

# The LADM Valuation Information Model based on INTERLIS

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# Content of the presentation

- **LADM Valuation Information Model**
- **INTERLIS**
- **Implementation of the LADM Valuation Information Model with INTERLIS**

# Valuation aspect of land administration

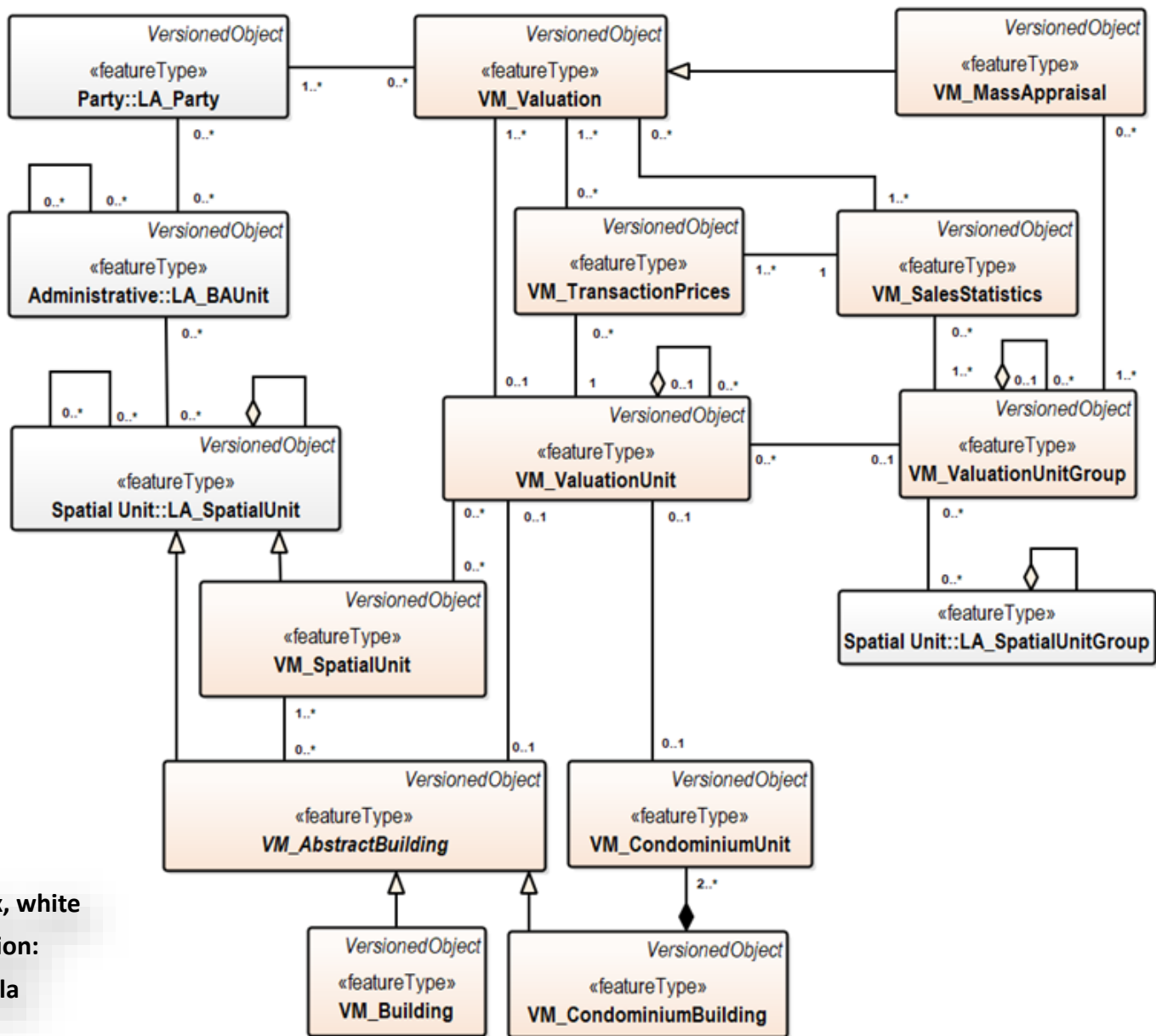
- **United New Urban Agenda** - *We will support local governments and relevant stakeholders, through a variety of mechanisms, **in developing and using basic land inventory information**, such as a **cadaster, valuation and risk maps**, as well as **land and housing price records** ... needed to assess **changes in land values** ... (Clause 104).*
- **Valuation** is the **missing component** in land administration. Studies on land administration more focused on land tenure, 3D aspects and technical issues.
- **A recently started joint activity group has started to extend LADM** for the **specification of valuation information** maintained by **public authorities** especially for property taxation.



# Short history of LADM Valuation Information Model

- The joint activity group has decided to develop an **information model for property valuation and taxation** in very beginning of **2015**.
  - A standalone data model OR
  - Extending the scope of an existing standard
- The first data model for property valuation and taxation was published in. In 11th 3D Geoinfo Conference, 20–21 October 2016, Athens, Greece (Çağdaş et al.). **LADM ExtTaxation** and **ExtValuation** were extended in this data model.
- After discussions, it was decided that the scope of the **extension** should be **limited only the property valuation** since the property taxation practices are more **country specific** and dependant to **local conditions**.

# LADM Valuation Information Model

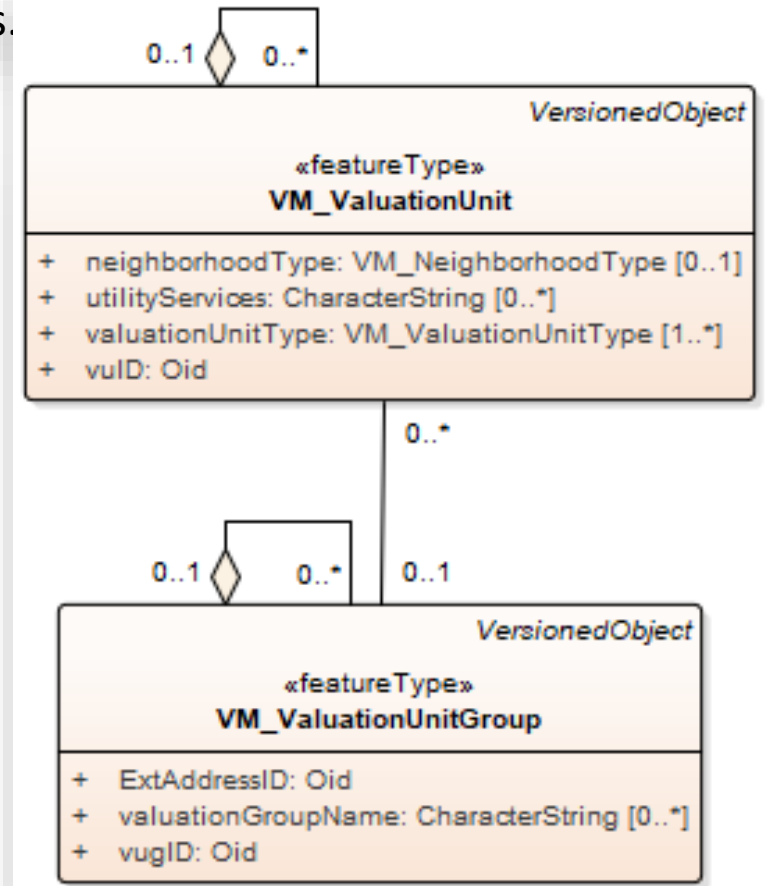
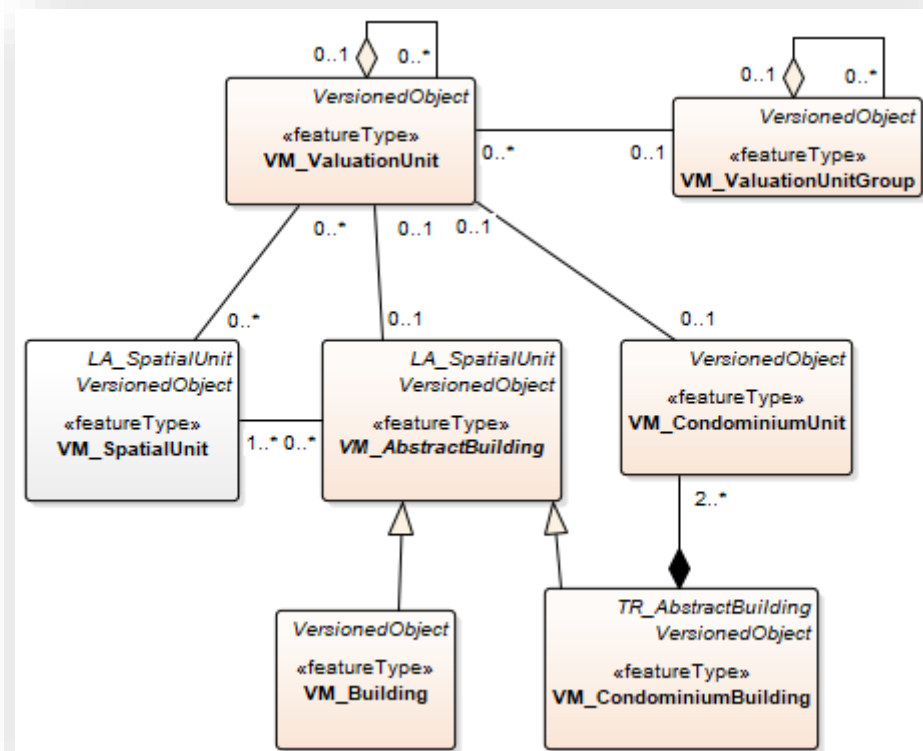


LADM: LA\_ prefix, white  
 Valuation extension:  
 VM\_ prefix, vanilla



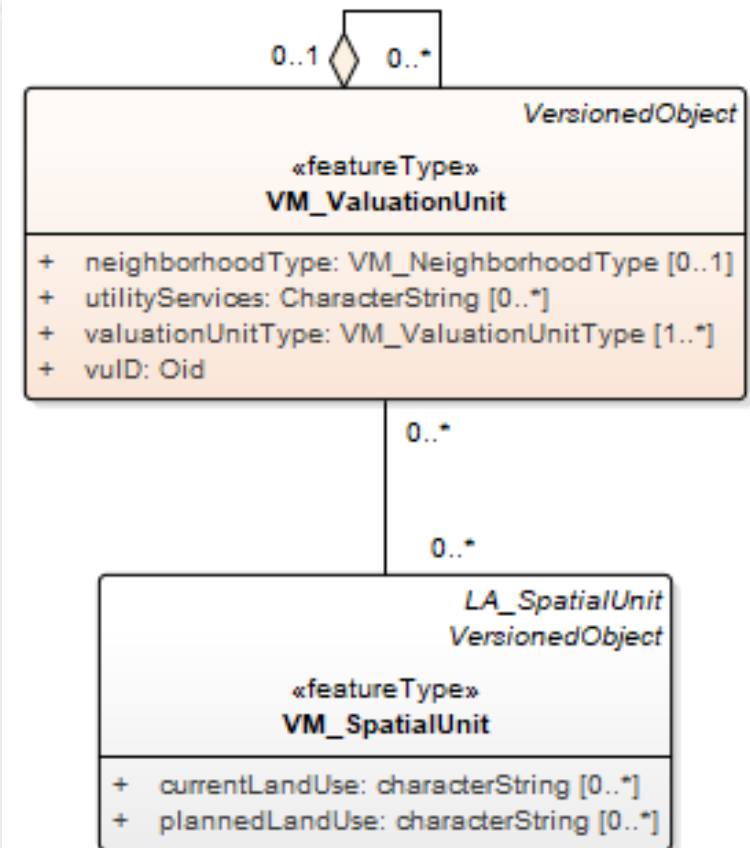
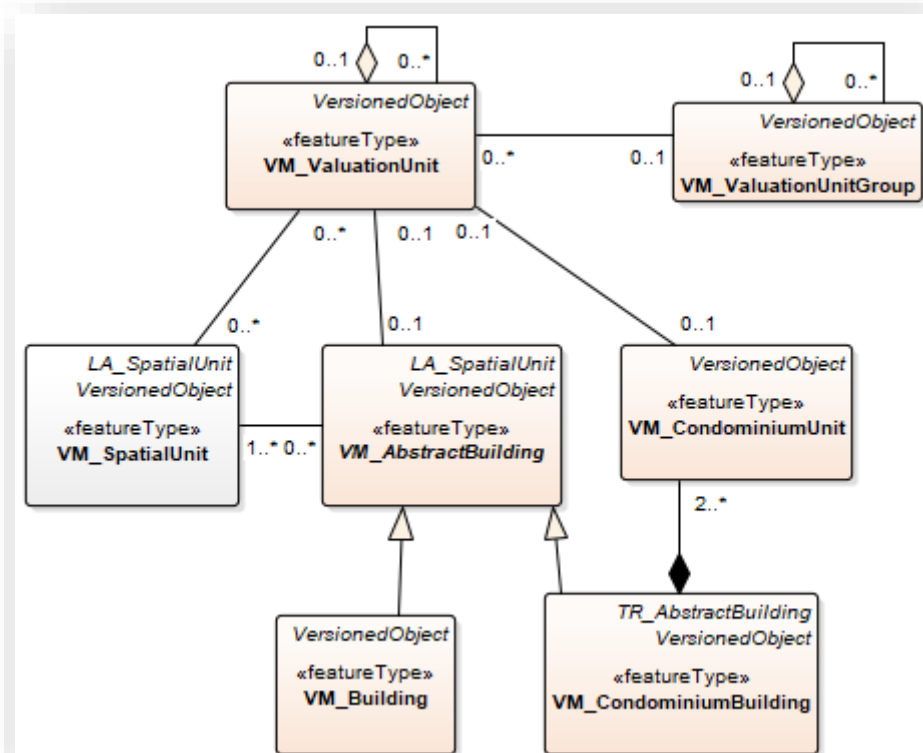
# Valuation information model – Valuation objects

**VM\_ValuationUnitGroup** clusters valuation units according to zones (e.g. administrative divisions, value zones) or type of valuation units (e.g. commercial, residential) that have similar functional characteristics.



# Valuation information model – Valuation objects

**VM\_SpatialUnit** specifies cadastral parcels, and sub-parcels that reflect a division of parcels according to land use categories for taxation (e.g. France and Spain).



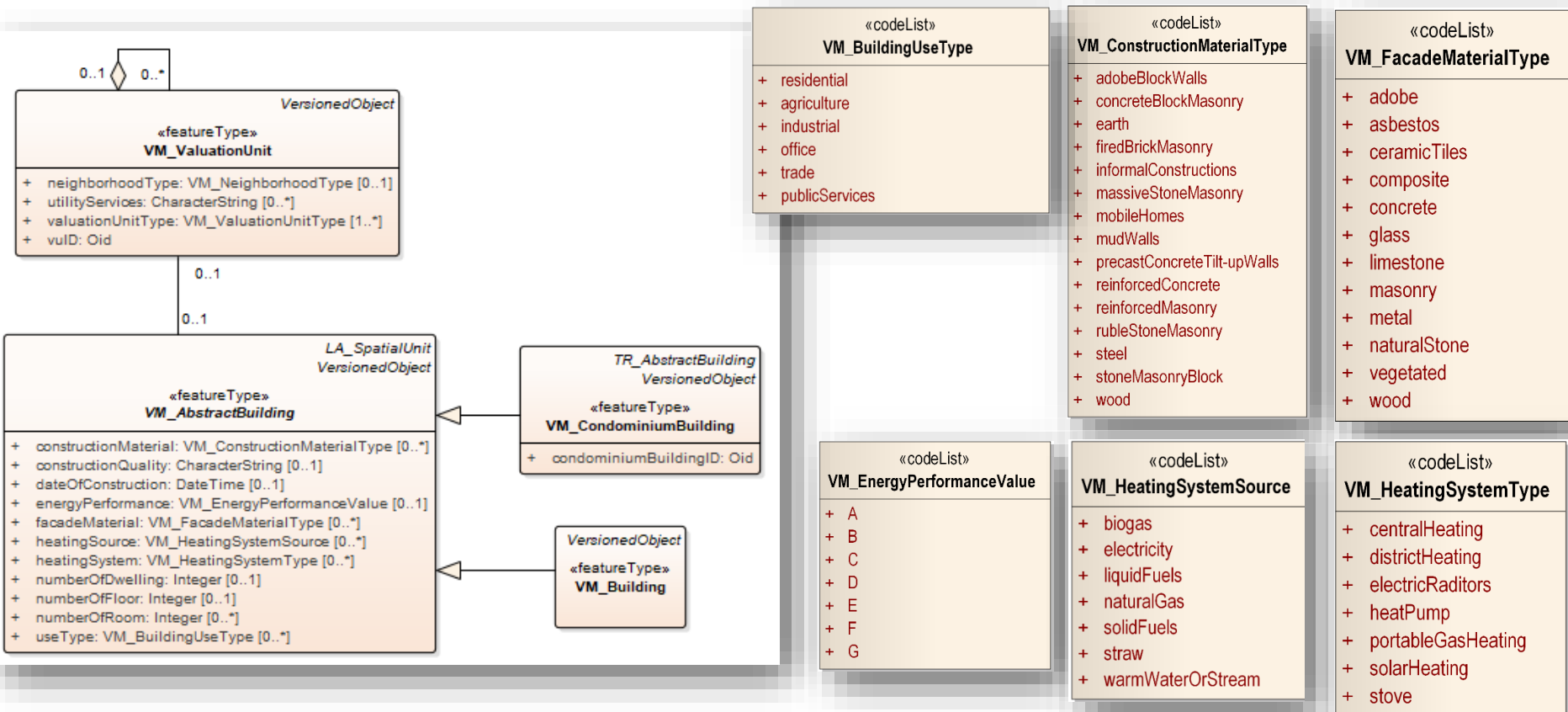


# Valuation information model – Valuation objects

**VM\_AbstractBuilding** specifies common aspects of buildings and condominium buildings.

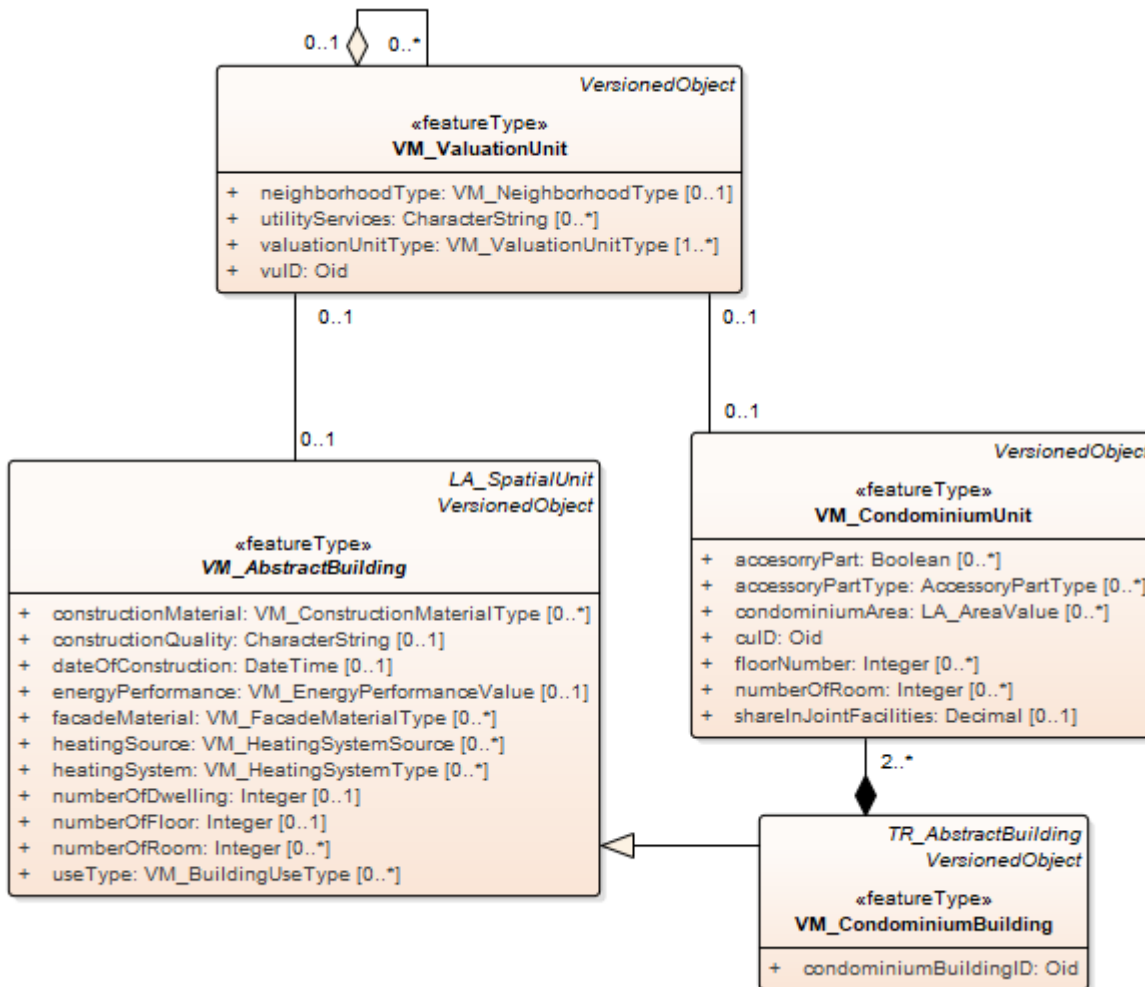
**VM\_Building** represents buildings that are considered as complementary parts of property units, which also may be taxed or valued separately from the parcels.

**VM\_CondominiumBuilding** specifies buildings that contain condominium units.



# Valuation information model – Valuation objects

**VM\_CondominiumUnit** represents main condominium units (e.g. apartments) and their physical and legal characteristics.



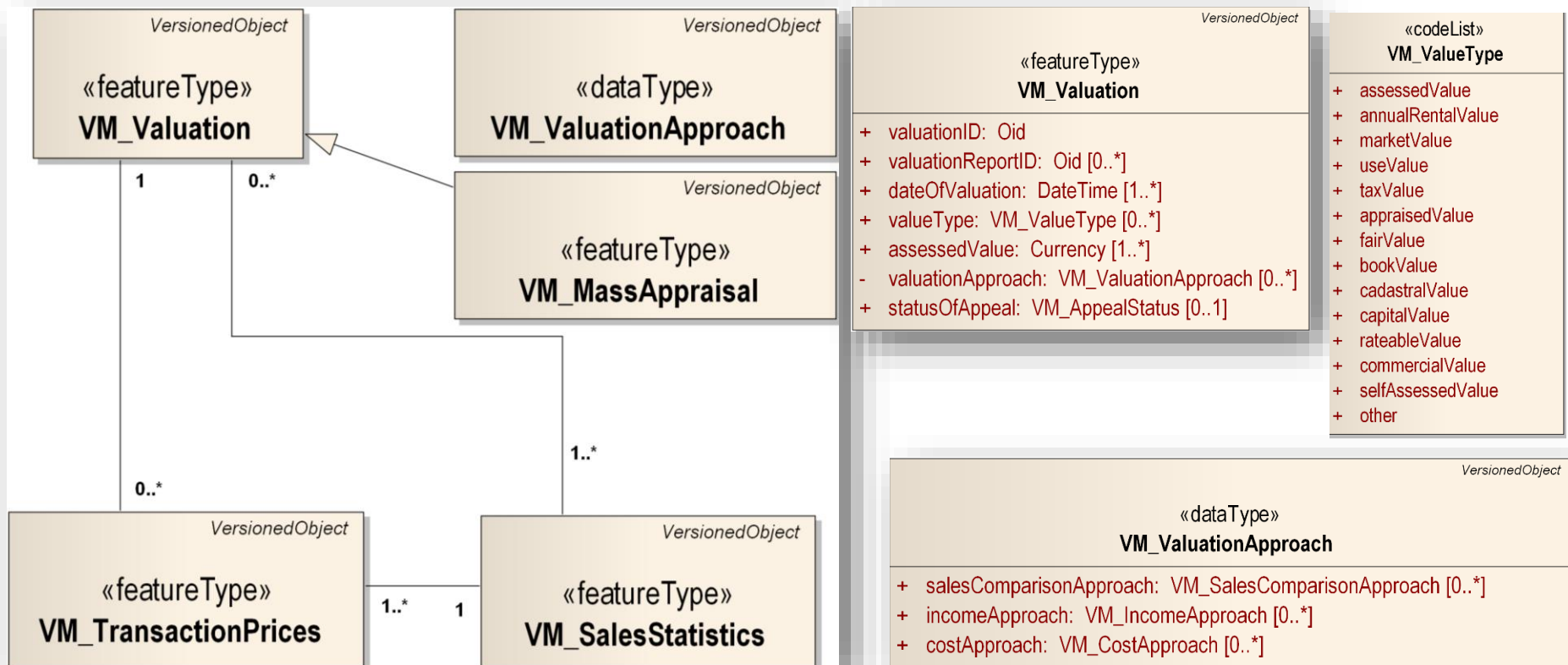
«codeList» VM_AccessoryPartType
+ garage
+ shop
+ laundry
+ other

«codeList» VM_BuildingUseType
+ residential
+ agriculture
+ industrial
+ office
+ trade
+ publicServices

# Valuation information model – Valuation

**VM\_Valuation** defines input and output data used and produced within single or mass appraisal processes.

**VM\_ValuationApproach** data type class specifies information about traditional valuation approaches or methods, used in both single property appraisal and mass appraisal.

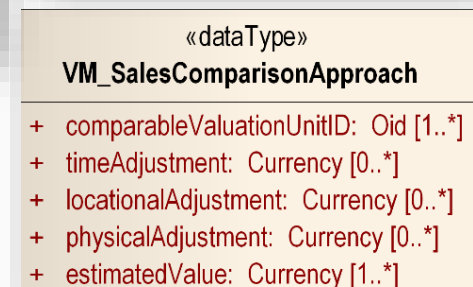
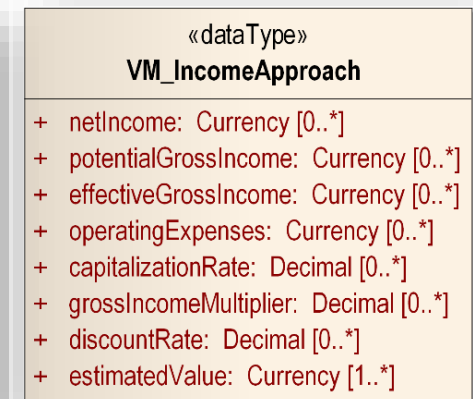
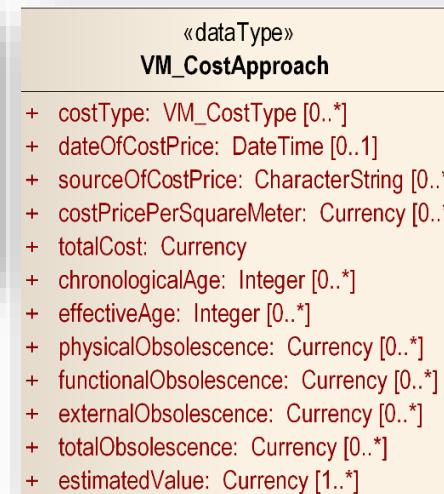
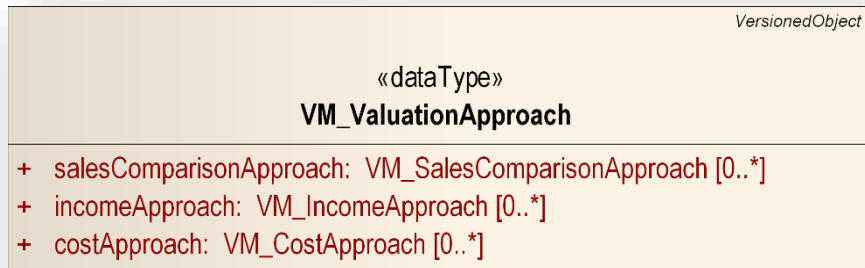


# Valuation information model – Valuation approach

**VM\_SalesComparisonMethod** documents comparable units used in comparison approach, and monetary adjustments made for the sales prices.

**VM\_CostMethod** organizes cost method related data, such as type, source and price of cost, age of improvements, and appreciated depreciations.

**VM\_IncomeMethod** renders gross and net incomes, capitalization and discount rates, and gross rent multipliers used in income capitalization procedures.

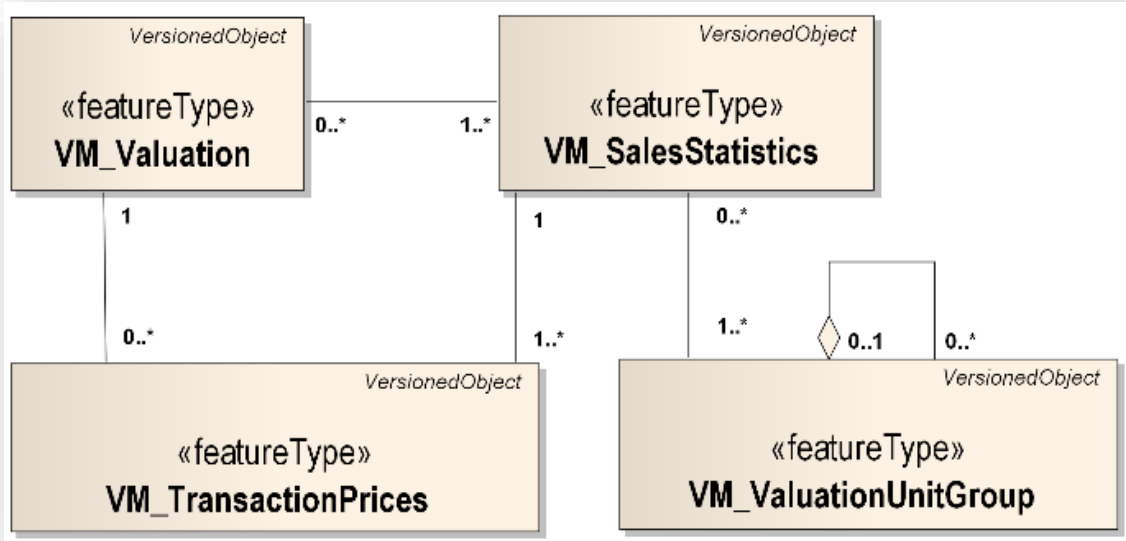


# Valuation information model – Mass appraisal

**VM\_MassAppraisal** specifies mass appraisal-related information, such as applied statistical models, analysis types (e.g. multiple regression), and accuracy or performance indicators.

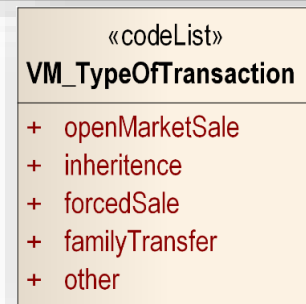
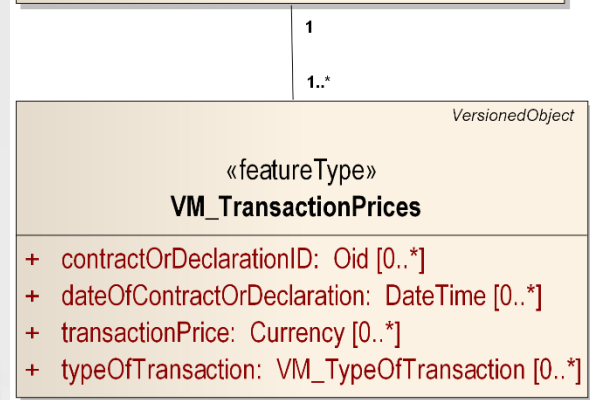
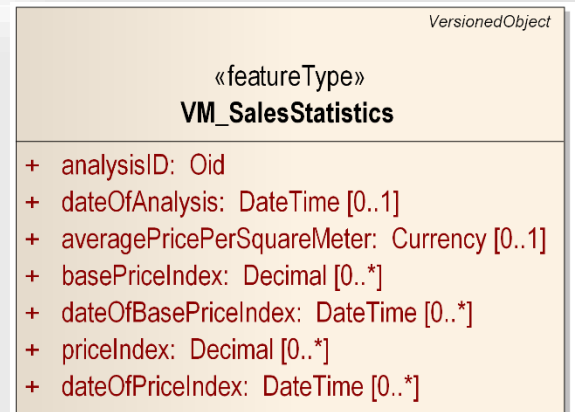


# Valuation information model – Sales statistics

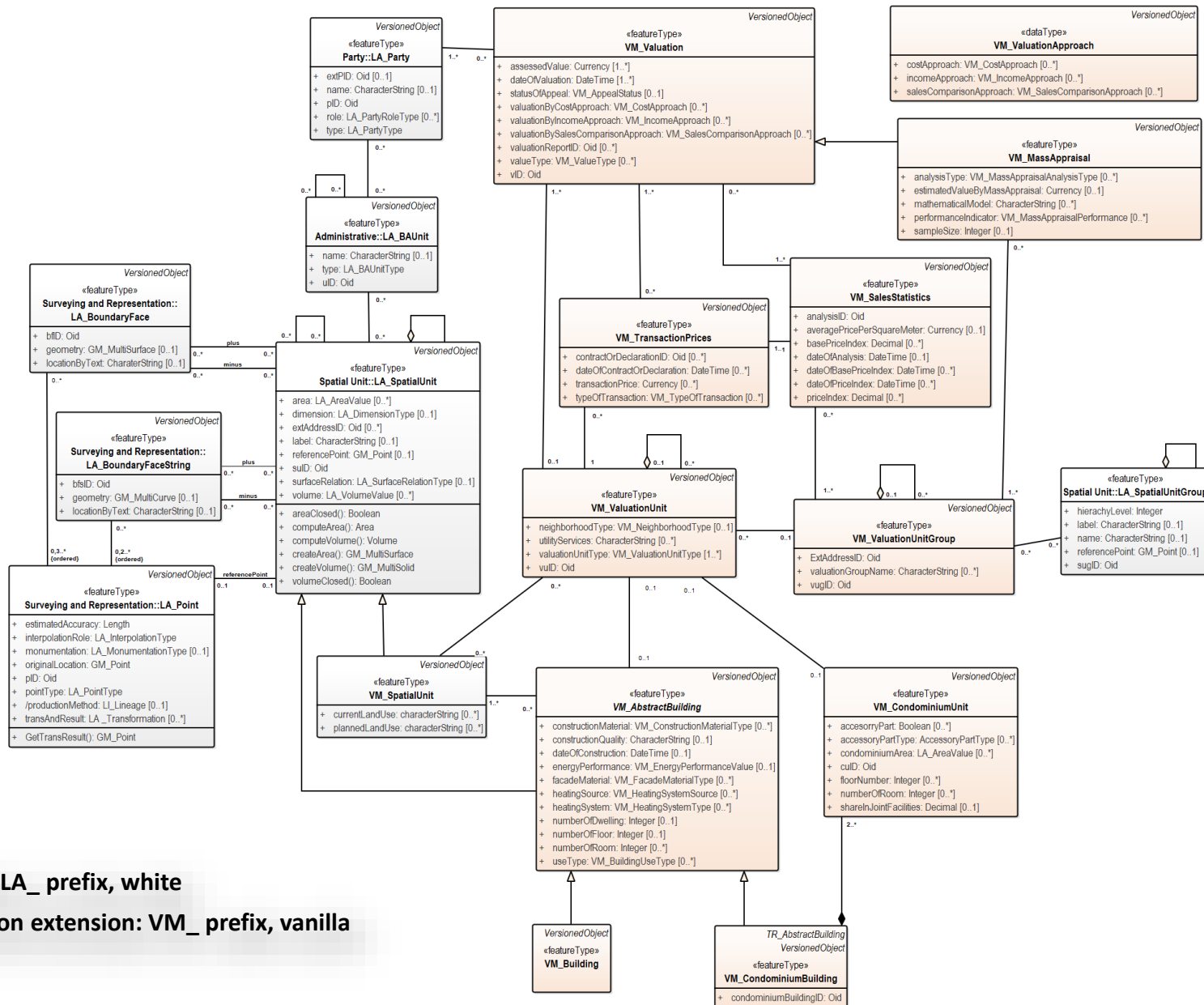


**VM\_TransactionPrices** defines information content of transaction contracts or declarations provided by parties.

**VM\_SalesStatistics** represents information related to price statistics produced through analysis of transaction prices.



# LADM Valuation information model



LADM: LA\_ prefix, white

Valuation extension: VM\_ prefix, vanilla





# From conceptual to technical model

**A conceptual model** identifies the objects of the chosen domain, their **characteristics**, the **associations** among them, **constraints** and the operations on each. The conceptual model makes data modeling **independent from implementation specific issues**, like changes in physical storage and performance tuning

There are some tools for automated transformation from conceptual model to the technical model.

**Enterprise Architect**

**INTERLIS**

# INTERLIS - Tool to describe, integrate and coordinate geodata

- INTERLIS is a **national standard** (SN 312031) implemented by the Swiss Federal Directorate for Cadastral Surveying.
- INTERLIS was initially designed for land administration, but **it is not restricted to land administration**.
- INTERLIS standard can be employed for **data modeling, model validation, data validation, spatial data exchange, and integration of data model geographic models** (KOGIS, 2006).
- The **conceptual schema language (CSL)** of the INTERLIS provides **precise description of the international data standards** and it can be utilized for generating its corresponding **technical implementation** and load some geographical data afterwards (Germann et al., 2015). In other words, it **automatically converts conceptual schema definitions into computer-processable format**.
- There are a number of **implementations of INTERLIS** in the land administration domain, as LADM based country profiles of countries, namely **Switzerland, Greece, the Netherlands and Colombia**, were developed for INTERLIS (Kalogianni et al., 2017).

# The tools of INTERLIS

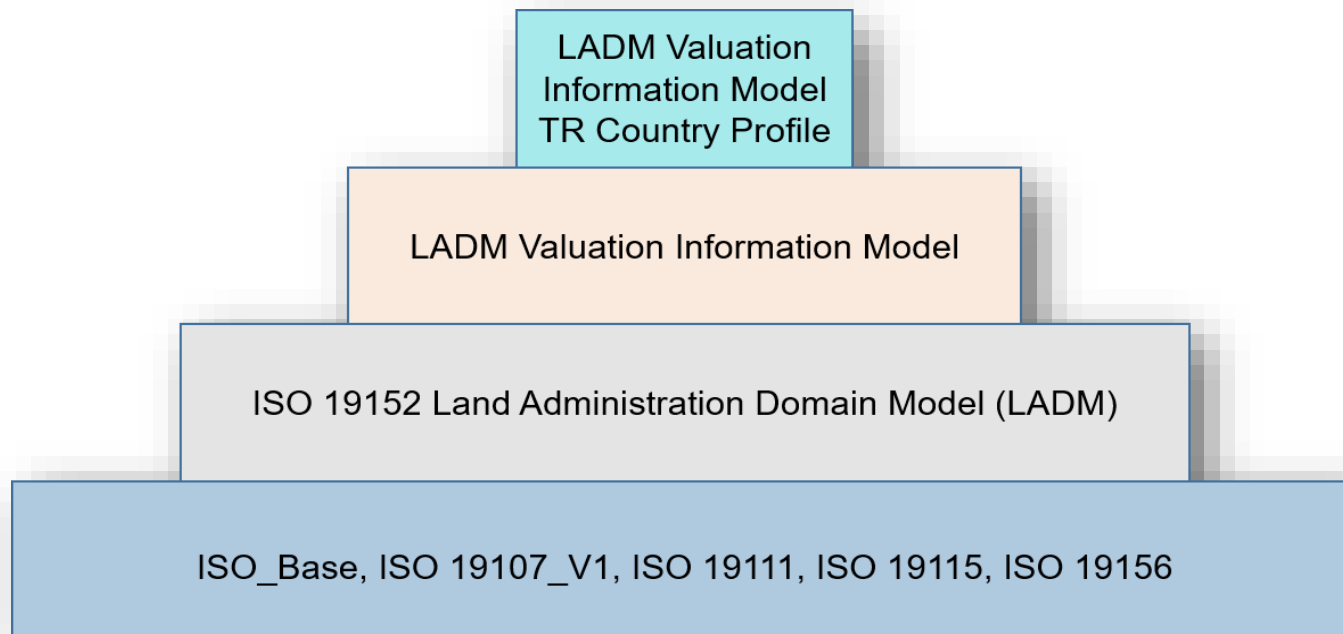
- INTERLIS is an object-oriented conceptual schema language (CSL), which is being used to define data models in textual form with a **rigid computer readable syntax**. **3D geometry types are supported** by INTERLIS data model.
- **INTERLIS/UML-editor**: visualize INTERLIS data models and generate INTERLIS data models files (\*.ili) from the UML diagram definitions. Compatible with the UML, XML schema and GML schema.
- **INTERLIS-Compiler**: the syntactic and semantic compliance of a newly created INTERLIS data model is validated with the INTERLIS-Compiler (ili2c).
- **INTERLIS SQL DB (ili2db)**: Oracle (ili2ora), PostgreSQL/PostGIS (ili2pg ) OGC Geopackage (ili2gpgk ), ESRI GDB (ili2geodb), Microsoft Access (ili2mdb) and Microsoft SQL server (ili2mssql )
- **INTERLIS Validator**: Validating model compliancy of data against its conceptual data model (iliValidator).
- **QGIS plugin**: Generating physical models from INTERLIS models and capturing, importing, editing and exporting data.
- **Reader/Writer to FME**: Read and write INTERLIS models in different data exchange format (ili2fme).





# Data models in INTERLIS

The **LADM ISO 19152** and a number of **ISO 19100** series standard including **ISO 19107**, **ISO 19115**, and **ISO 19156** were **described with INTERLIS** by the Swiss Land Management (SLM). The second version of the INTERLIS data model of LADM was described in the context of the Project 'Modernization of Land Administration in Colombia'. The second version LADM described in INTERLIS and the second version of ISO 19107 in INTERLIS supports both 2D and **3D geometries**.



# INTERLIS description of classes and associations

UML Diagram	INTERLIS Description
<pre> classDiagram     class VM_Valuation {         &lt;&lt;featureType&gt;&gt;         +assessedValue: Currency [1..*]         +dateOfValuation: DateTime [1..*]         +statusOfAppeal: VM_AppealStatus [0..1]         +valuationID: Oid         +valueType: VM_ValueType [0..*]     }     class VM_ValuationUnit {         &lt;&lt;featureType&gt;&gt;         +neighborhoodType: VM_NeighborhoodType [0..1]         +valuationUnitID: Oid         +valuationUnitType: VM_ValuationUnitType [1..*]     }     VM_ValuationUnit "1" -- "1..*" VM_Valuation : valuation     </pre>	<pre> <b>CLASS</b> VM_Valuation <b>EXTENDS</b> LADM_V1.VersionedObject = <b>assessedValue</b>: Currency; <b>dateOfValuation</b>: XMLDate; <b>statusOfAppeal</b>: LIST {0..1} OF VM_AppealStatus; <b>valuationID</b>: MANDATORY Oid; <b>valueType</b>: LIST {0..*} OF VM_ValueType; <b>END</b> VM_Valuation;  <b>CLASS</b> VM_ValuationUnit <b>EXTENDS</b> LADM_V1.VersionedObject = <b>neighborhoodType</b>: LIST {0..1} OF VM_NeighborhoodType; <b>valuationUnitID</b>: MANDATORY Oid; <b>valuationUnitType</b>: LIST {1..*} OF VM_ValuationUnitType; <b>END</b> VM_ValuationUnit;  <b>ASSOCIATION</b> valuation = unit -- {1..*} TR_ValuationUnit; value -- {0..1} VM_Valuation; <b>END</b> valuation;     </pre>

# Description of code lists in INTERLIS

```
STRUCTURE VM_PartyRoleType EXTENDS
LADM_V1.Party.LA_PartyRoleType =
cID: MANDATORY Oid;
parentcID: Oid REFERENCE TO
LADM_V1.Party.LA_PartyRoleType.CID;
beginLifeSpanVersion: XMLDate;
endLifeSpanVersion: XMLDate;
code: XMLDate;
description: CharacterString;
MANDATORY CONSTRAINT
end_Date_Time>=begin_Date_Time
!! Possible code list values:
(valuer,externalValuer,internalValuer,
qualifiedValuer,assessor,taxpayer,
bank,certifiedSurveyor,citizen,conveyor,employee
,farmer,moneyPrivider,
notary,stateAdministrator,surveyor,writer);
END VM_PartyRoleType;
```

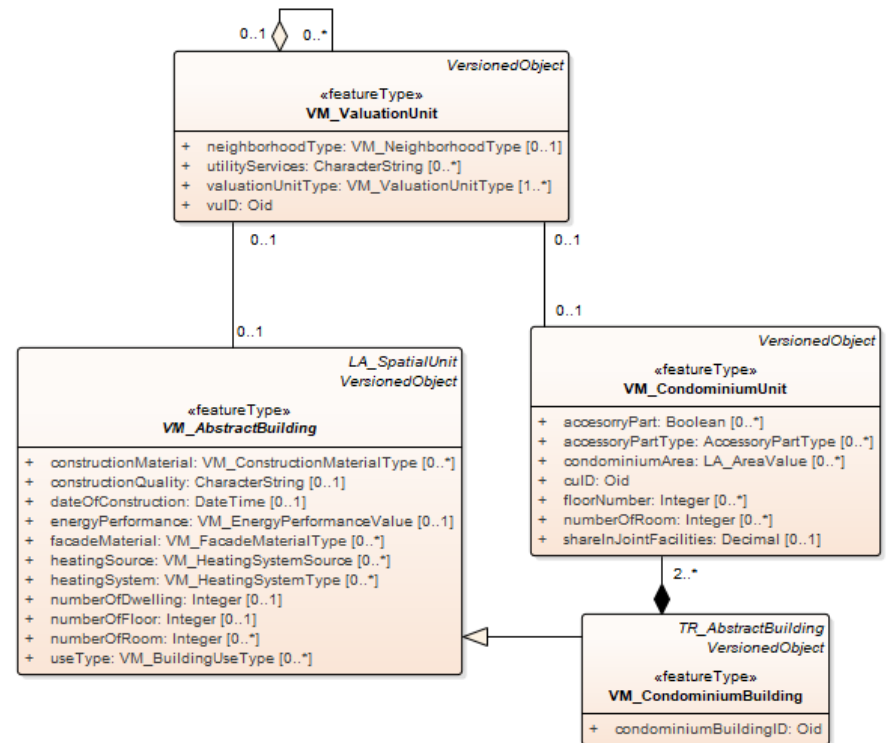
Meaningful Code Lists proposed by (Kalogianni, 2017).

«codeList»	
Party::LA_PartyRoleType	
+	assessor = 5
+	bank
+	certifiedSurveyor
+	citizen
+	conveyor
+	employee
+	externalValuer = 2
+	farmer
+	internalValuer = 3
+	moneyProvider
+	notary
+	qualifiedValuer = 4
+	stateAdministrator
+	surveyor
+	taxpayer = 6
+	valuer = 1
+	writer



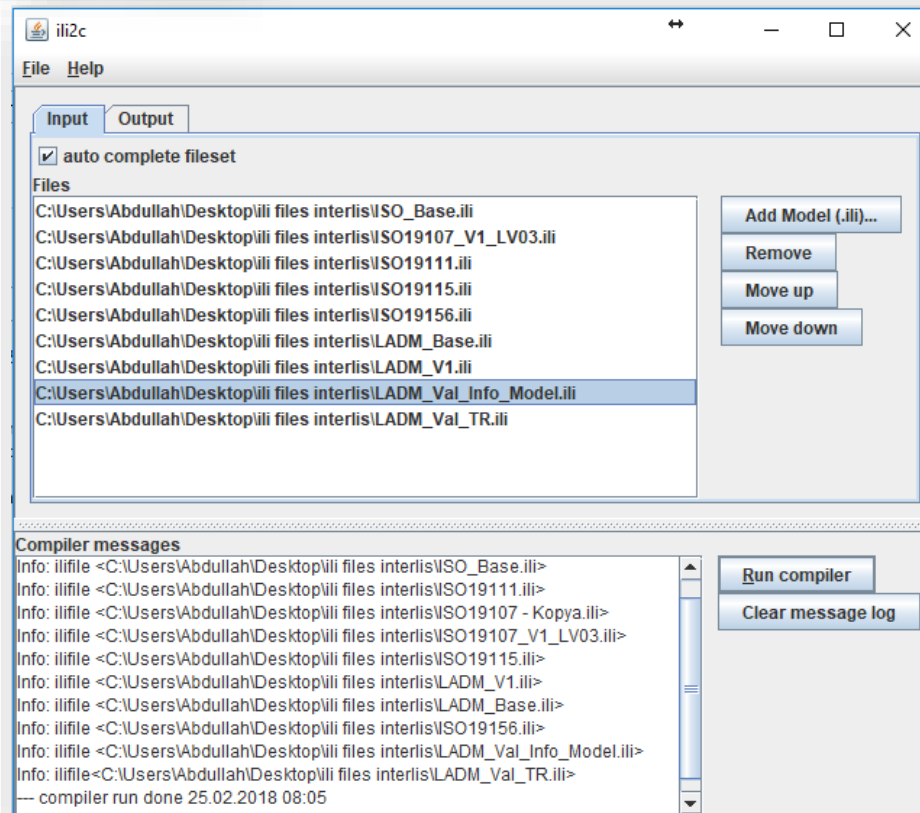
# Description of constraints in INTERLIS

```
CLASS VM_CondominiumUnit EXTENDS  
LADM_V1.VersionedObject =  
cuID: MANDATORY Oid;  
accessoryPart: BOOLEAN;  
accessoryPartType: MANDATORY  
(garage, laundry, shop, other);  
condominiumArea:  
VM_BuildingAreaType;  
floorNumber: Integer;  
numberOfRoom: Integer;  
shareInJointFacility: Fraction;  
MANDATORY CONSTRAINT  
VM_ValuationUnit.valuationUnitType  
= "condominium" ;"  
END VM_CondominiumUnit;
```



# Implementation with INTERLIS (INTERLIS-Compiler)

After LADM Valuation Information Model was described in INTERLIS (\*.ili) file, the model and all the other INTERLIS models (ISO\_Base, ISO 19107\_V1, ISO 19111, ISO 19115, ISO 19156, LADM\_Base, and LADM\_V1) on which the model is based were imported in the **INTERLIS-Compiler tool (ili2c)** in order to check the **structural correctness of the newly created INTERLIS data models. XML schema and GML schema** of the LADM Valuation Information Model were created.

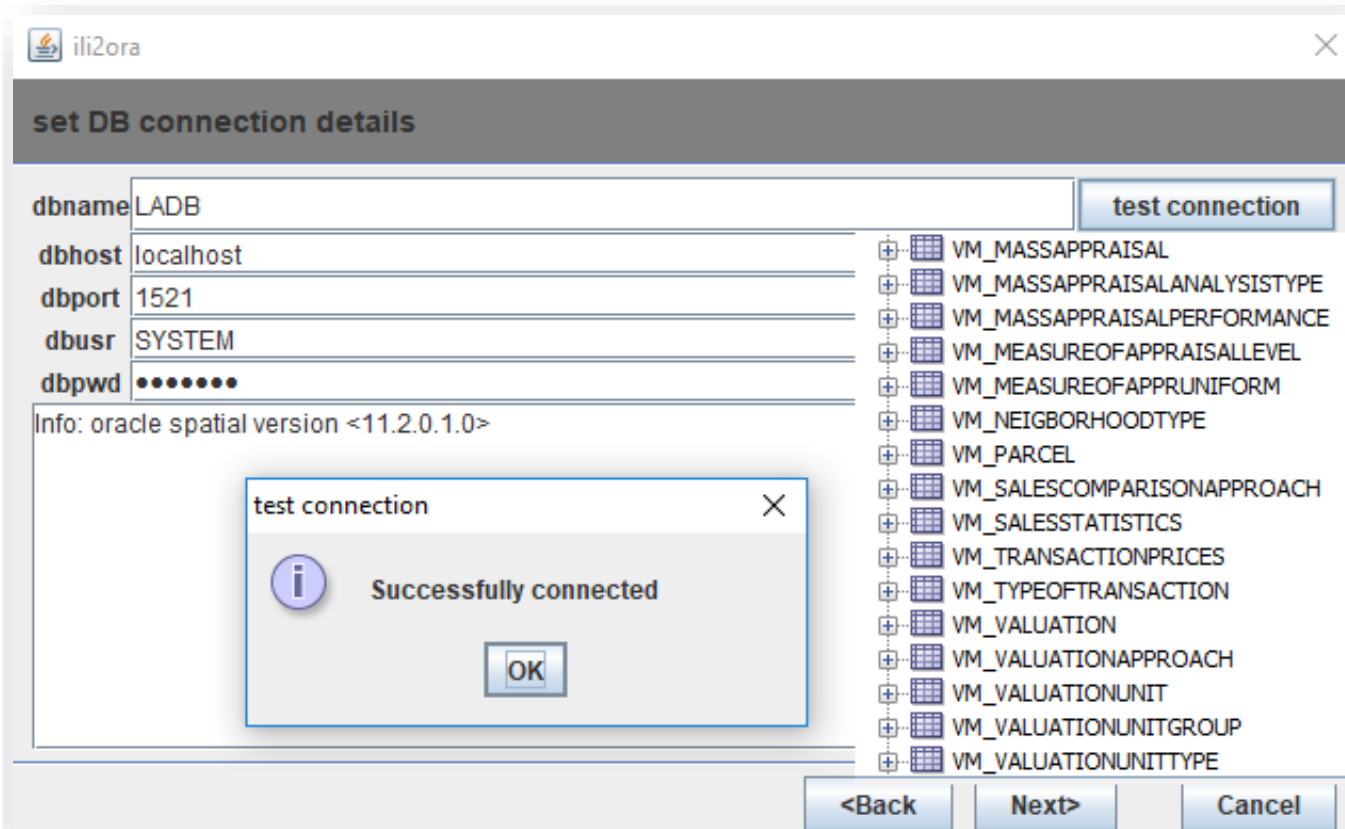


# Implementation with INTERLIS (INTERLIS SQL DB)

After LADM Valuation Information Model and Turkish Country Profile were described in INTERLIS (\*.ili), **an empty schema** was created in the **Oracle Spatial 11g** database.

**Connection between the database and INTERLIS** was created with the **ili2ora** to tool.

Then, **all the INTERLIS files** (e.g. ISO\_Base, LADM\_Base, LADM\_V1, and LADM\_Val\_Info\_Model, etc.) were imported to the database **one by one**.



# Challenges encountered in INTERLIS implementation

There are a number of challenges in the transformation phase such as;

- **IMPORT statements** in the INTERLIS files were not processed by ili2ora in some cases and it creates confusions since the data types defined in one INTERLIS files could not use by another file, therefore, **corresponding database schema cannot be created**.
- The **rendering of relations** between classes in database is another limitation of the ili2ora tool. The relations between classes defined in INTERLIS files (e.g. association relation) were not mapped to the Oracle database.
- The most of the Primary Keys (PK) were automatically converted into ORACLE database schema, **Foreign Keys (FK)** and **indexes** were missing in the created database.
- All the table in the model were created in the database. This may create negative effects in database performance
- Some **manual fine-tuning** are **needed** when creating an Oracle database from INTERLIS files with the INTERLIS tools.
- As stated by Kalogianni (2016), deriving a physical model from the conceptual using INTERLIS tools is a **repetitive** and **circular process**.

# Conclusions

## Concluding remarks

- The INTERLIS tools provide **maximum reuse of existing standards** for implementing **system-neutral** and **computer-processable** models.
- The use of INTERLIS tools can provide **semantic and syntactic interoperability**. Moreover, there are also some features that make INTERLIS standard and tools unique, such as **3D geometry support** including GM\_Solid, 3D topology, **open source tools, model validation,** and **automatic conversion of constraint from conceptual to technical model**. The usage of INTERLIS may **speed up the prototype implementation processes**.

## Future works

- Improving the INTERLIS description of LADM Valuation Model and Turkish Country Profile.
- Automated transformation of spatial constraints in LADM.

Questions / Comments ?