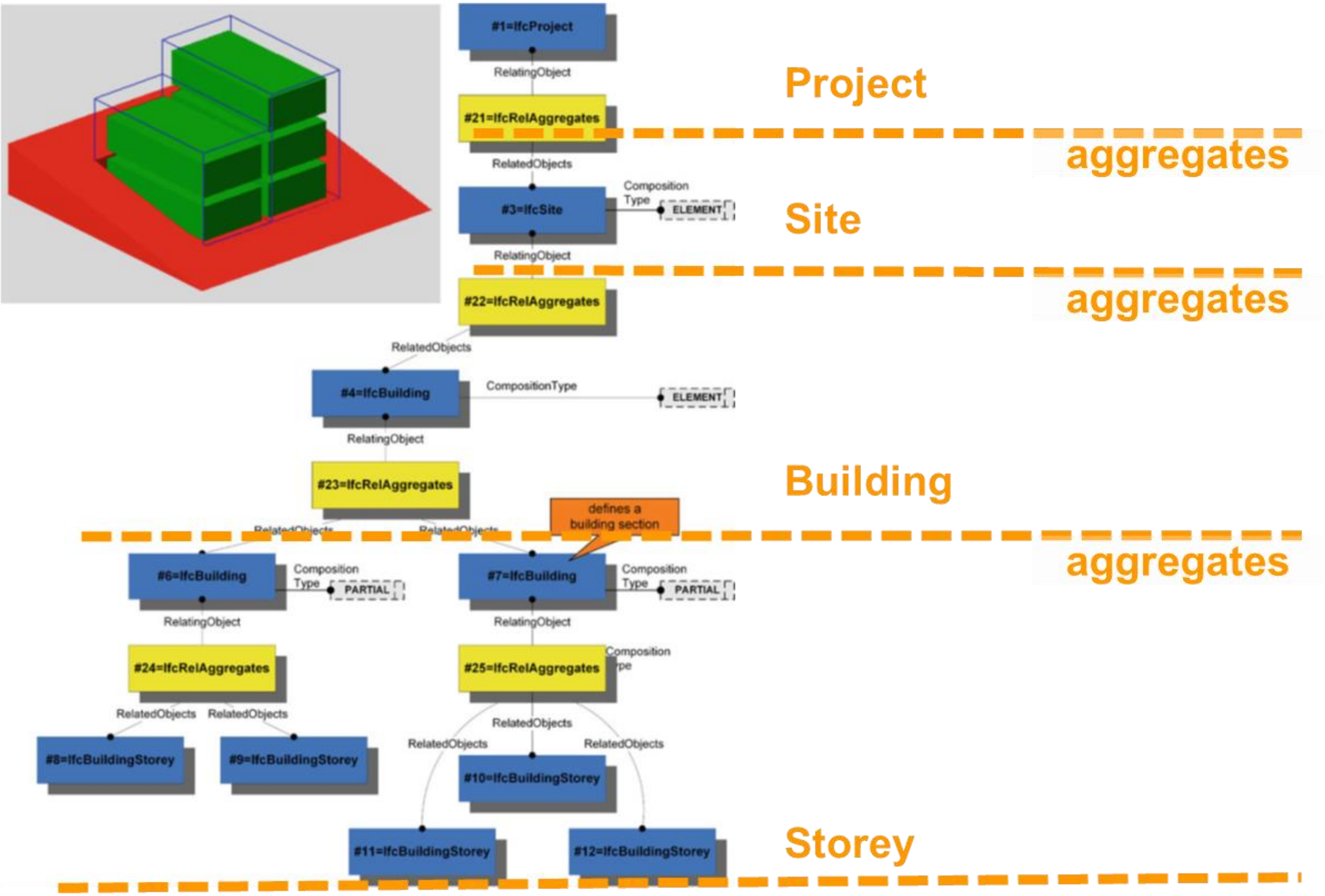


Topology of the components among themselves

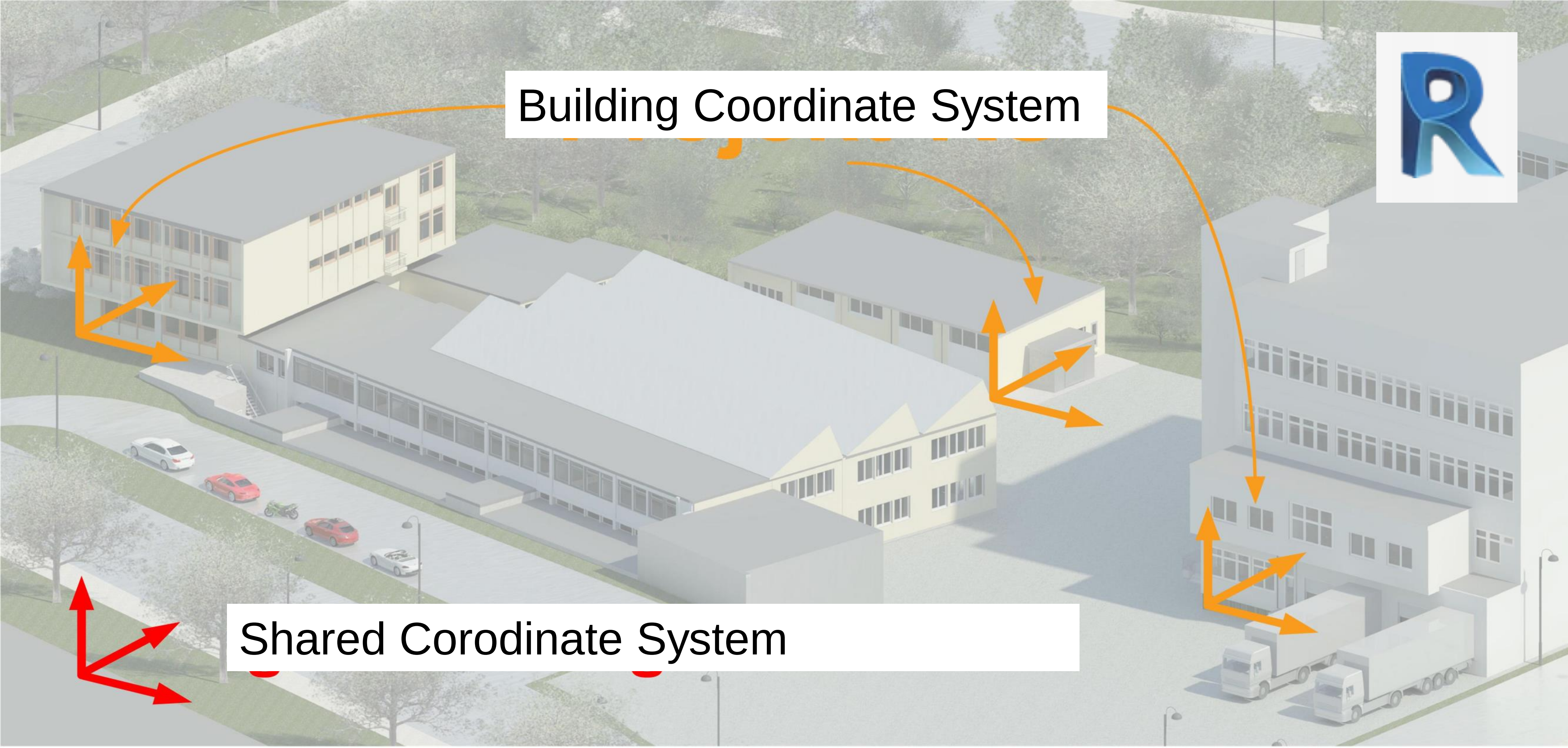
Direct Topology:
- rule-based,
- Rules are defined by element type (semantics)



Topology between (functional) spaces (e.g. IFC)



Georeferencing BIM



Project Base Point

Surveying Point … ?

1. Understanding Needs
2. Understanding IFC Standard
3. Simple Level Concept (LoGeoRef)
4. (our) Software Implementation

- Extraction/Verification of georeferencing
- Editing/Integrity of proper georeferencing

10 20 30 40 50

Link to LoGeoRef paper

buildingSMART Australasia

Model Setup IDM
Geo-referencing in IFC

Read for introduction to geodetic concepts, that are related to BIM, use cases and workflows (IDM) !

Georeferencing: Rotation of Project or Site

Engineering/geodetic CRS (LoGeoRef 50) (☺)

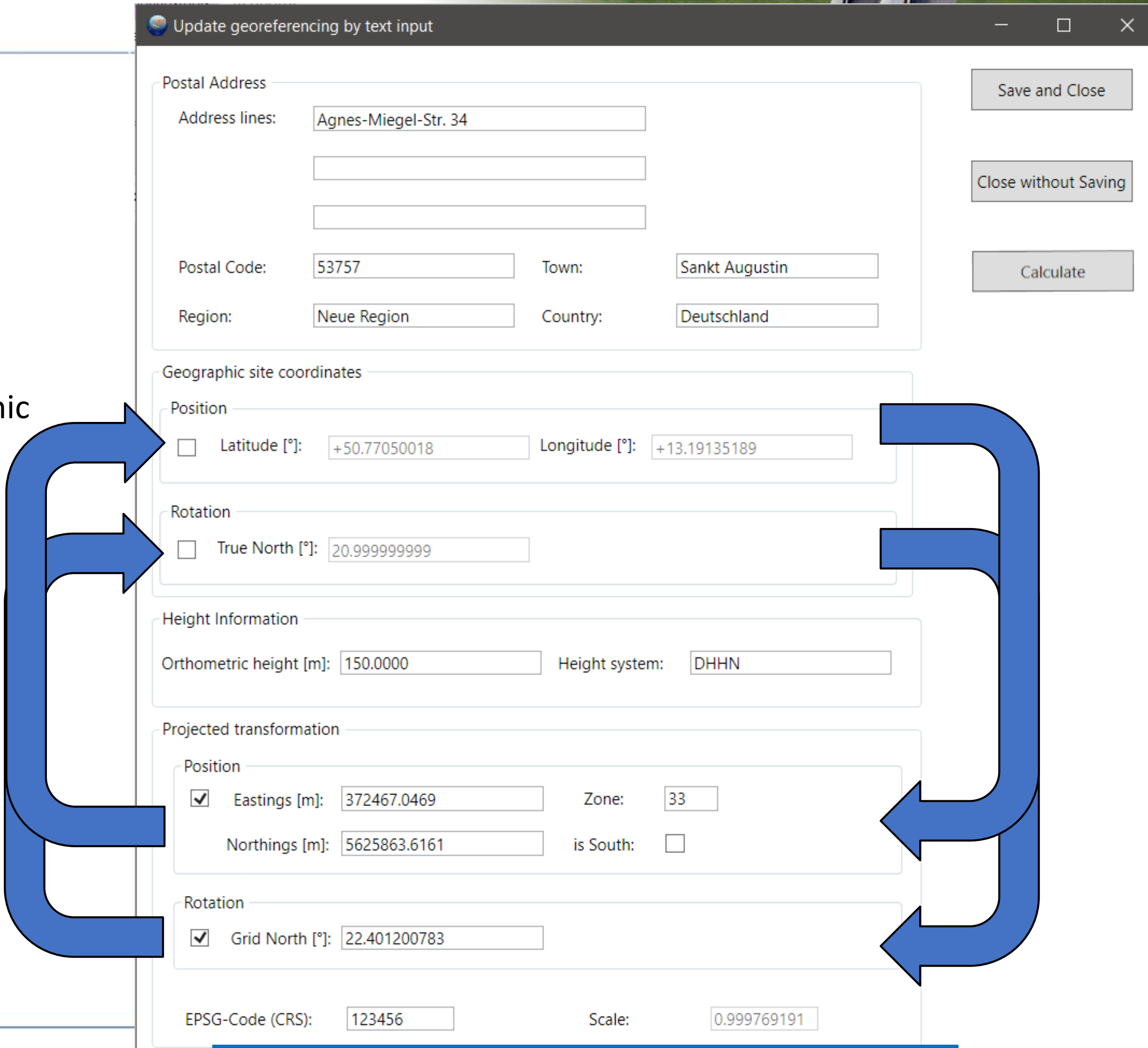
- SourceCRS: IfcGeometricRepresentationContext of Project (probably WCS)
- TargetCRS: IfcProjectedCRS
- Rotation: XAxisAbsicca, YAxisOrdinate for GridNorth !!!!
- Careful: Grid Convergence, GridNorth != Geographic North
- IfcGeometricRepresentationContext.TrueNorth only for information, geographic North
- Only IFC4, but IFC2x3 IfcPropertySet defined by buildingSmart Australasia

GeometricRepresntationContext (LoGeoref 40) (😐)

- No IfcMapConversion
- If no level 50, “true north” in GeometricRepresentationContext means “GridNorth”, if level 50 “true north” for information only

Placement of IfcSite (LoGeoref 30) ☹

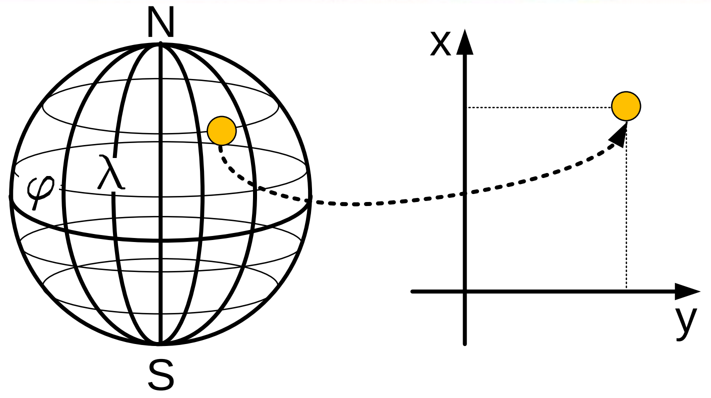
- Rotation from (BIM) to ProjectedCRS (local engineering or national grid) by `IfcSite.ObjectPlacement.IfcDirection`



Calculations with Geographic Lib
https://geographiclib.sourceforge.io/

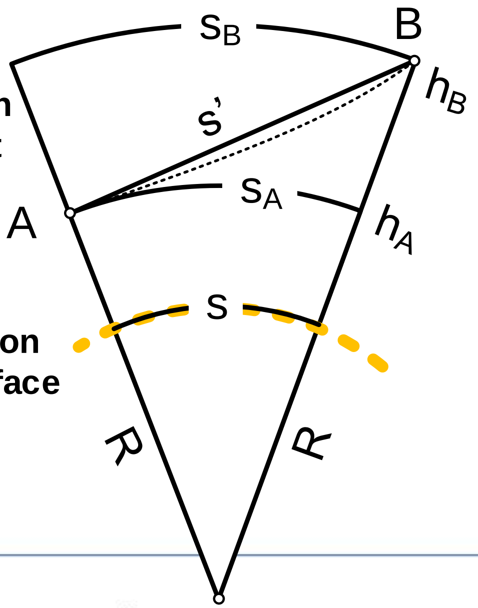
Reasons for different scales in BIM (project coordinate system) and GIS (target crs)

- Unit conversion, e.g. [m] -> [mm] or [ft] -> [m]
- Reduction of natural length (BIM) to projected length in CRS (GIS) due to map projection (differs with distance to central meridian of zone!)
- Reduction of natural length (BIM) to projected length in CRS (GIS) due to height above reference surface (e.g. ellipsoid)



Scale in IFC:

- Not in LoGeoRef 10,20,30,40;
- only LoGeoRef 50: [IfcMapConversion.Scale]
- IFC4, but IFC2x3 PropertySet defined by buildingSmart Australasia
- But: Text in IFC-Standard „apply on 3 axis“ is not suitable, should be changed to „apply only to x,y“ [Jaud,2019][Uggla,2018]



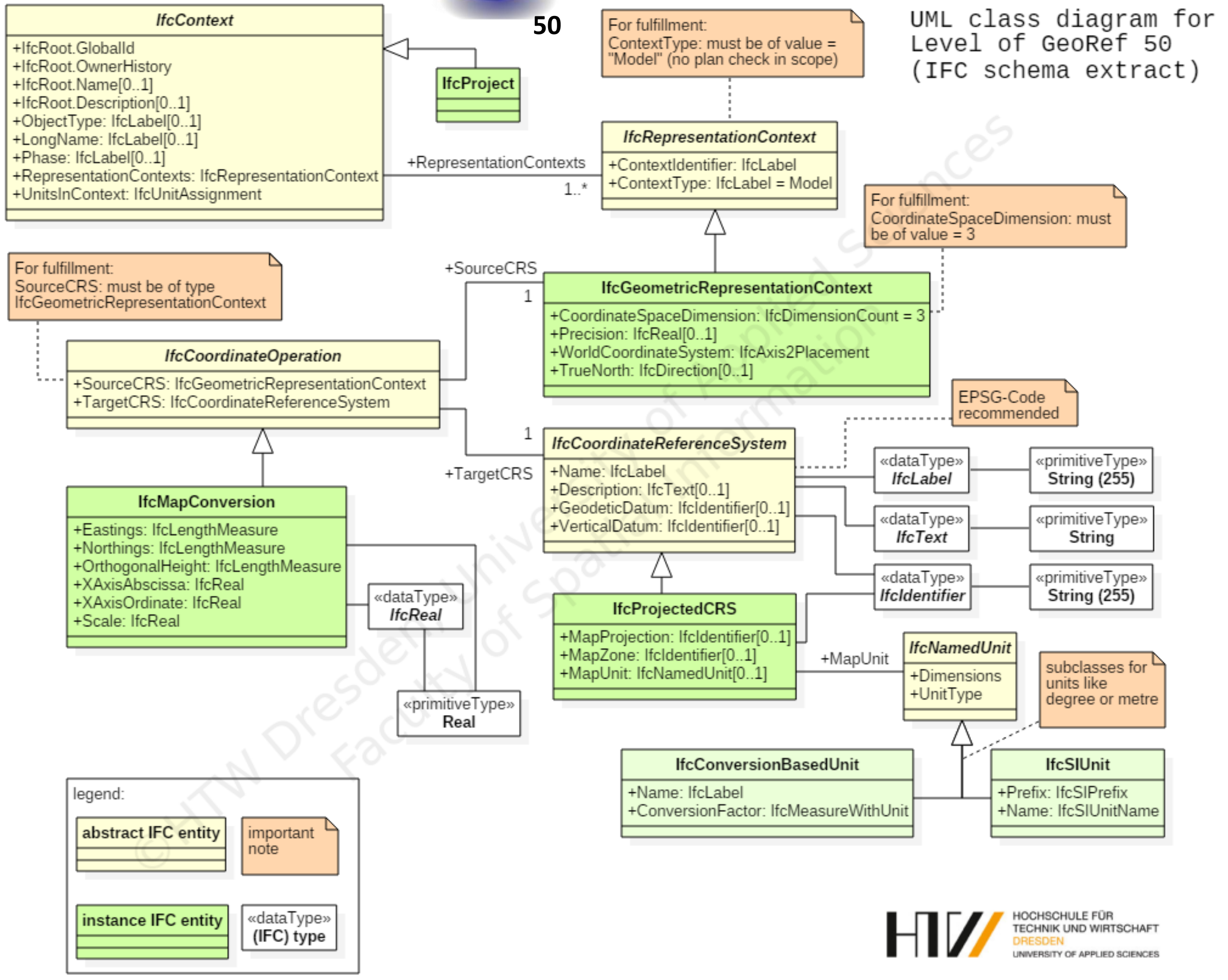
LoGeoRef 50: Conversion and Metadata

IfcMapConversion is a coordinate-operation (transformation) from SourceCRS (close, project) to TargetCRS (remote, GIS/Engineering Surveying)

position: IfcMapConversion.Easting/Northing

since IFC4, but work-around for IFC2x3 as IfcPropertySet is possible (see buildingsmart Australasia)

+rotation +scale +metadata



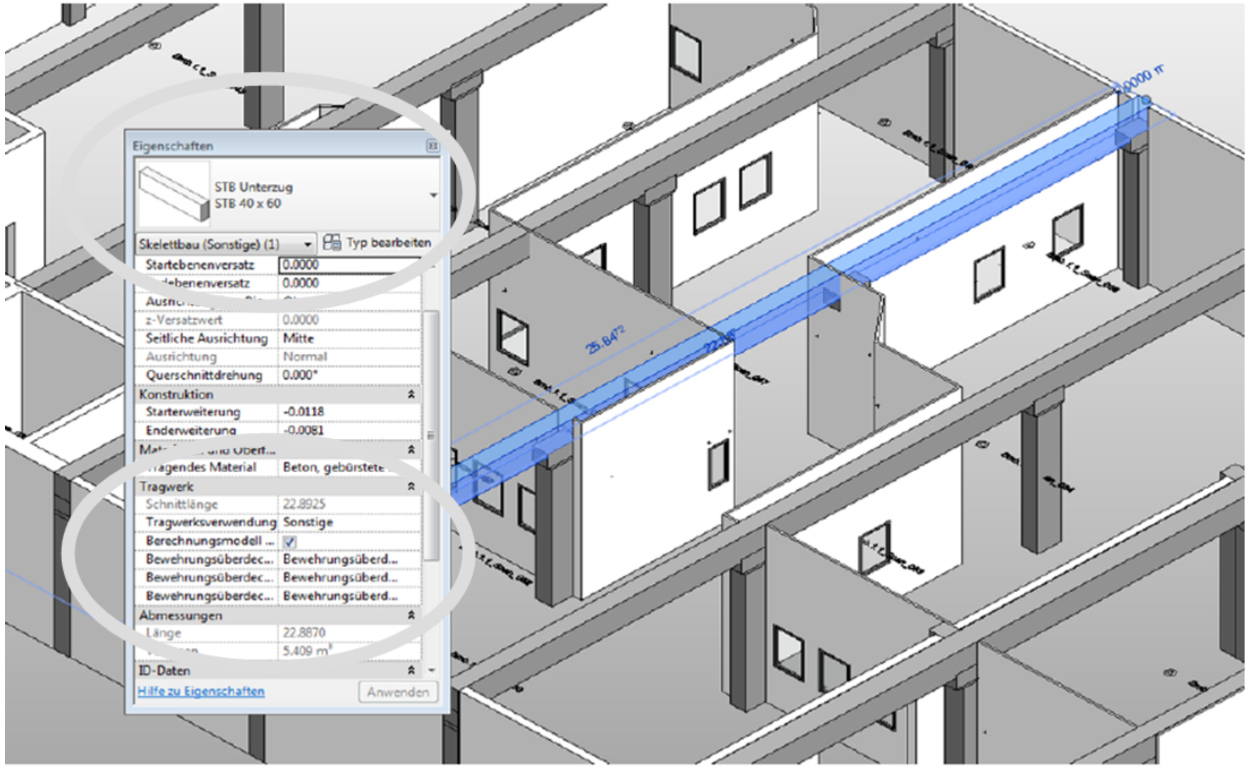
Semantics in BIM

The goal of BIM in general:

- Machine readable exchange of information
- Automation of validation, filtering, modification, ...

Semantics in CAD:

- CAD - graphical: expressed by color, line style, layer etc.
- CAD - alphanumeric: block attributes or XDATA
- Geodetic CAD: point code/line type/object designation/attributes



Example: BIM Author Software Revit

The Building Component makes the Difference!

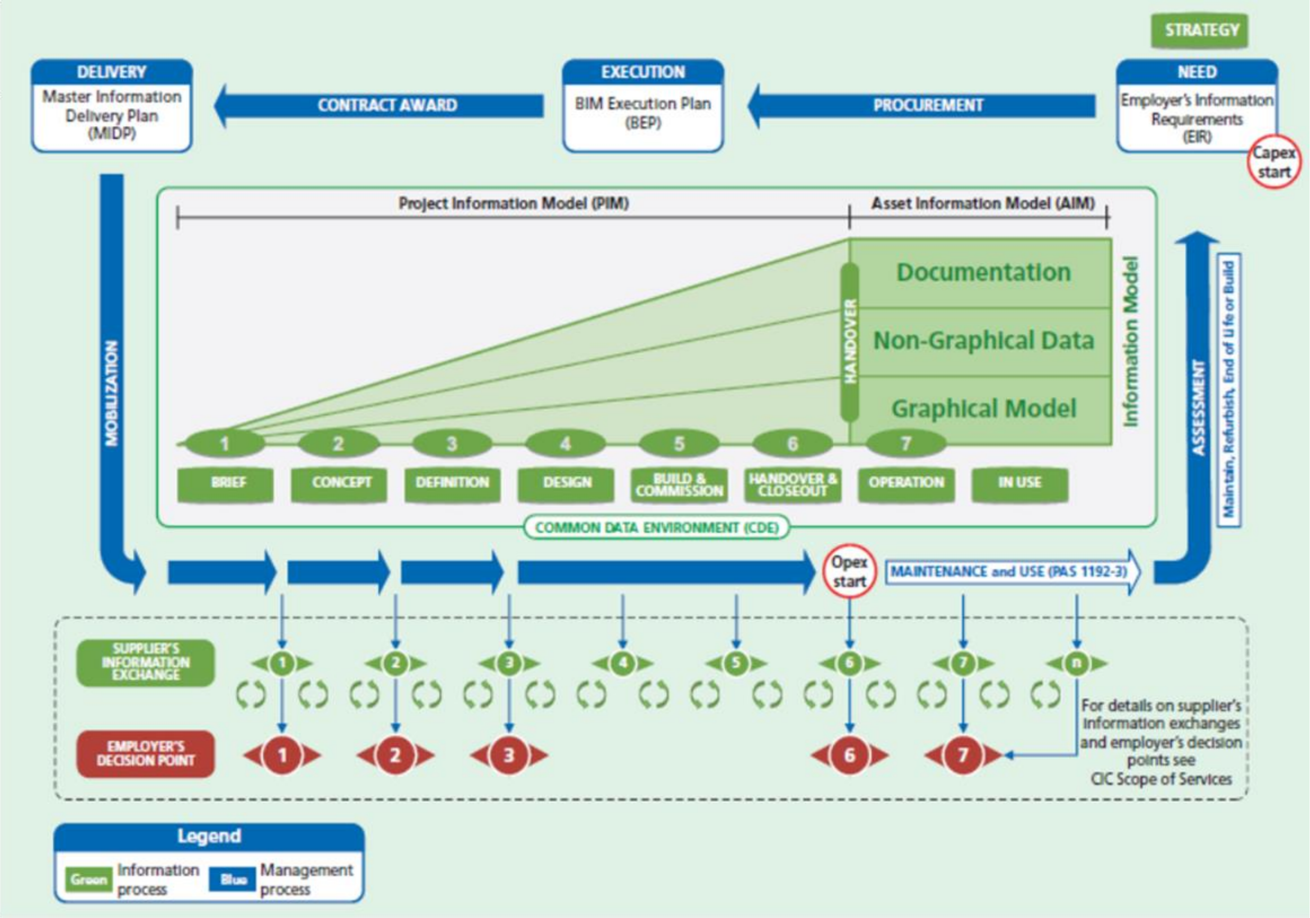
- 3D-Geometry
- Topology
- Semantics

Semantics via

- Component Types (Classes)
- Attributes (Features)
- <u>NO Layer Allocation</u>

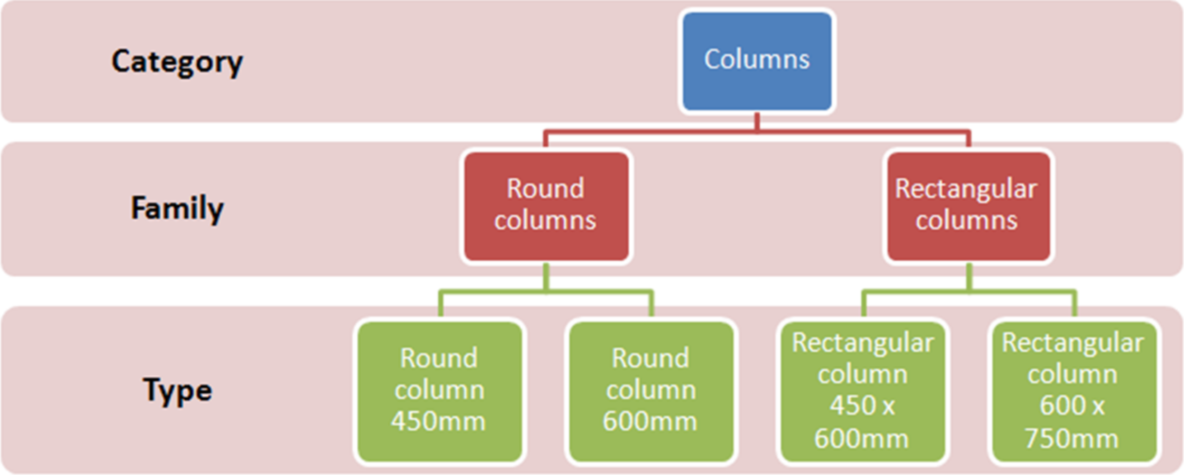
Important:

- Semantics <u>always</u> necessary!
- Different in every software, therefore standardization



"The information delivery cycle" by Mervyn Richards (BSI 2013)

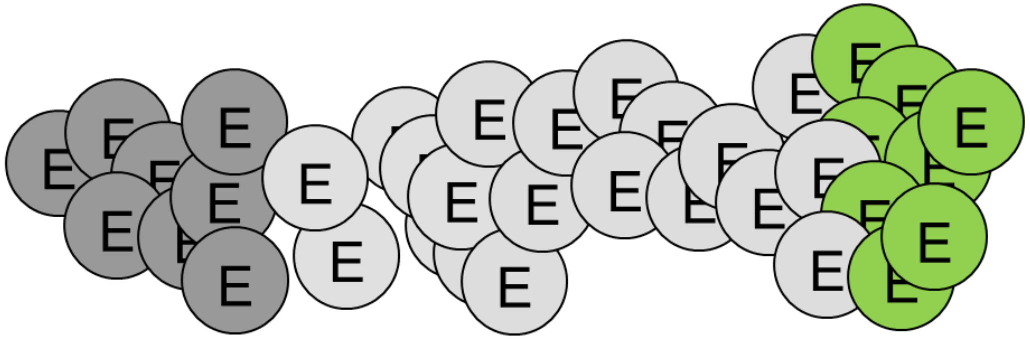
The hierarchy of the component classes can be given by the software (e.g. Autodesk Revit)



e.g. walls, columns

Common quantity of parameters

Common quantity of some values



Many Samples!

...can also be attributed individually.

https://knowledge.autodesk.com/support/revit-products/learn-explore/

Three theses on semantics:

#1 Not geometry, but semantic is the **central system of ordering** for BIM

#2 Differences **(semantic heterogeneity)** between taxonomies are (difficult) to overcome

#3 In BIM practice, semantics could easily be implemented using information technology - but surveyors need better training and an independent (semantic) BIM submodel **"Surveying"**

ISO12006-3 (IFD)

Data Templates for construction objects (concepts and principles)

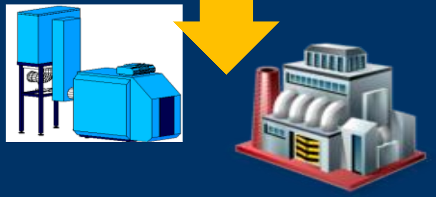
ISO 23387

Expert knowledge

Expert process to describe author and maintain properties

ISO 23386

Building codes



Data templates for construction objects

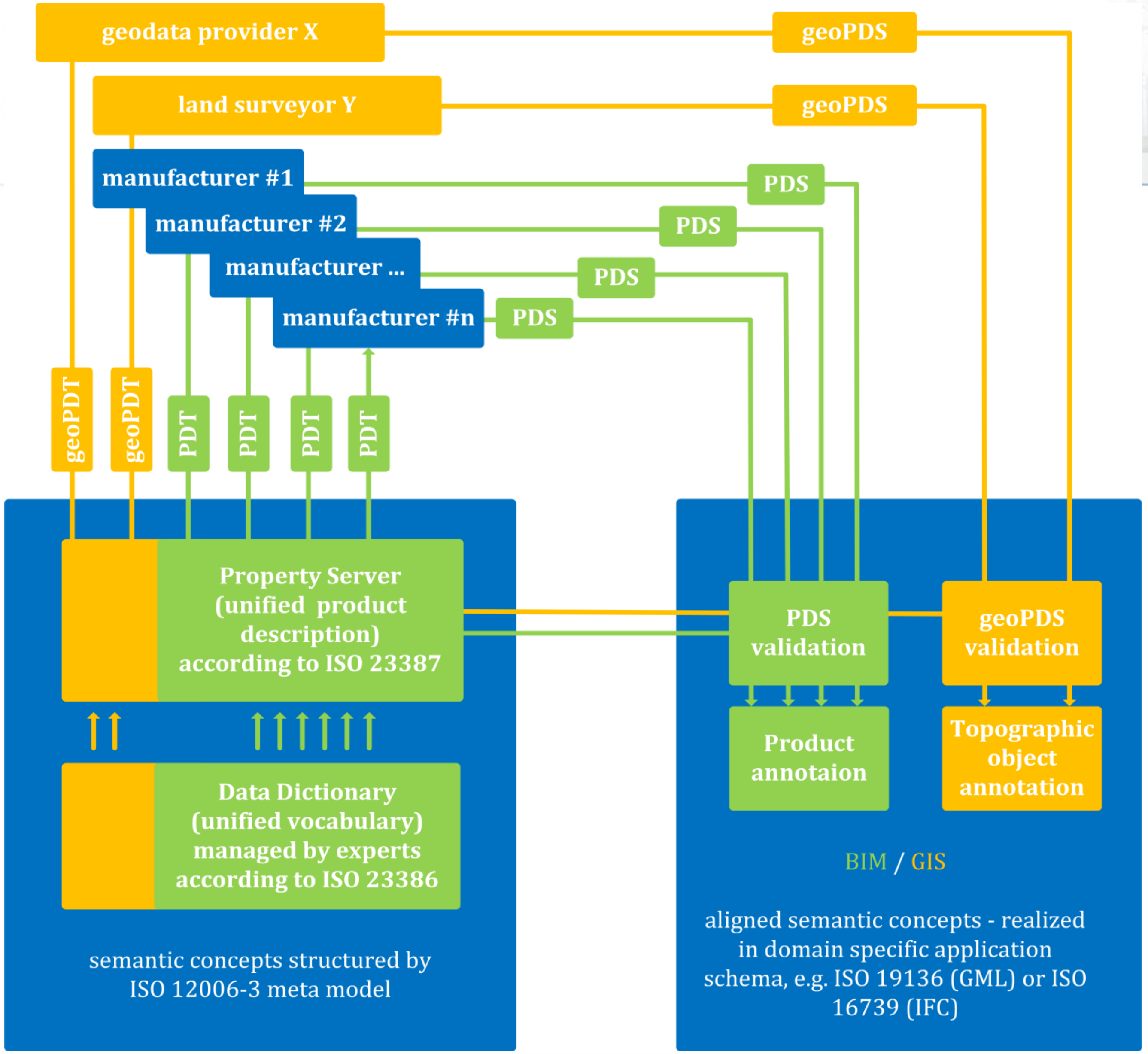
WHO ?

IFC

IFC exchange structure for product data templates

https://buildingsmart.github.io/ProductData/

Espen Schulze: Data templates for construction objects

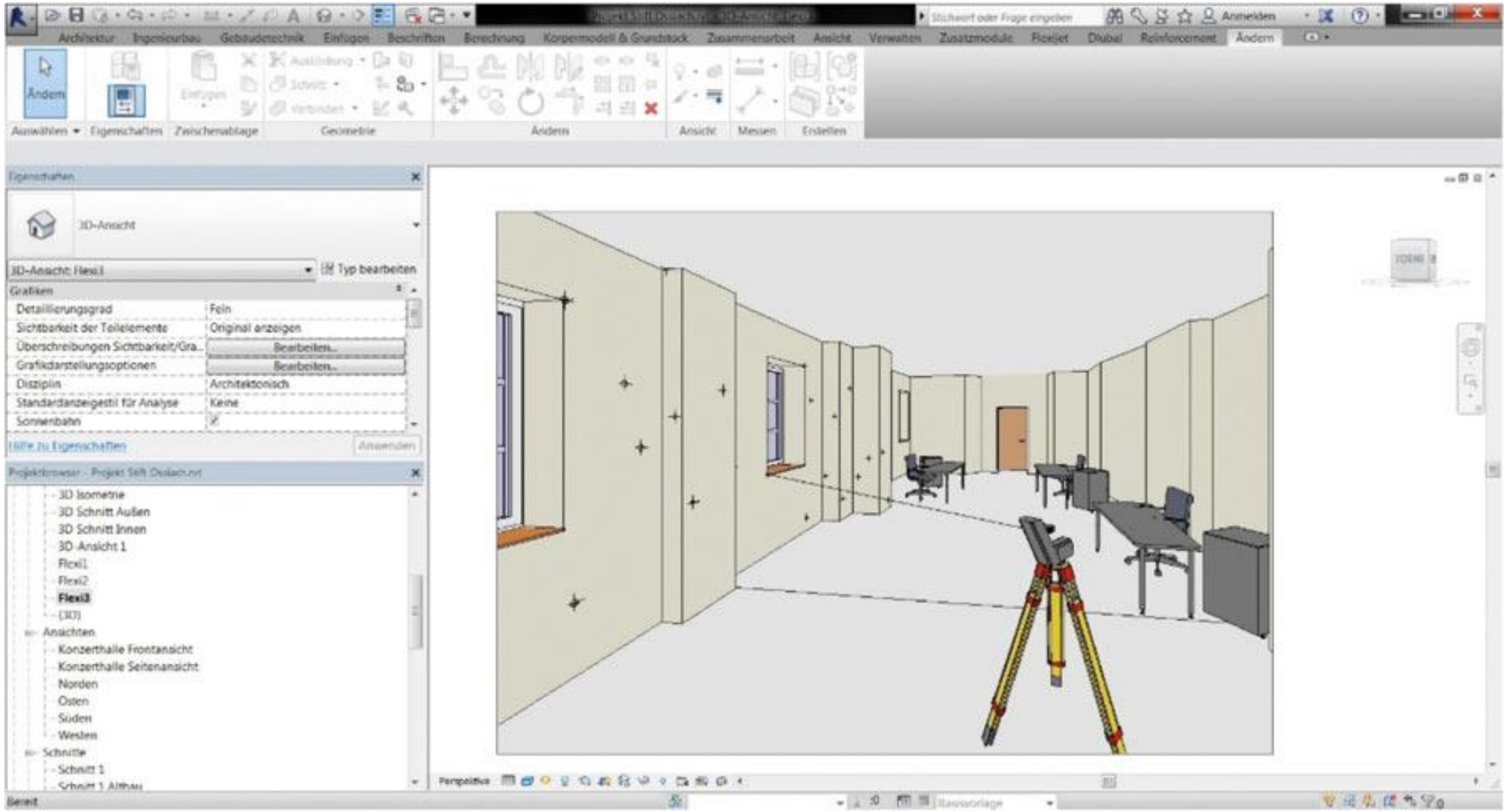

geodata provider X
geoPDS
land surveyor Y
geoPDS
manufacturer #1
PDS
manufacturer #2
PDS
manufacturer ...
PDS
manufacturer #n
PDS
geoPDT
geoPDT
PDT
PDT
PDT
PDT
Property Server (unified product description) according to ISO 23387
Data Dictionary (unified vocabulary) managed by experts according to ISO 23386
semantic concepts structured by ISO 12006-3 meta model
PDS validation
geoPDS validation
Product annotaion
Topographic object annotation
BIM / GIS
aligned semantic concepts - realized in domain specific application schema, e.g. ISO 19136 (GML) or ISO 16739 (IFC)

Have you heard of any **semantic** standardizations efforts on your national, state or regional level?

A) **Yes**
B) **No**
C) **I don’t understand the question**

BIM in Engineering Surveying

1. **Surveying during planning (as-built documentation)**
2. Surveying during construction (staking out, construction progress control)
3. BIM and Infrastructure


Architektur
Ingenieurbau
Gebäudetechnik
Einfügen
Beschriften
Berechnung
Körpermodell & Grundstück
Zusammenarbeit
Ansicht
Verwalten
Zusatzmodule
Ändern
Auswählen
Eigenschaften
Zwischenablage
Geometrie
Ändern
Ansicht
Messen
Erstellen
Eigenschaften
3D-Ansicht
3D-Ansicht: Flexi3
Typ bearbeiten
Grafiken
Detaillierungsgrad
Fein
Sichtbarkeit der Teilelemente
Original anzeigen
Überschreibungen Sichtbarkeit/Gra...
Bearbeiten...
Grafikdarstellungsoptionen
Bearbeiten...
Disziplin
Architektonisch
Standardanzeigestil für Analyse
Keine
Sonnenbahn
Hilfe zu Eigenschaften
Anwenden
3D Isometrie
3D Schnitt Außen
3D Schnitt Innen
3D-Ansicht 1
Flexi1
Flexi2
Flexi3
{3D}
Ansichten
Konzerthalle Frontansicht
Konzerthalle Seitenansicht
Norden
Osten
Süden
Westen
Schnitte
Schnitt 1
Perspektive
Bereit

Semiautomatic methods for the evaluation of point clouds

Snapping. Recognition of geometric elements in Point Cloud

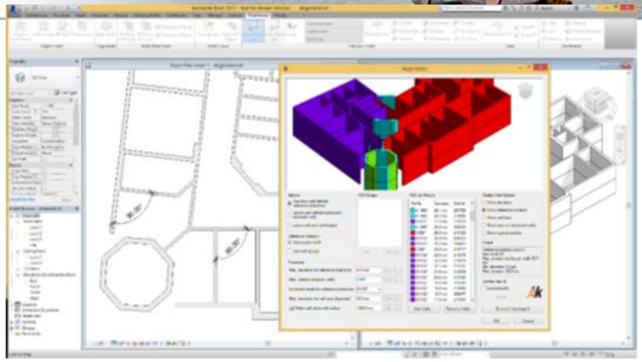
Fitting. Automatic assignment of component from catalog to Point Cloud

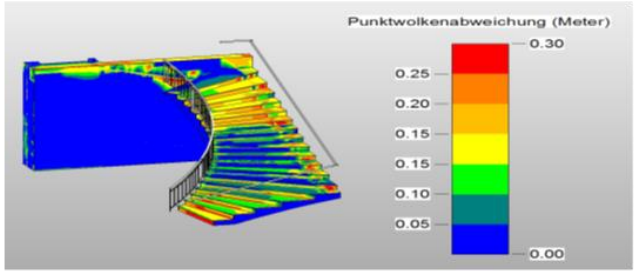
Manage. Creating new part types

Generalize. Geometric generalization of Angle conditions

Compare. Target/actual comparison with point cloud

All inclusive. Fully automatic building model?

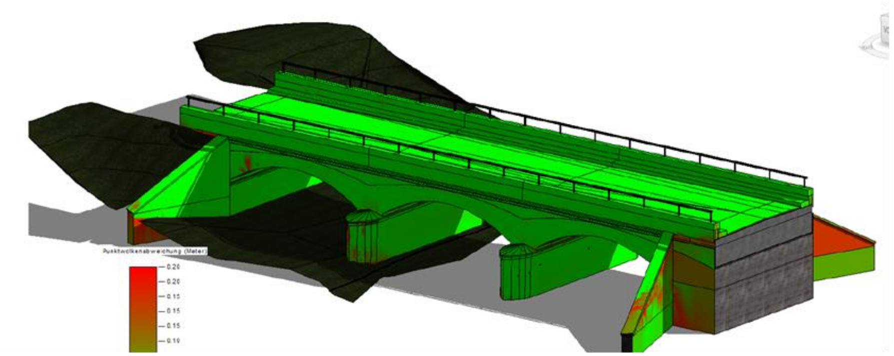




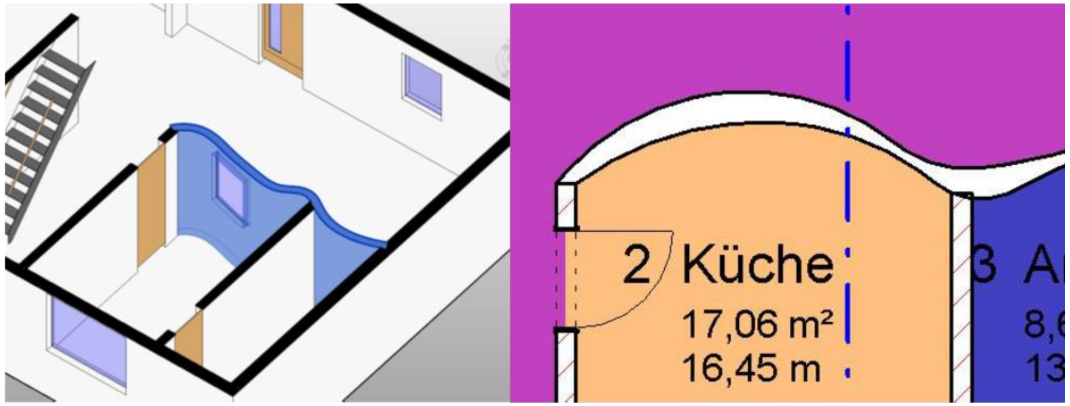
Components: So I can't make a deformation-true measurement for BIM?

More BIM

1. Insert/link CAD elements
2. Create BIM Proxy Elements
3. Simple classified volume body
4. Create one complex part type for each part



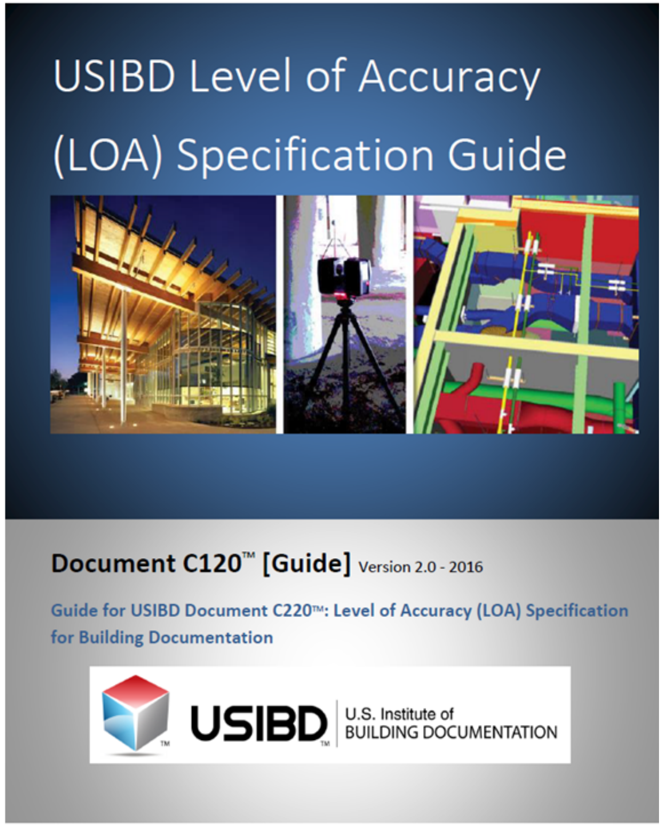
Deformation-true measurement with components
Haupt u.a. „BIM-konforme Modellierung des Brückenbauwerkes an der B85 in Kelbra", Leitfaden Geodäsie und BIM, 2017



Deformation-true bodies **can participate in BIM logic**! (Window in wall, area calculation, ...)

- DIN18710 is the guideline for accuracy classes
- Separate indication of measuring and model accuracy
- Definition of standard cases (Normal, Monumental, Metric, Imperial)
- Difference between relative and absolute accuracy
- The LOA distinguishes between part types!
- Data for control (Validation)

LOA10 User defined - 5 cm
LOA20 5 cm - 15 mm
LOA30 15 mm - 5 mm
LOA40 5 mm - 1 mm
LOA50 1 mm - 0



SMART SURVEYORS FOR LAND AND WATER MANAGEMENT
CHALLENGES IN A NEW REALITY

7 Appendix B – Detailed Modelling Methods and Considerations

This Appendix provides a more detailed description of the modelling techniques used for the primary surveyed building components specified in the LOD or otherwise agreed with the Client. It also contains a description of more detailed aspects of BIM modelling that need to be considered as part of the BIM Survey Specification. Examples are also given for typical parameters which would be included at each LOI.

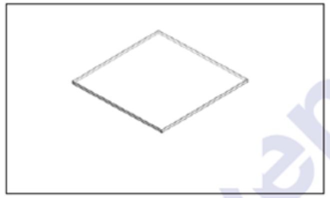
This section should be used for reference by the Client's BIM Manager or Technical Team in order to agree and understand the precise method used to model the building. It is imperative to agree modelling methods prior to a survey being taken as re-work of the model can incur significant costs and delays.

7.1 Floors/Slab

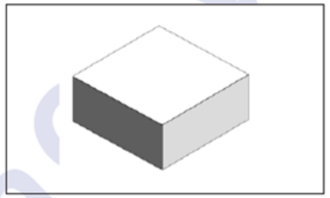
All floors and slabs will be modelled using the Revit® System Family: Floors. In some instances, or where appropriate, floors may have to be modelled In-Place. The floor will be referenced to the appropriate Level and given an overall thickness from Finished Floor Level (FFL) to Underside of Slab - or to that which was measured or visible at the time of survey. In many instances floor thicknesses cannot be ascertained from a survey due to finishes, etc., therefore a floor will be given a nominal thickness and named as 'undefined'.

Typical Levels of Information

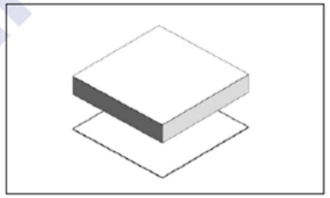
LOI 100	Conceptual Mass
LOI 200	Floor: SURVEY 180mm
LOI 300	Floor: SURVEY STRUCTURAL 180mm
LOI 400	Floor: SURVEY STRUCTURAL 180mm [Carpet]
LOI 500	Floor: SURVEY STRUCTURAL 180mm [75mm Sand/Cement Screed]



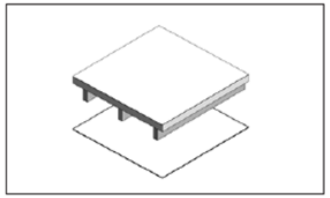
LOD 1



LOD 2



LOD 3



LOD 4

DOORS AND WINDOWS		LOI 100	LOI 200	LOI 300	LOI 400	LOI 500
Not Required	☐					
LOD 1	N/A					
LOD 2	Structural openings shown only		☐			
LOD 3	Modelled using generic families with basic detail			☐	☐	☐
LOD 4	Modelled using generic families showing detail such as sills, frames and architraves			☐	☐	☐

LEVEL OF DETAIL / LEVEL OF INFORMATION

Comments:

SITE TOPOGRAPHY		LOI 100	LOI 200	LOI 300	LOI 400	LOI 500
Not Required	☐ Linked AutoCAD ☐					
LOD 1	Topography shown as simplified contour Revit® surface	☐				
LOD 2	As LOD 1, with roads shown as sub-regions	☐				
LOD 3	As LOD 2, with all hard surfaces identified, including car parks and pavements	☐				
LOD 4	As LOD 3, with street furniture, lighting and surface evidence of underground services modelled in basic form		☐			

LEVEL OF DETAIL / LEVEL OF INFORMATION

Comments:

UNDERGROUND SERVICES		LOI 100	LOI 200	LOI 300	LOI 400	LOI 500
Not Required	☐					
LOD 1	N/A					
LOD 2	3D CAD underground services and topographic survey as linked AutoCAD DWG		☐	☐		
LOD 3	Underground services modelled as intelligent Revit® objects		☐	☐		
LOD 4	N/A					

LEVEL OF DETAIL / LEVEL OF INFORMATION

Comments:

Example from UK: BIM Survey Specification and Reference Guide

– Extensive **modeling manual**

– Standardized **checklists** for the drafting of contracts

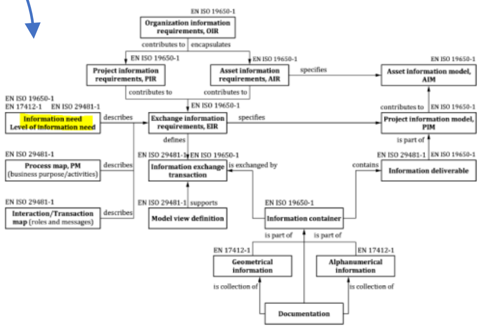
Building Information Modelling - Level of Information Need - Part 1: Concepts and principles

LOIN

Why?
When?
Who?
What?

LOG How? Geometrical Information	LOI How? Alphanumerical Information	DOC How ? Documentation
Detail (simplified to detailed)	Identification (Name, ID)	Identification of set of documents
Dimension (0D,1D,2D,3D)	Information content (property 1, property 2, …)	Identifaction of documents
Location (absolut, relativ)		Format
Appearance (symbolic, to realistisch)		
Parametric Behaviour		

EUROPEAN COMMITTEE FOR STANDARDIZATION
COMITÉ EUROPÉEN DE NORMALISATION
EUROPÄISCHES KOMITEE FÜR NORMUNG

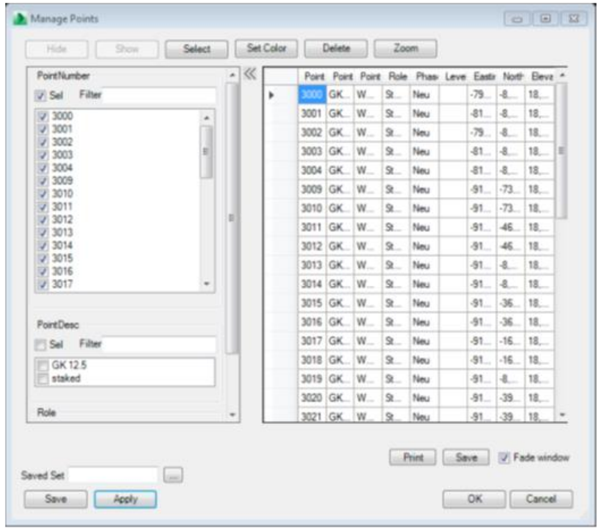


„LOIN“ … akronym should not be used? …Why?

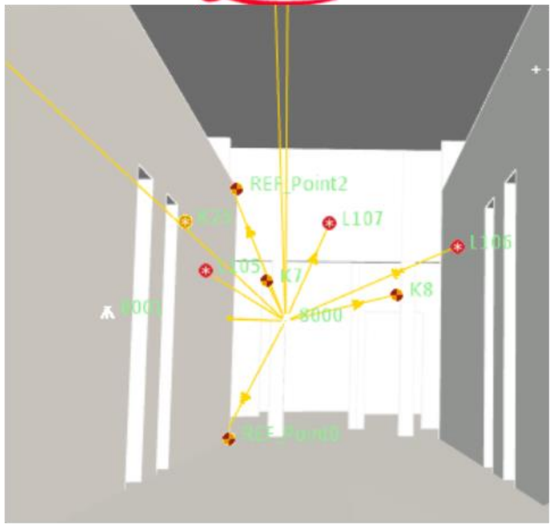
1. Surveying during planning (as-built documentation)
2. **Surveying during construction (staking out, construction progress control)**
3. Infrastructure

Question: I get a "BIM file". Am I able to stake out the building?

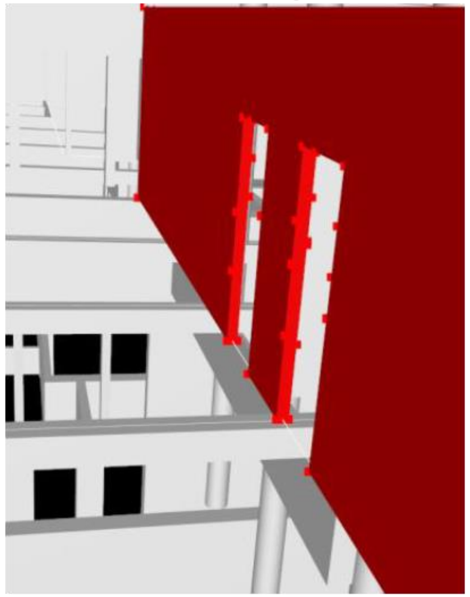
AUTODESK



Leica



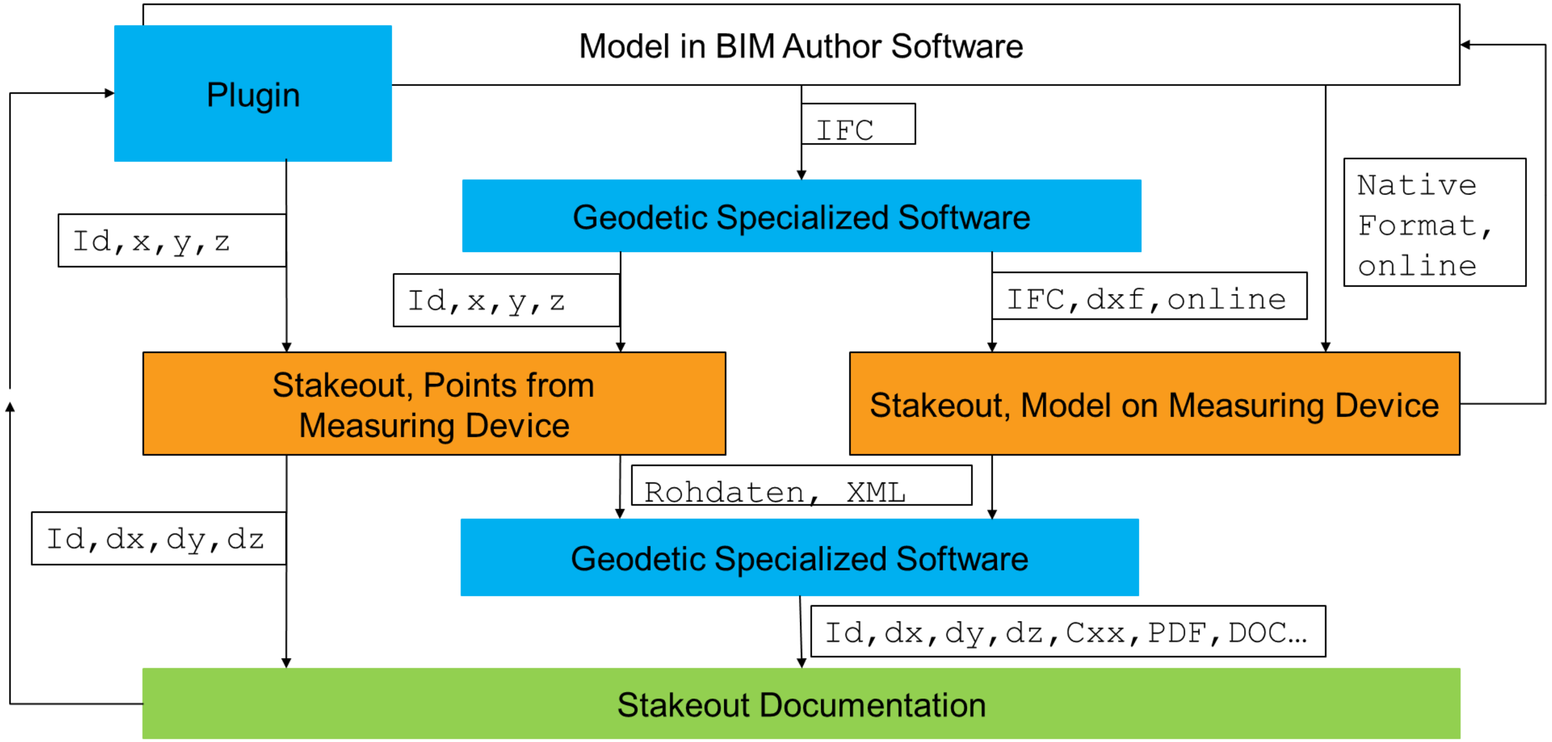
Neo geospatial software



Schinke, Marcel (2017): Building Information Modeling (BIM) for Surveyors – Execution and documentation of a stakeout with open standards (IFC), Bachelor thesis at HTW Dresden

1) **Load** model (proprietary, **open standards**)
2) **Create** points (intersection points, model elements)
3) **Naming and managing** points
4) **Transfer** points to total station (CSV, point database/XML, online)
5) **Document** stakeout

Stakeout Data Flow



Do you think model-based stake-out is the future?

A) No, I love points only
B) No, BIM is to complex
C) Not the future, I do this every day!
D) Yes, that is what I expect
E) I don’t understand the question

1. Surveying during planning (as-built documentation)
2. Surveying during construction (staking out, construction progress control)
3. **Infrastructure**

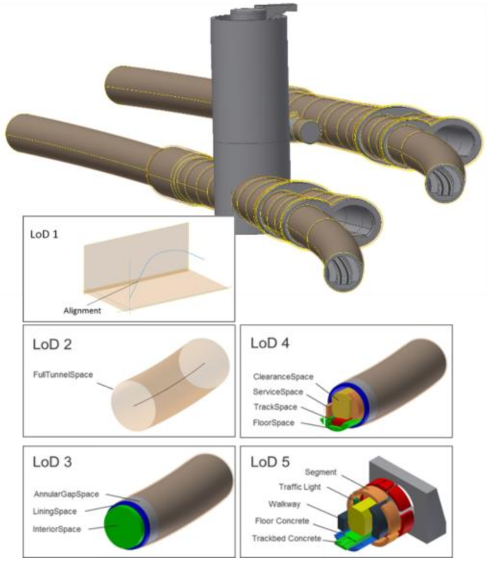
Similarities between building- and infrastructure construction

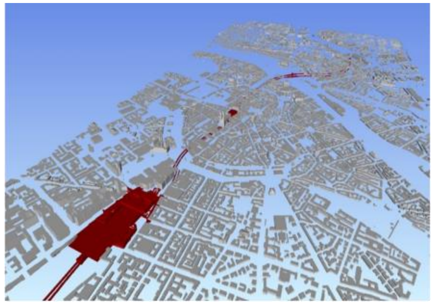
Similarities in the application of the BIM method:

– Work with a **<u>geometric-semantic</u>** model,

– The subject model based work with regular merging of all submodels to a **<u>coordination model</u>** and

– the use of the models for various **<u>applications</u>** such as
  - Quantity determination,
  - the cost estimate,
  - the preparation of the bill of quantities,
  - the use for different calculations,
  - as well as verifications and simulations





- multi-scale data model for shield tunnels
- Application in the context of the planning of the second S-Bahn main line in Munich
- Transfer to CityGML realized,
- Provide planning model and GIS analyses
- Consistency assurance

Borrmann, A.; Berkhahn, V. (2015): Fundamentals of geometric modeling. In: Borrmann et al. (2015): Building Information Modeling – Technological foundations and industrial practice. Wiesbaden: Springer Vieweg. ISBN 978-3-6580-5605-6.

Differences between building- and infrastructure construction

<u>1. Greater Geographical Extent</u> than buildings

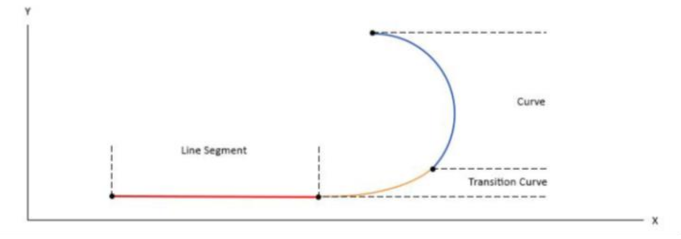
- Use of a geographical reference system and
- the consideration of the necessary reductions of measured lengths (projection, height).

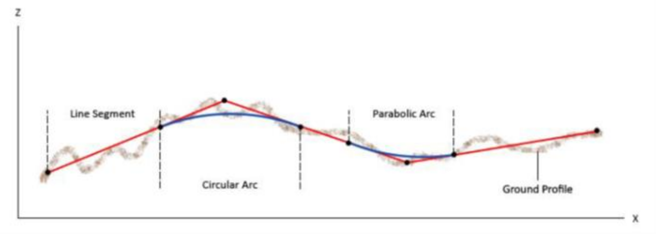
<u>2. Alignement</u> Linear infrastructure projects such as roads and railroads, including their bridges and tunnels, are essentially based on the concept of **alignement**

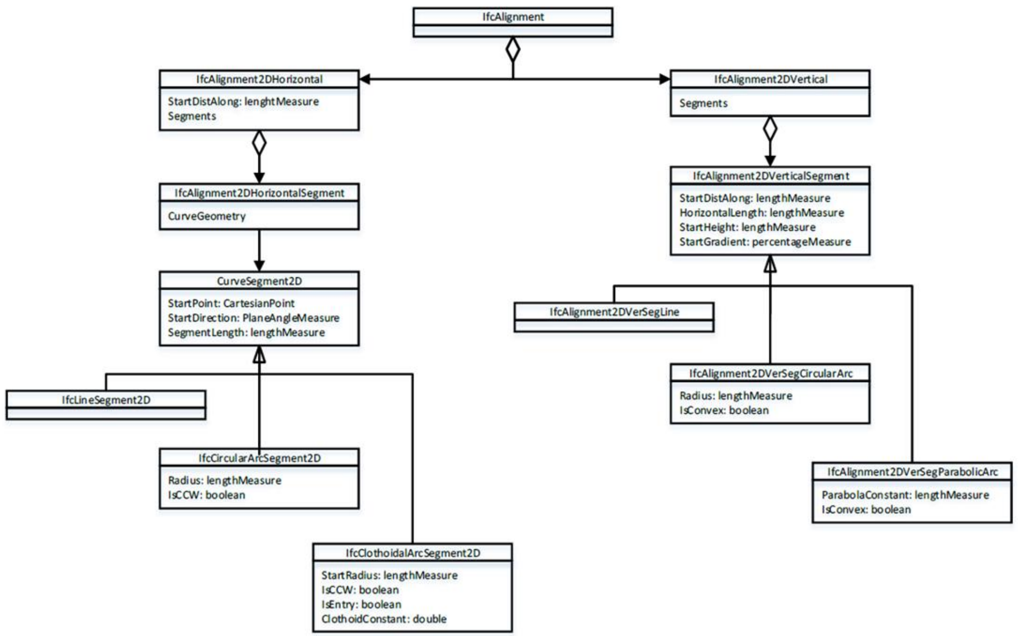
- Description of routing curves and the
- Possibility of linear positioning along this axis

As a result of the above-mentioned points, the tools currently available in the field of "Building Construction BIM" are only of limited use. A reasonable use is generally limited to the modeling of engineering structures. However, programming and workarounds are often required to align the geometry with the route, for example.

IFC4 Alignement und IFC 5 „Infrastructure“

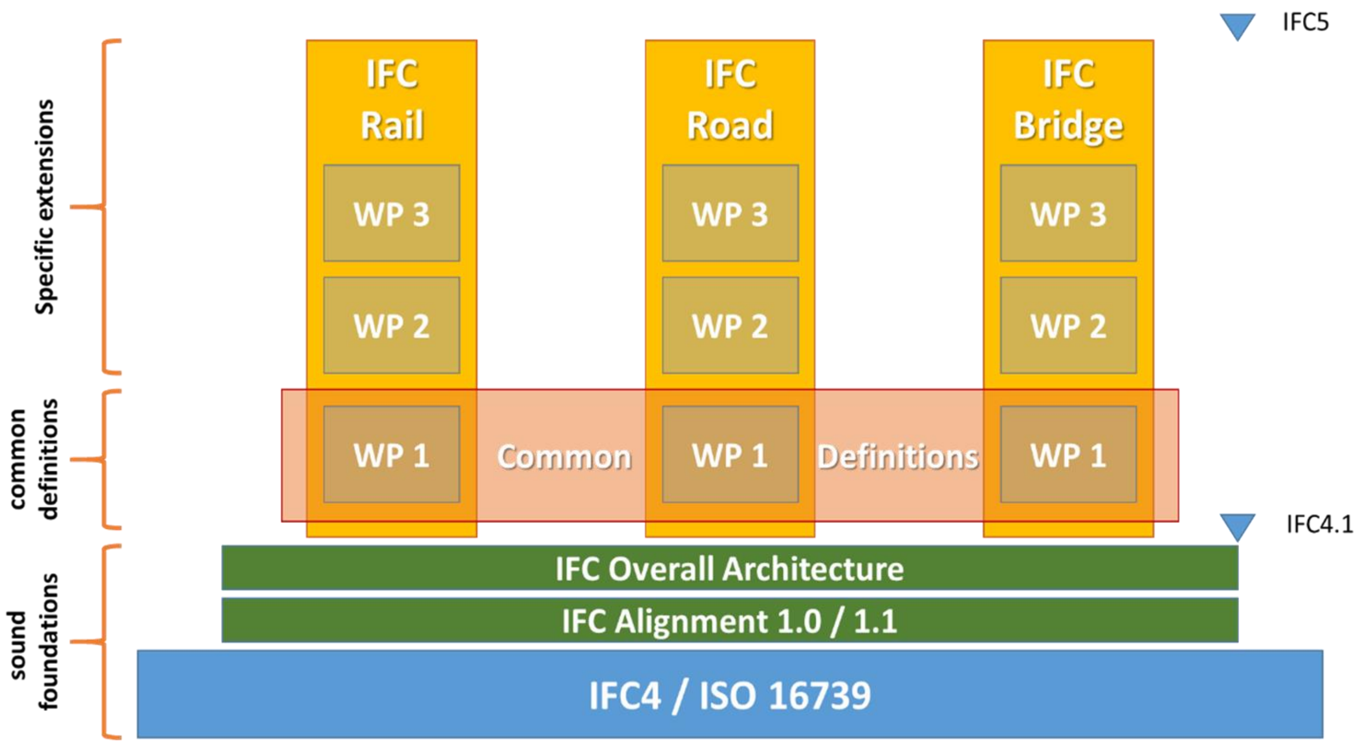






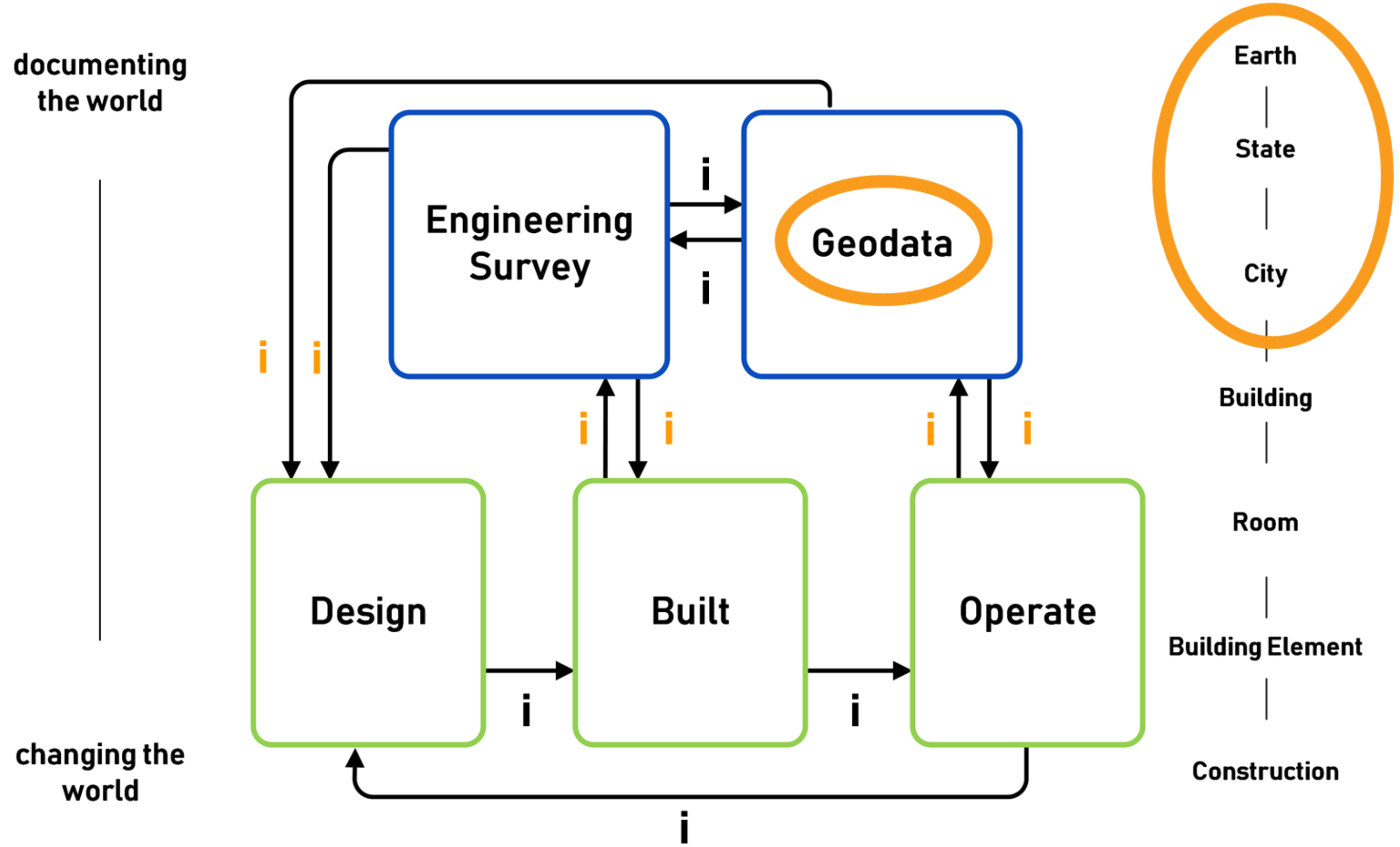
L.I.H. (Luuk) Wijnholts, **AUTOMATED GEOMETRY CHECKING FOR INFRASTRUCTURE PROJECTS,** Eindhoven University of Technology

IFC 5 „Infrastructure“



Geospatial vs. BIM

Use Cases of BIM and GIS



Differences (selection !)	GIS (ISO19xxx)	BIM (IFC)
Model intention	descriptive	prescriptive
Model creation	Few authors (commissioned data collection by the state or large companies)	Many authors (property planners, specialist engineers, operators from various companies)
Typical Products	PostGIS, Q-GIS, ESRI (a lot of very good Open Source ☺)	Revit, ArchiCAD, Allplan, Solibri, Trimble… (lack of OpenSource ☹)
Pre-Standardization	OGC	buildingSmart
Software Architecture	More service-oriented (at least theoretically)	More file-based (at least currently)
Main „Product“ ?	Digital model (data set)	Physical things (windows, construction work)

Differences (selection !)	GIS (ISO19xxx)	BIM (IFC)
Vendor-neutral data exchange	GML (CityGML, InfraGML, Deutschland ALKIS/NAS)	IFC
Meta models	UML	EXPRESS
Conceptual Basis (Geometry)	ISO 19107 (Spatial Schema, conceptual schemas for describing, representing and manipulating the spatial characteristics of geographic entities. Vector data)	ISO 10303-42 (STEP) Industrial automation systems and integration -- Product data representation and exchange -- Part 42: Integrated generic resource: Geometric and topological representation
Coordinates	absolute, georeferenced	relativ, lokal
Geometry-Representation	Simple Surfaces (B-Rep)	Hybride Models (Parametric, CSG, B-Rep)

Geospatial and BIM standardisation

ISO JWG 14 – GIS-BIM interoperability

…many working groups….

- Background
- Semantic interoperability
- Processes
- Spatial referencing
- Geometric representation
- Joint principles for conceptual modelling
- Domain expert communication
- Product Handling

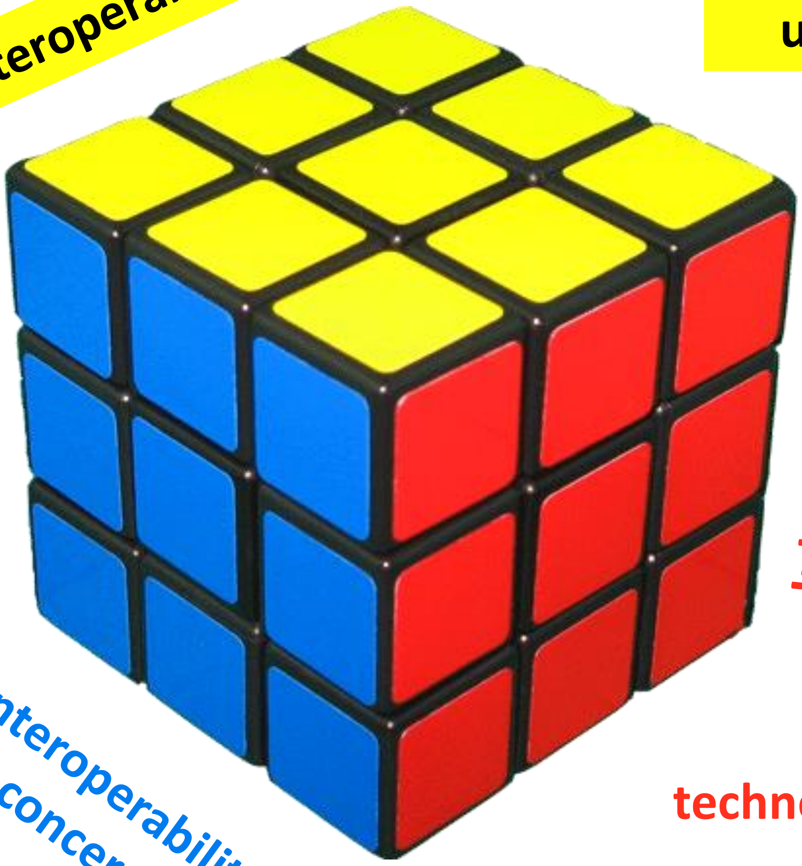
➢ **Recommendations for new ISO standardization projects**

Interoperability

- Ability of companies and organizations to communicate and interact effectively within and between them (cmp to ISO 11354-1)

- The ability to communicate, run programs, or transfer data between various functional units in a manner that requires that users have little or no knowledge of the unique properties of these units. (cmp to ISO/TC211)

BIM-Geospatial interoperability?



ISO 11354-1 Framework for enterprise interoperability

ICS › 35 › 35.240 › 35.240.67

ISO/TR 23262:2021

GIS (geospatial) / BIM interoperability

Contents Page

„Compendium“ on BIM and GIS standards

Opportunities, if interoperability was realized

Recommendations for new ISO standardization projects

Annex with many extra info

1. Linking abstract concepts in BIM and GIS standards

Similarities and differences are examined in order to establish links and transformations between abstract concepts in BIM and GIS standards.

2. Geospatial and BIM dictionary

Mutual explanation and "comparison" of technical terms (ontology?)

3. Guidelines for information exchange between BIM and GIS

The technical report contains guidelines for the exchange of information using open standards between the construction and spatial data sectors. Domain-specific aspects are: georeferencing, spatial representation (2D / 3D), semantic alignment and metadata. Spatial data managers and BIM managers use the guidelines for quality management to define information requirements, organize the exchange of information and check data deliveries. IT professionals receive cross-domain conceptual guidelines for designing software interfaces.

ICS › 35 › 35.240 › 35.240.67

ISO/TR 23262:2021

GIS (geospatial) / BIM interoperability

Recommendations for new ISO standardization projects

OGC® Making location count.

buildingSMART® International

Built environment data standards and their integration: An analysis of IFC, CityGML and LandInfra

Proposed actions:

[…] use cases in plain, succinct language [..] These use cases should include details of the software applications that are commonly used […]

[…] best practice document that recommends the use of three-dimensional georeferencing […]

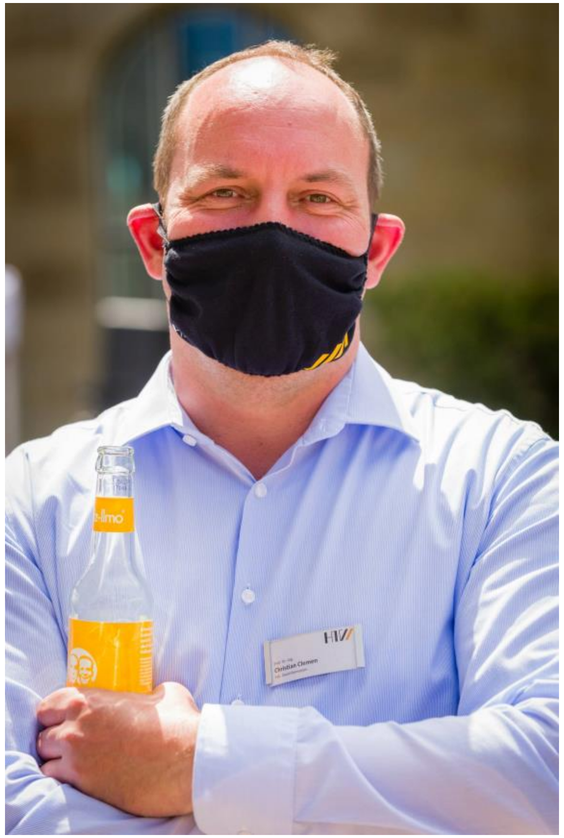
[…] a shared vocabulary […] from terms that are already used in the standards […]

[…] common unique identifiers for real-world, physical objects […]

[…] collaborative mechanism for opportunistic harmonization of conceptual representation […]

What are your concerns about geospatial and BIM interoperability?

A) **Incompatible Data formats / services**
B) **Georeferencing**
C) **Diverging semantics**
D) **“Cultural” barriers / Lack of mutual understanding**
E) **hm….I’ll use the chat**



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