



## L1.2 BIM-GIS Integration Workflow

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## Learning outcomes

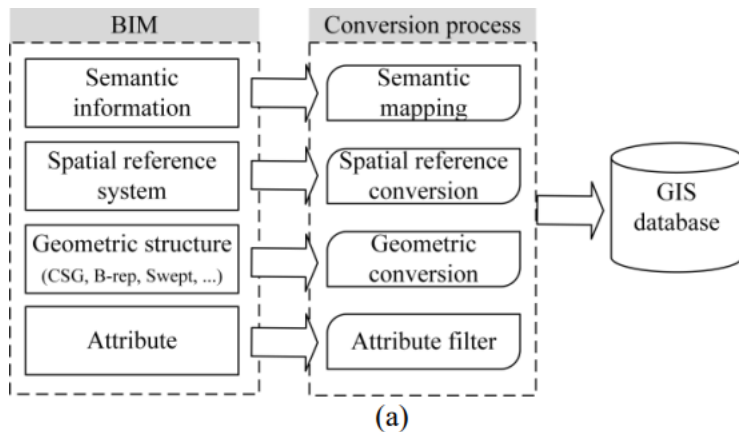
At the end of this lecture, the learner is expected to be able to:

- Name different integration approaches
- Know the steps in the integration workflow
- Understand importance of data quality and possible issues of the conversion

## Integration approaches: Conversion and full Integration

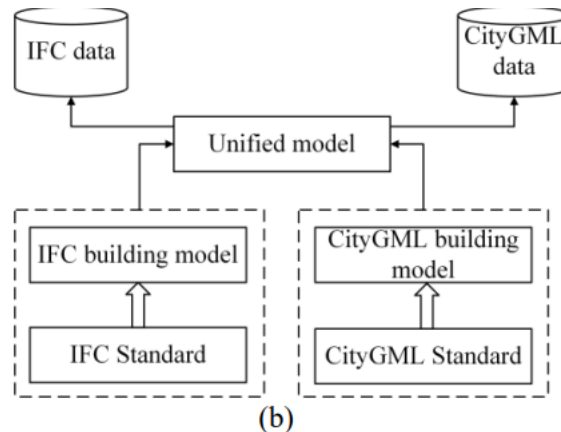
### Data conversion

- The simplest approach
- Both geometry and semantic



### Integration

- Aggregating both BIM and GIS data into a single unified model

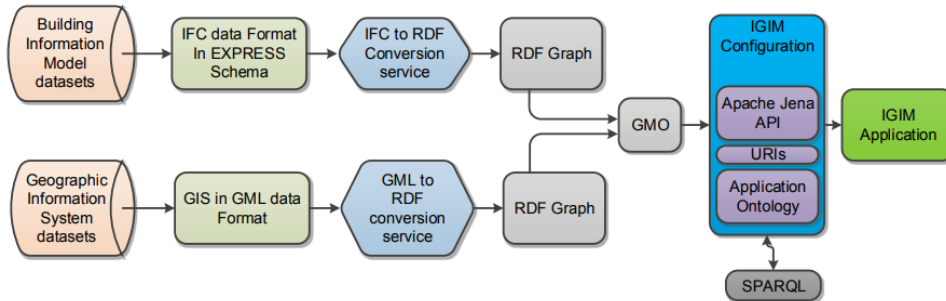


**FIGURE 1.** The integration process between BIM and GIS, (a) the simplified conversion process from BIM to GIS, (b) the bidirectional transformation between IFC and CityGML.

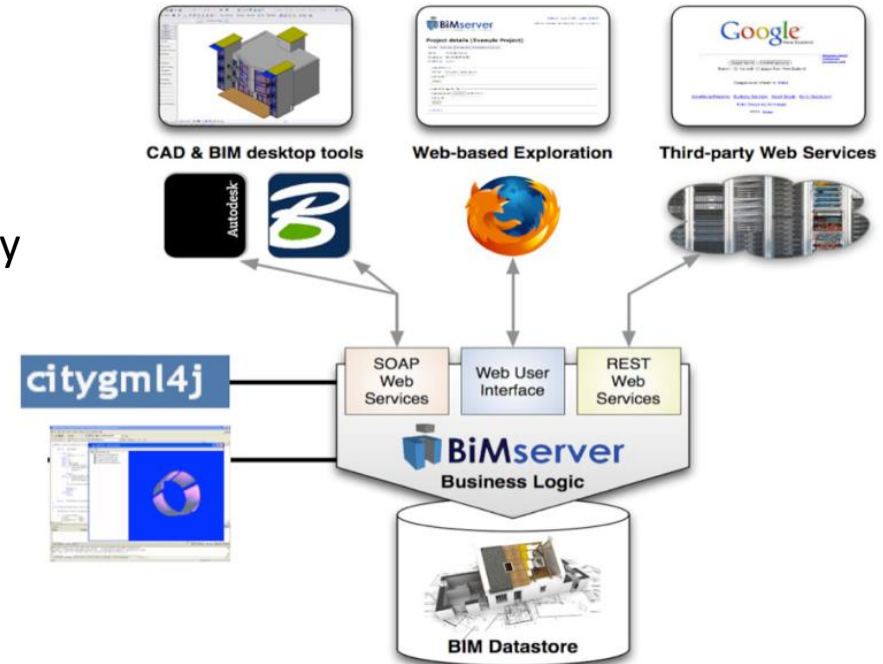
From: Ding et al (2017)  
Integrating IFC and CityGML  
Model at Schema Level by  
Using Linguistic and Text  
Mining Techniques

## Semantic web approach

- Selected data from both BIM and the GIS are combined into a third system
- IFC and CityGML converted into “web ontology language” (OWL)
- Can be used both in BIM and GIS
- Original data unchanged



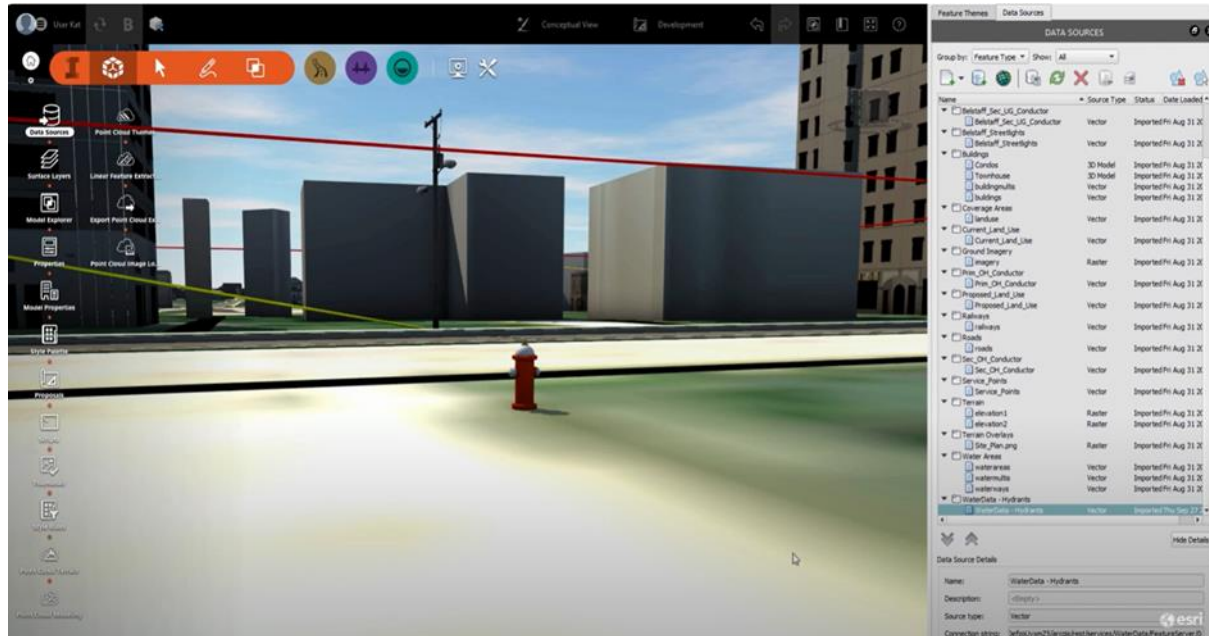
Data translation flow in semantic approach. From: [BIM-GIS INTEGRATED GEOSPATIAL INFORMATION MODEL USING SEMANTIC WEB AND RDF GRAPHS \(researchgate.net\)](#)



Semantic approach parts. From: [Integration of BIM and GIS: The Development of the CityGML GeoBIM Extension | SpringerLink](#)

## Vendor systems

- Esri-Autodesk cooperation most relevant
- Several applications for full integration
- Easy to use with well-looking results
- Cost for software licences



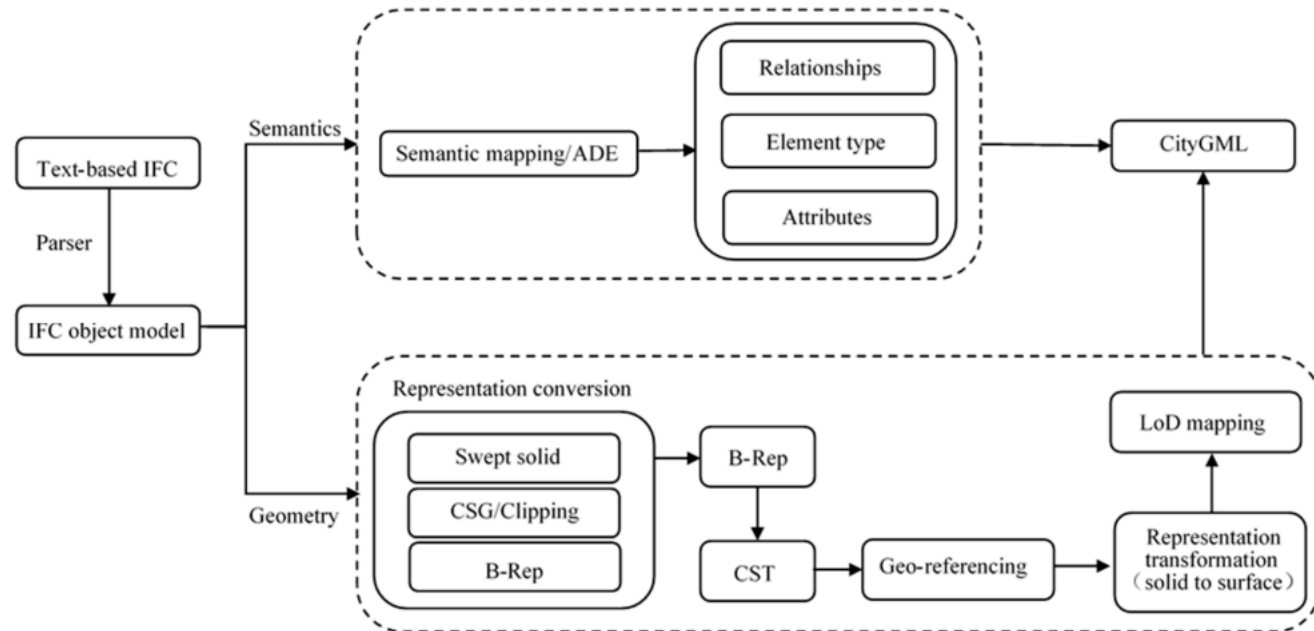
Adding City furniture in CityGML to Autodesk's InfraWorks, screenshot

## Model parts to be integrated

Both IFC and CityGML can be divided into 5 comparable subparts:

- Semantics
- Geometry
- Geographical coordinates
- Topology
- Encoding

Semantic information most challenging to be converted properly

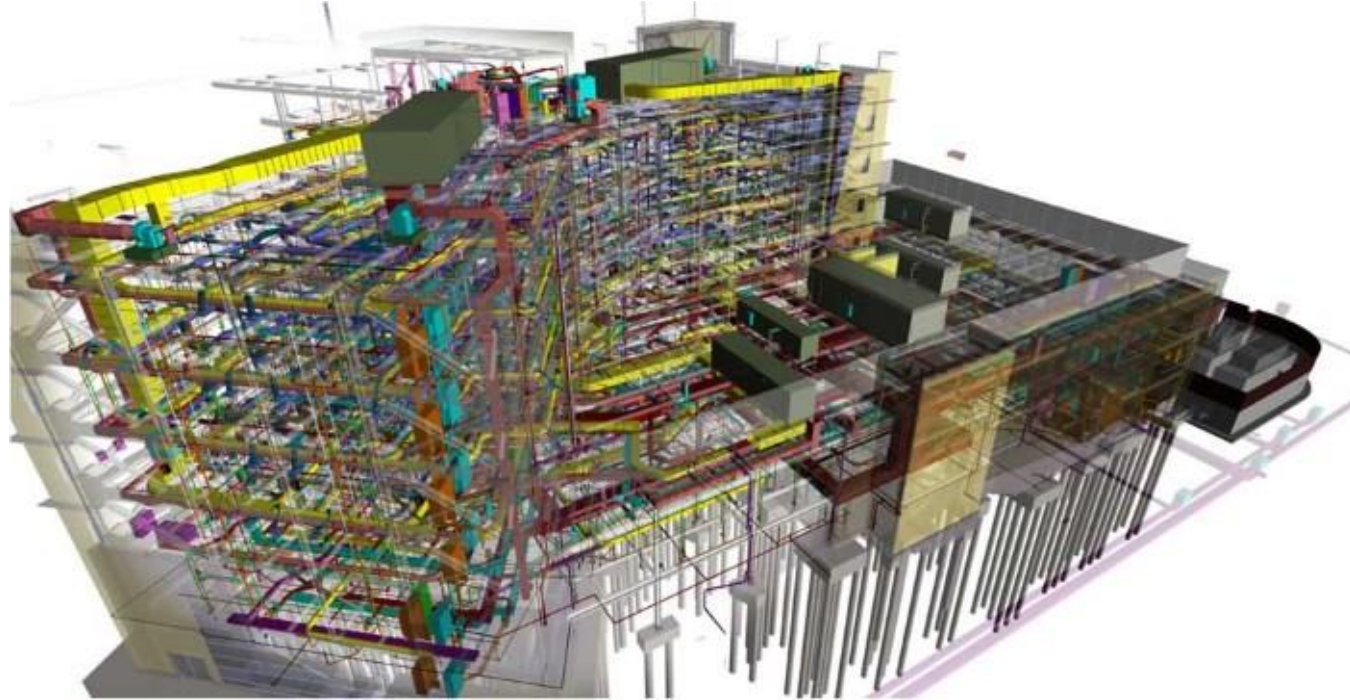


Parts to be converted in IFC-to-CityGML conversion. From: CityGML in the Integration of BIM and the GIS: Challenges and Opportunities



## 1. Data requirements

- BIM models are complex with thousands of details
- Not everything can/should be converted to CityGML
- From CityGML to BIM, it becomes simple model (compared to original BIM)



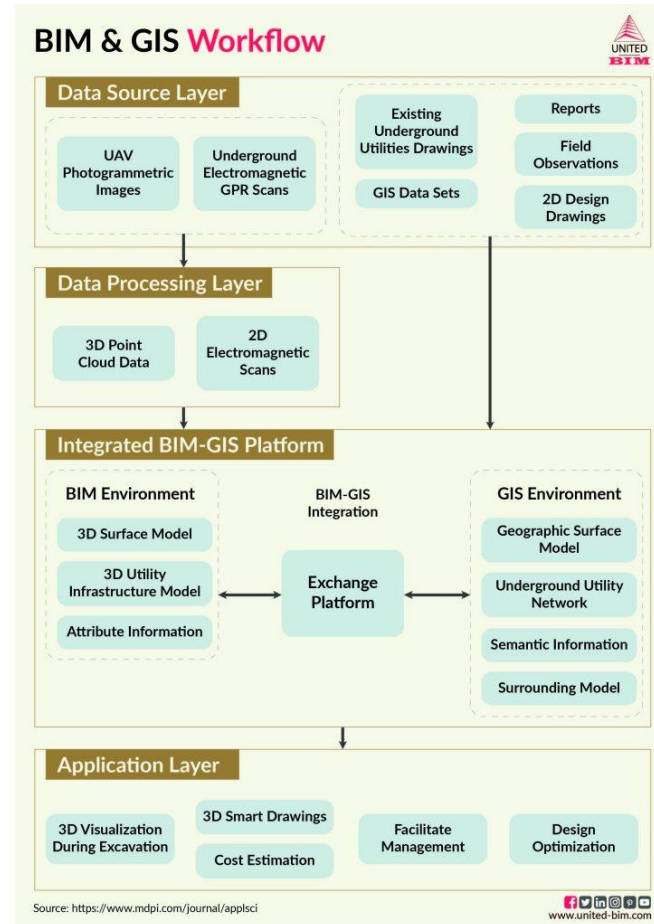
Multidisciplinary BIM model. Source tecla.com through [Guide to Building Information Modeling \(BIM\) | Scan2CAD](#)



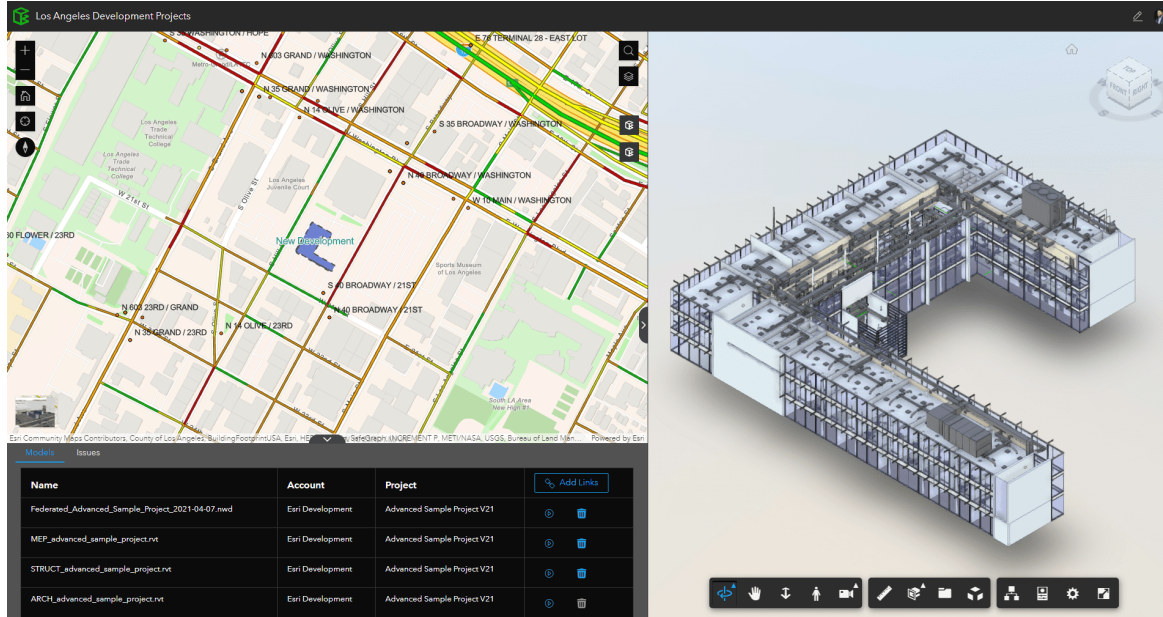
## Data quality

Crucial for reliable integration:

- Data consistency
- Accuracy
- Missing values
- Comprehensive metadata
- Georeferencing
- Coordinate system
- Measurement units



## Data conversion



<https://www.techzine.nl/wp-content/uploads/2021/12/BIM-and-GIS-cloud-collaboration.png>

- from GIS to BIM
- from BIM to GIS
- from BIM and GIS to a third system

Schema and attribute mappings:

- how the objects and their attributes in BIM dataset correspond to those in GIS dataset
- data fields with similar meanings are aligned correctly

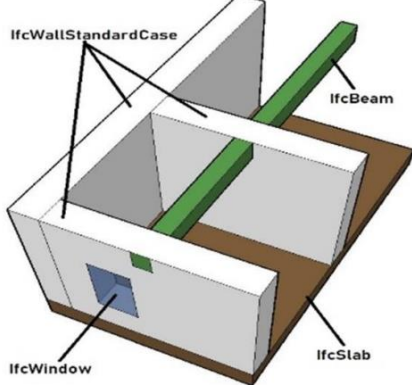
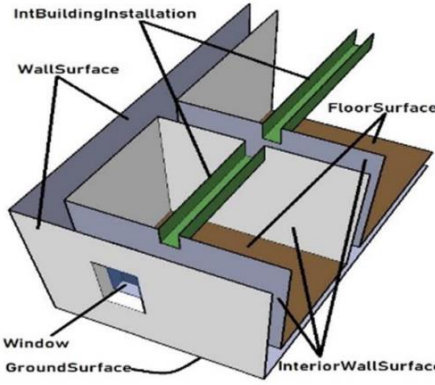
## Errors induced in the conversion

- loss of information
- loss of relationships
- improper conversion
- schema errors

The higher detail level, the more errors  
in the converted dataset

Cross-linking and frequent automatic  
updates = multiplying of errors

An example of true match generation between IFC and CityGML. From:  
Ding et al (2017) Integrating IFC and CityGML Model at Schema Level by  
Using Linguistic and Text Mining Techniques

IFC model	CityGML model
	
<p>The "IfcWallStandardCase" defined in IFC model file</p> <pre>#1930=IFCWALLSTANDARDCASE('2TChZebQlws', #33,'Basic Wall:Exterior - Block on Mtl. Stud:128093',\$, 'Basic Wall:Exterior - Block on Mtl. Stud:54538', #1917,#1929,'128093'); #33=IFCOWNERHISTORY(#32,#2,\$,..NOCHANGE., \$,\$,\$,0); #32=IFCPERSONANDORGANIZATION(#30,#31,\$); #30=IFCPERSON(\$,\$,'lyh',\$,\$,\$,\$); #31=IFCORGANIZATION(\$,\$,\$,\$,\$); #2=IFCAPPLICATION(#1,'2012','Autodesk Revit Architecture 2012','Revit'); #1=IFCORGANIZATION(\$,'Autodesk Revit Architecture 2012',\$,\$,\$); #1917=IFCLOCALPLACEMENT(#38,#1916); #1929=IFCPRODUCTDEFINITIONSHAPE(\$,\$, (#1920,#1928)); ...</pre>	<p>The "WallSurface" defined in CityGML model file</p> <pre>&lt;bldg:boundedBy&gt; &lt;bldg:WallSurface gml:id="2TC9qPqY9bQIdR"&gt; &lt;bldg:lod4MultiSurface&gt; &lt;gml:MultiSurface&gt; &lt;gml:surfaceMember&gt; &lt;gml:Polygon&gt; &lt;gml:exterior&gt; &lt;gml:LinearRing&gt; &lt;gml:posList srsDimension="3"&gt; 1.2706554713458518E7 2554433.9815080473 0.0 .... &lt;/gml:posList&gt; &lt;/gml:LinearRing&gt; &lt;/gml:exterior&gt; &lt;/gml:Polygon&gt; &lt;/gml:surfaceMember&gt; ... &lt;/bldg:WallSurface&gt; &lt;/bldg:boundedBy&gt;</pre>

## 4. Validation and documentation



- Validation of the integrated dataset
- Established procedures for updating the integrated dataset
- All the data sources and integration steps should be properly documented

<https://www.esri.com/en-us/industries/blog/articles/getting-real-with-bim-and-gis-integration/>



## Successful integration

Goal is:

- Seamless exchange of information between BIM and GIS
- Limiting complexity to desired level
- New insights impossible without the integration



Esri's training data, screenshot.

**Thank you for your attention**



<https://birgitproject.eu/>

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