

# **Towards an international information standard for immovable property valuation**

**&**

## **A knowledge organization system for the development of ISO 19152:2012 LADM Valuation Module**

**Volkan Çağdaş, Yıldız Technical University, Turkey**

Abdullah Kara, Yıldız Technical University, Turkey

Ümit Işıkdag, Mimar Sinan Fine Arts University, Turkey

Peter van Oosterom, Delft University of Technology, The Netherlands

Christiaan Lemmen, Kadaster International, The Netherlands

Erik Stubkjær, Aalborg University, Denmark

**79<sup>th</sup> FIG Working Week, 29 May - 2 June 2017, Helsinki / Finland**

# Research domain – Valuation aspect of land administration

## HABITAT III - 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 ... to assess changes in land values ... (Clause 104).*

**Land administration** is the processes of determining, recording and disseminating information about the ownership, **value** and use of land.

**Management of value information has not been addressed in research and standardization.**

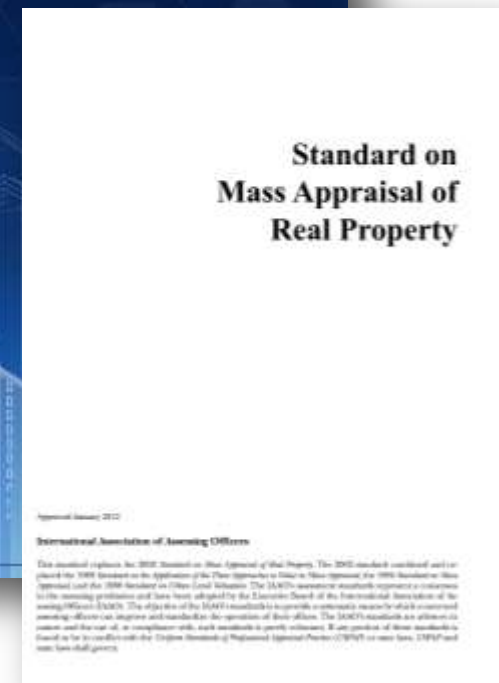
This research presents a **valuation information model** which provides a template for the specification of **valuation databases** used for recurrently levied property taxes.

Land (Real Estate) Mass Valuation Systems  
for Taxation Purposes in Europe



# Valuation standards

- International Valuation Standards, International Valuation Standards Council (IVSC)
- European Valuation Standards, The European Group of Valuers' Associations (TEGoVA)
- Standard on Mass Appraisal of Real Property, International Association of Assessing Officers (IAAO)
- Standard on Ratio Studies, International Association of Assessing Officers (IAAO)



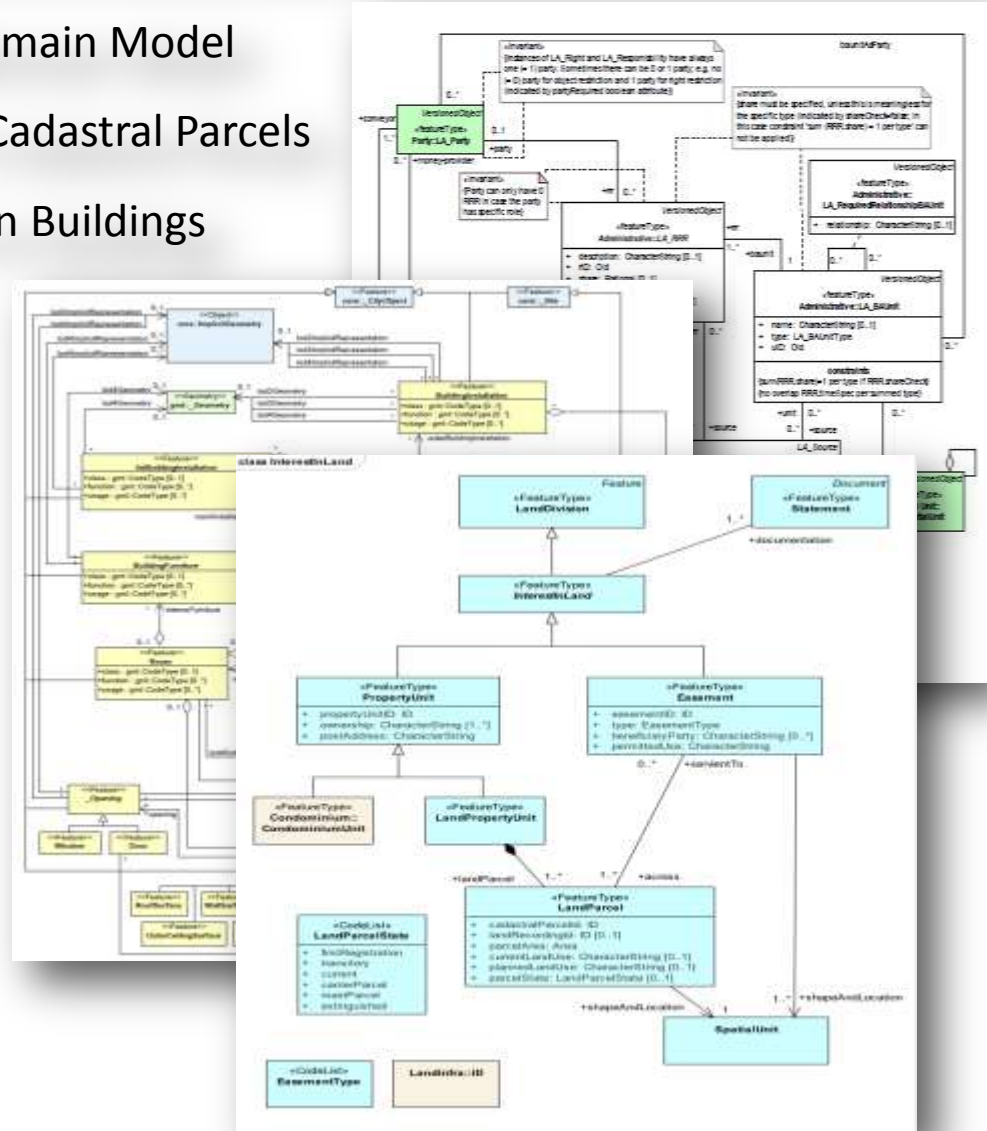
# Area and volume measurement standards

- EN 15221-6:2011 Facility Management, Part 6: Area and Space Measurement in Facility Management
- ISO 9836:2011 Performance Standards in Building – Definition and calculation of area and space indicators
- International Property Measurement Standards: Office Buildings
- RICS Code of Measuring Practice



# Geographic information standards

- ISO 19152:2012 Land Administration Domain Model
- INSPIRE D2.8.I.6 Data specifications on Cadastral Parcels
- INSPIRE D2.8.III.2 I Data specifications on Buildings
- OGC CityGML
- OGC LandInfra / InfraGML
- OGC IndoorGML



# Research problem, aim and methodology

**Problem** - No standardized information model that defines the semantics of valuation databases or registries.

**Aim** - An information model for valuation databases for public valuations for recurrently levied immovable property taxes.

## Stage 1 - Identification of valuation domain semantics

- **Method** – A linguistic analysis for procedural valuation standards
- **Output** – A knowledge organization system for property valuation domain in terms of thesaurus

## Stage 2 - Identification of country applications

- **Method** – Questionnaire based country analyses
- **Output** – Description of valuation system in respondent countries

## Stage 3 - Evaluation of existing geographic information standards

- **Method** – A comparative analysis for geographic information standards
- **Output** – Selection of base standard for valuation information model

## Stage 4 - Development a valuation information model

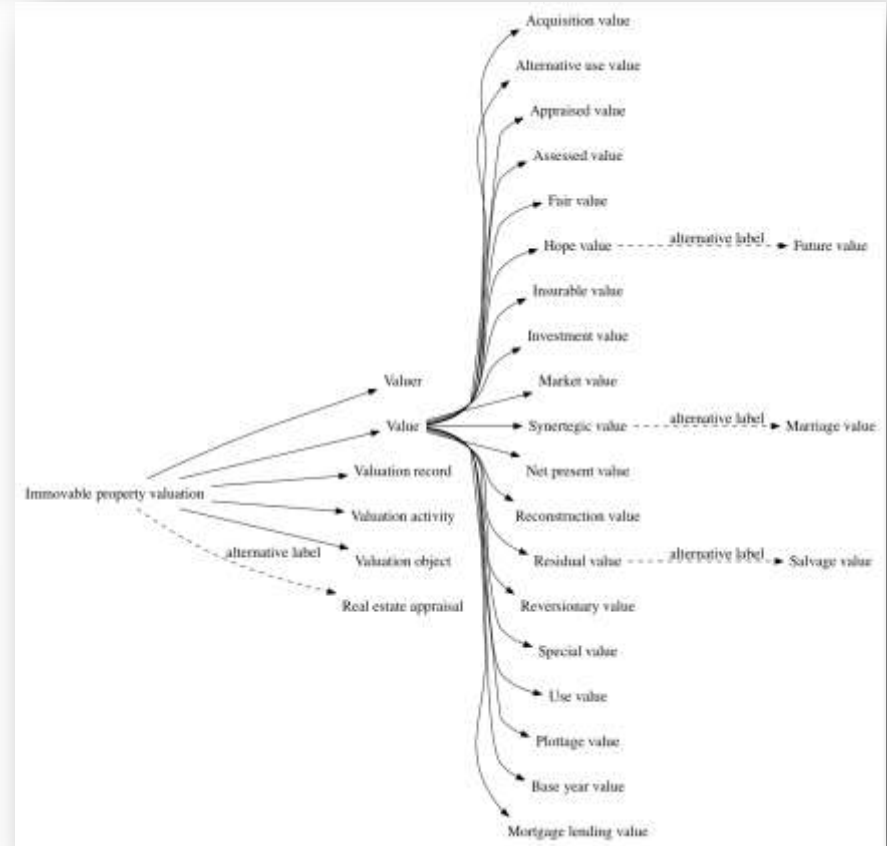
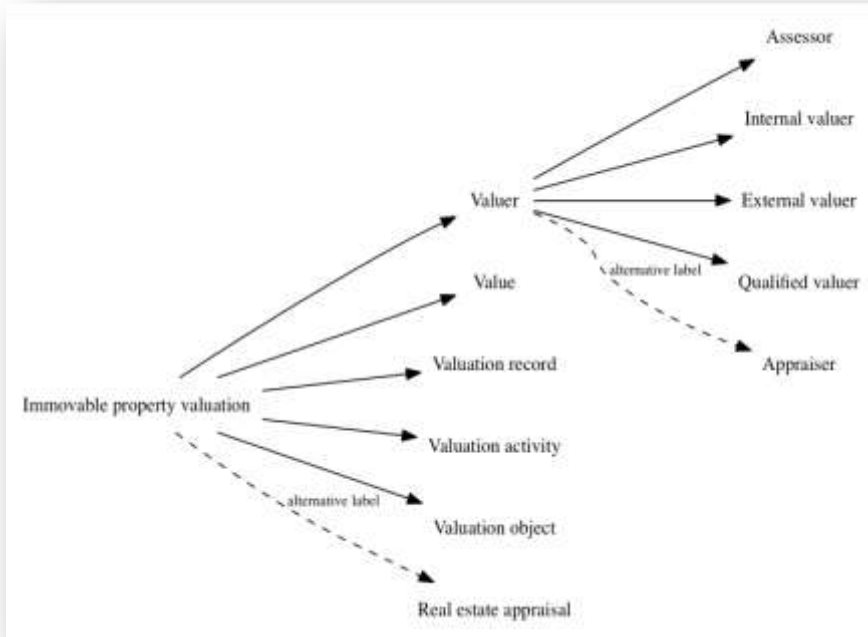
- **Method** – Data modeling based on findings of the previous analyses
- **Output** - A conceptual valuation information model based on ISO LADM

# Stage 1 – Identification of valuation domain semantics

## An Immovable Property Valuation

**Thesaurus** was developed in order to reveal core semantic (terms and term relationships) of the valuation domain.

The purpose is to support the identification of candidate classes and attributes for the development of valuation information model.



**The thesaurus consists of five concept collections and 139 terms derived from glossaries and main text of the international valuation standards.**

# Stage 1 – Identification of valuation domain semantics

The thesaurus was encoded through the Simple Knowledge Organization Systems (SKOS) specifications developed by W3C. See, <http://cadastralvocabulary.org/IPVT.rdf>.

```
- <rdf:RDF xml:lang="en">
- <skos:ConceptScheme rdf:about="http://www.cadastralvocabulary.org/IPVT">
  <skos:prefLabel>Immovable property valuation</skos:prefLabel>
  <skos:altLabel>Real estate appraisal</skos:altLabel>
- <dc:title>
  IPVT - Immovable Property Valuation Term , version 1.0
</dc:title>
<skos:description>IPVT - Immovable Property Valuation Term</skos:description>
<dc:description>IPVT - Immovable Property Valuation Term</dc:description>
<dc:creator>Volkan Cagdas</dc:creator>
<dc:date>2017-04-01</dc:date>
<dc:issued>2017-04-01</dc:issued>
<skos:hasTopConcept rdf:resource="http://www.cadastralvocabulary.org/IPVT/Valuer"/>
<skos:hasTopConcept rdf:resource="http://www.cadastralvocabulary.org/IPVT/Value"/>
<skos:hasTopConcept rdf:resource="http://www.cadastralvocabulary.org/IPVT/ValuationRecord"/>
<skos:hasTopConcept rdf:resource="http://www.cadastralvocabulary.org/IPVT/ValuationActivity"/>
<skos:hasTopConcept rdf:resource="http://www.cadastralvocabulary.org/IPVT/ValuationObject"/>
</skos:ConceptScheme>
- <skos:Concept rdf:about="http://www.cadastralvocabulary.org/IPVT/ImmovablePropertyValuation">
  <skos:prefLabel>Immovable property valuation</skos:prefLabel>
  <skos:scopeNote>IVSC Valuation Standards Glossary</skos:scopeNote>
- <skos:definition>
  (1) The process of establishing the value of an asset or liability; (2) The amount representing an opinion or estimate of value (IVSC, 2016).
</skos:definition>
<skos:changeNote>Established with version 1.0</skos:changeNote>
<skos:inScheme rdf:resource="http://www.cadastralvocabulary.org/IPVT"/>
<skos:altLabel>Real Estate Appraisal</skos:altLabel>
<skos:narrower rdf:resource="http://www.cadastralvocabulary.org/IPVT/Valuer"/>
<skos:narrower rdf:resource="http://www.cadastralvocabulary.org/IPVT/Value"/>
<skos:narrower rdf:resource="http://www.cadastralvocabulary.org/IPVT/ValuationRecord"/>
<skos:narrower rdf:resource="http://www.cadastralvocabulary.org/IPVT/ValuationActivity"/>
<skos:narrower rdf:resource="http://www.cadastralvocabulary.org/IPVT/ValuationObject"/>
</skos:Concept>
- <skos:Concept rdf:about="http://www.cadastralvocabulary.org/IPVT/Valuer">
  <skos:prefLabel>Valuer</skos:prefLabel>
<skos:changeNote>Established with version 1.0</skos:changeNote>
<skos:inScheme rdf:resource="http://www.cadastralvocabulary.org/IPVT"/>
<skos:altLabel>Appraiser</skos:altLabel>
<skos:broader rdf:resource="http://www.cadastralvocabulary.org/IPVT/IPVT/ImmovablePropertyValuation"/>
<skos:narrower rdf:resource="http://www.cadastralvocabulary.org/IPVT/Assessor"/>
<skos:narrower rdf:resource="http://www.cadastralvocabulary.org/IPVT/InternalValuer"/>
<skos:narrower rdf:resource="http://www.cadastralvocabulary.org/IPVT/ExternalValuer"/>
<skos:narrower rdf:resource="http://www.cadastralvocabulary.org/IPVT/QualifiedValuer"/>
```



# Stage 2 – Identification of country applications

A questionnaire based dataset has been obtained from delegates of FIG Comm. 7 and Comm. 9 in order to create an inventory that reveals commonalities and differences among valuation systems used for recurrently levied property taxes.

Section A. General questions for property valuation systems in XX country	
Questions	Responses
1. Please indicate the organizations responsible for valuation of properties for property taxation purposes through name in national language and English translation.	
2. What are the types of valuation for property taxation (e.g. unimproved parcel, building)? Name and date of the ordinance to be listed.	
3. Please mention value type (e.g. market value, tax value, capital value) used by the responsible organization for property taxation?	
4. Please mention the public registry datasets (e.g. cadastre, land registry, building registry) which are used in valuation procedures, and their mutual functions?	
5. Which methods are applied for collecting market data needed for valuation?	
6. Is there any special valuation database for storing datasets used in (e.g. property characteristics) or produced with (e.g. sales statistics) valuation procedures? If yes, please give the name of database, indicate responsible authority, and describe its content.	
7. Is there a web-based dissemination of valuation information? If yes, please indicate which data (e.g. sales statistics) is open to the public.	
8. How frequently are general revaluations made?	
9. Is there a system of indexation affecting property value between regular revaluations?	
10. Do taxpayers have a right to appeal against the appraised values? If yes, please indicate how disputes are resolved.	

Section B - Questions for mass appraisal procedures in XX country	
Questions	Responses
1. Do you have a (computer aided) mass appraisal system in your country? If yes, please indicate also responsible authorities.	
2. Is there any other use of the mass appraisal system than property taxation?	
3. Which CAD/GIS/CAMA (Computer-aided design / Geographic information system / Computer Assisted Mass Appraisal) software packages are used in mass appraisal?	
4. Which geographical or spatial datasets are used in mass appraisal? Please describe the source of these datasets.	
5. Which geographic or spatial analysis methods (e.g. visibility analysis, proximity analysis) are applied in mass appraisal?	
6. Is three-dimensional (3D) data used in mass appraisal? Please describe source of 3D data (e.g. floor plans). Does Valuation objects include condominium, strata title, freehold flats or other 3D units.	
7. Is there any relationship between the CAMA system and other public registers (e.g. cadastre, land registry, building registry, ...)?	
8. Please describe the statistical models (e.g. additive, multiplicative) applied in mass appraisal according to type or functions of properties?	
9. Please indicate statistical analysis methods (e.g. multiple regression analysis, artificial neural network) applied in mass appraisal?	
10. Which land use characteristics (e.g. land use zones) are used as variables in mass appraisal models? Please describe the source(s) of these characteristics.	
11. Which environmental and locational characteristics (e.g. location nuisance, distance to points of interest / POIs, environmental risks) are used as variables in mass appraisal models? Please describe the source(s) of these characteristics.	

Section C. Questions for single property valuation procedures in XX country	
Questions	Responses
1. Which valuation methods are used for single property appraisal for property taxation? Please relate valuation methods with the type of valuation objects (e.g. sales comparison approach for unimproved parcels).	
2. Which geographical or spatial datasets are used for single property appraisal? Please describe the source(s) of these datasets.	
3. Which legal property characteristics (e.g. property rights) are taken into account for single property appraisal? Please describe also the source of these characteristics.	
4. Which land use characteristics (e.g. land use zones) are taken into account for single property appraisal? Please describe also the source(s) of these characteristics.	
5. Which environmental and locational characteristics (e.g. location nuisance, distance to POIs, environmental risks) are taken into account for single property appraisal? Please describe the source(s) of these characteristics.	
6. Which building or improvement characteristics (e.g. number of unit, construction type and material) are taken into account for single property appraisal? Please describe the source(s) of these characteristics.	
7. If there is a special valuation database, please indicate which sales comparison method related data (e.g. comparable property identifiers, monetary adjustment for time, physical differences) are kept in this database.	
8. If there is a special valuation database, please indicate which cost method related data (e.g. type and source of cost price, chronological age, depreciations) are kept in this database.	

# Stage 2 – Identification of country applications

24 responses from 22 countries are available at <http://isoladm.org/ValuationQuestionnaire>

The screenshot shows a TU Delft Wiki page. The header includes the TU Delft logo and navigation options like 'Log In', 'Jump', and 'Search'. The main content area is titled 'Questionnaire for the development of ISO 19152:2012 LADM Valuation Module'. The text describes a collaborative research project aimed at developing a LADM-based international information model for external registrations. It mentions the purpose of the questionnaire is to define the semantics of valuation information and extend the scope of LADM from a fiscal perspective. The page also includes a list of contact persons: Volkan Cagdas, Peter van Oosterom, and Erik Stubkjaer.

Some results are ...

## Respondents

1. Argentina (D. A. Erba, C. A. Basilio)
2. Bolivia (J. G. A. Flores)
3. Brazil (E. Silva)
4. Colombia (D. R. Gutiérrez)
5. Costa Rica (J. M. Díaz)
6. Croatia (H. Tomić)
7. Cyprus (A. Aristidou)
8. Denmark (E. Stubkjaer)
9. Denmark (M. Velpuri)
10. Ecuador (F. R. Bueno)
11. Greece (P. Chryssy)
12. India (M. Velpuri)
13. Latvia (R. Pētersone)
14. Macedonia (V. Miskovski)
15. The Netherlands (R. Kathmann)
16. Poland (P. Parzych, J. Bydłosz)
17. Singapore (M. Velpuri)
18. Slovenia (D. Mitrović)
19. South Africa (M. Velpuri)
20. South Korea (L. Young-ho, K. Bong-Jun)
21. Spain (A. Velasco)
22. Turkey (V. Çağdaş, A. Kara)
23. UK (B. Elder)
24. UK (P. Wyatt)

# Stage 2 – Identification of country applications

**A1 - Please indicate the organizations responsible for valuation of properties for property taxation purposes through name in national language and English translation.**

<b>Ministry of Finance / Taxation</b>	Croatia, Denmark, Greece, Singapore
<b>Municipalities / local governments</b>	Macedonia, Turkey, the Netherlands, Bolivia, Brazil, Costa Rica, Ecuador, South Africa, India
<b>Surveying and cadastral authorities</b>	Slovenia, Cyprus, Argentina, Colombia, Spain
<b>Other authorities</b>	South Korea (Ministry of Land, Infrastructure and Transport), Latvia (State Land Service under Ministry of Justice)

**A3 - Please mention value type (e.g. market value, tax value, capital value) used by the responsible organization for property taxation?**

<b>Annual value</b>	Singapore, India
<b>Book value</b>	Poland (for commercial properties)
<b>Cadastral value</b>	Spain
<b>Capital value</b>	India
<b>Commercial value</b>	Costa Rica (for commercial properties)
<b>Market value</b>	Brazil, Colombia, Croatia, Cyprus, Denmark, Ecuador, Latvia, Macedonia, Slovenia, the Netherlands, United Kingdom (for domestic dwellings)
<b>Rateable value</b>	United Kingdom (for non-domestic hereditaments)
<b>Self assessed value</b>	Bolivia
<b>Tax value</b>	Greece, South Korea, Turkey
<b>Area</b>	Poland (for properties other than commercial)

# Stage 2 – Identification of country applications

**A4 - Please mention the public registry datasets (e.g. cadastre, land registry, building registry) which are used in valuation procedures, and their mutual functions?**

<b>Cadastre</b>	Croatia, Macedonia, Slovenia, Turkey, the Netherlands, Argentina, Brazil, Colombia, Costa Rica, Ecuador, Latvia, Poland, South Africa, South Korea
<b>Land register</b>	Croatia, Slovenia, Turkey, Latvia, Poland
<b>Municipal registers / inventories</b>	Denmark, Macedonia, Turkey, Bolivia, Costa Rica
<b>Address register</b>	Slovenia, Turkey, the Netherlands,
<b>Land use plans</b>	Slovenia, Turkey
<b>Other inventories</b>	United Kingdom (Rating List, Council Tax List), Cyprus (Land Information System), the Netherlands (Base register for inhabitants and companies), Costa Rica (building permits), India (Property and Vacant Land Tax Information System)

**A5 - Which methods are applied for collecting market data needed for valuation?**

<b>Public registries</b>	Croatia, Denmark, Macedonia, Slovenia, the Netherlands, Ecuador, Latvia, South Korea, Spain
<b>Declaration / statements (by request)</b>	Denmark, Greece, Macedonia, United Kingdom, the Netherlands, Brazil, India, South Africa, Spain
<b>Field investigation</b>	Macedonia, Cyprus
<b>Other sources (Internet, newspapers)</b>	Brazil, Colombia, India, Spain
<b>Market data is not collected</b>	Argentina, Costa Rica, Turkey, Poland

# Stage 2 – Identification of country applications

**A6 - Is there any special valuation database for storing datasets used in (e.g. property characteristics) or produced with (e.g. sales statistics) valuation procedures?**

<b>Yes, national level</b>	Croatia (eProperty), Denmark (SVUR), Greece (TAXIS), Macedonia (Registry for Lease and Prices), Slovenia (Real Estate Valuation Database), United Kingdom (VOA & Land Registry), Cyprus (Computerised Integrated Land Information System), the Netherlands (Basisregistratie WOZ), India (Property and Vacant Land Tax Information System), Latvia (Real Estate Market Database), Singapore, South Africa (eCadastre), Spain (Cadastre)
<b>Yes, municipal level</b>	Turkey, Bolivia, Costa Rica, South Korea
<b>Yes, other</b>	Poland (local appraisal associations)
<b>No</b>	Argentina, Brazil, Colombia, Ecuador

**B1 - Do you have a (computer aided) mass appraisal system in your country? If yes, please indicate also responsible authorities?**

<b>Yes</b>	Denmark, Slovenia, the Netherlands, Cyprus, Spain, South Korea, South Africa, Latvia, India, Costa Rica (partly), Colombia (partly), Brazil, Bolivia
<b>No</b>	Croatia, Greece, Macedonia, Turkey, United Kingdom, Poland, Ecuador, Argentina

**B3 - Which CAD/GIS/CAMA software packages are used in mass appraisal?**

<b>In-house developed software</b>	Denmark, Slovenia, Cyprus, the Netherlands, Spain
<b>Commercial software</b>	Cyprus (SPSS), Bolivia (AutoCAD, MicroStation, ArcGIS), Colombia (ArcGIS, AutoCAD, MapInfo, QGIS, Gvsig, Erdas and econometric software), Costa Rica (ArcGIS, AutoCAD, QGIS, Gvsig),

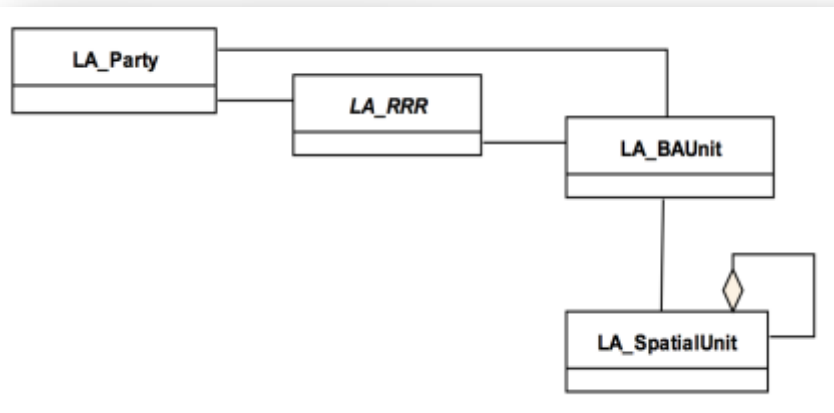
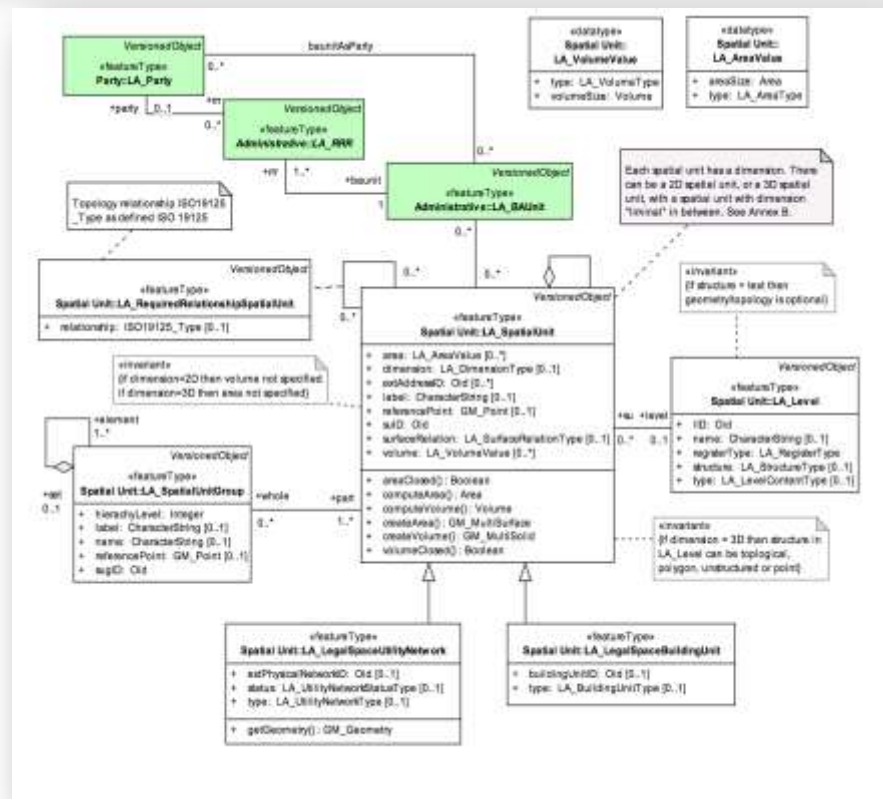
# Stage 3 - Evaluation of geographic information standards

## ISO LADM

LADM is an abstract conceptual model that focuses on the legal and geographical aspects of land administration.

The conceptual data model of LADM consists of the following three packages: (1) Administrative Package, (2) Spatial Unit Package, and (3) Party Package.

LADM also relates cadastral information systems with other property related databases, such as address, taxation and valuation databases.



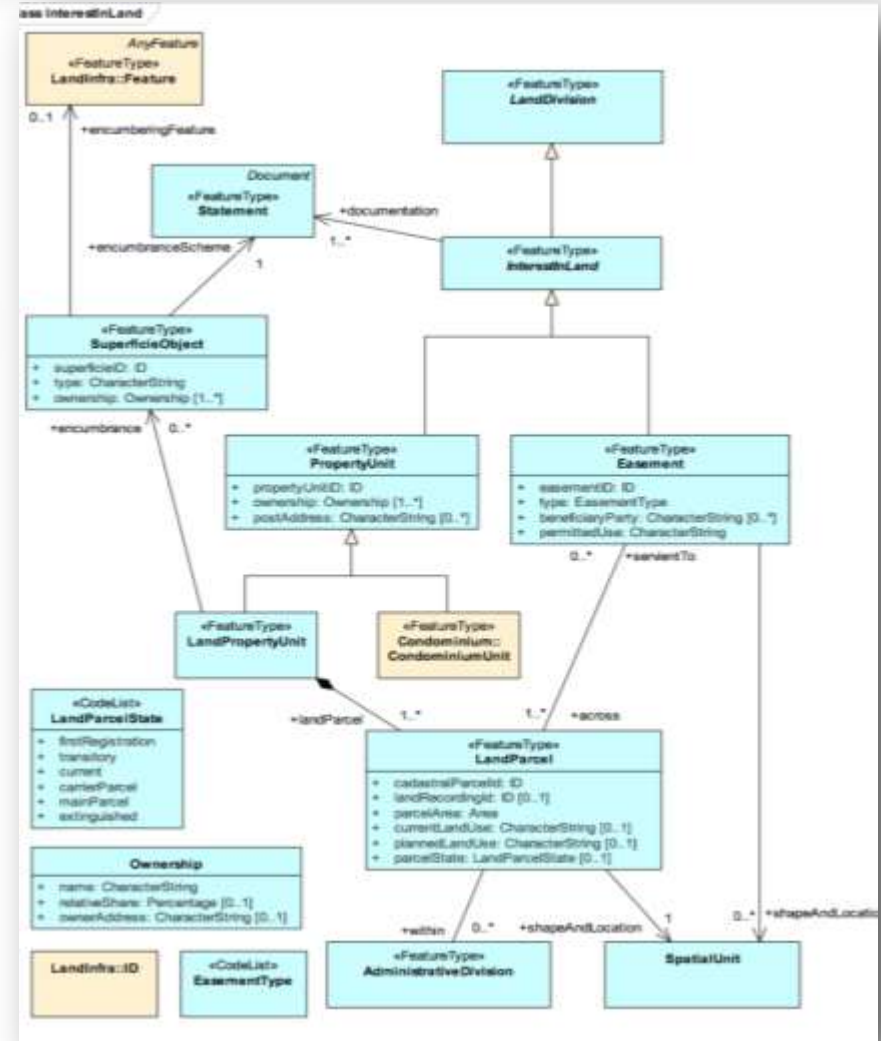
# Stage 3 - Evaluation of geographic information standards

## OGC LandInfra

OGC LandInfra is a conceptual data model focusing on land and civil engineering facilities.

LandInfra's **LandDivision** and **Condominium** packages specify the representation of **property units, land parcels, and condominiums.**

The scope is limited to activities in respect to infrastructure facilities, therefore attributes assigned to mentioned packages are related to determination and surveying of boundaries of divisions of land.



# Stage 3 - Evaluation of geographic information standards

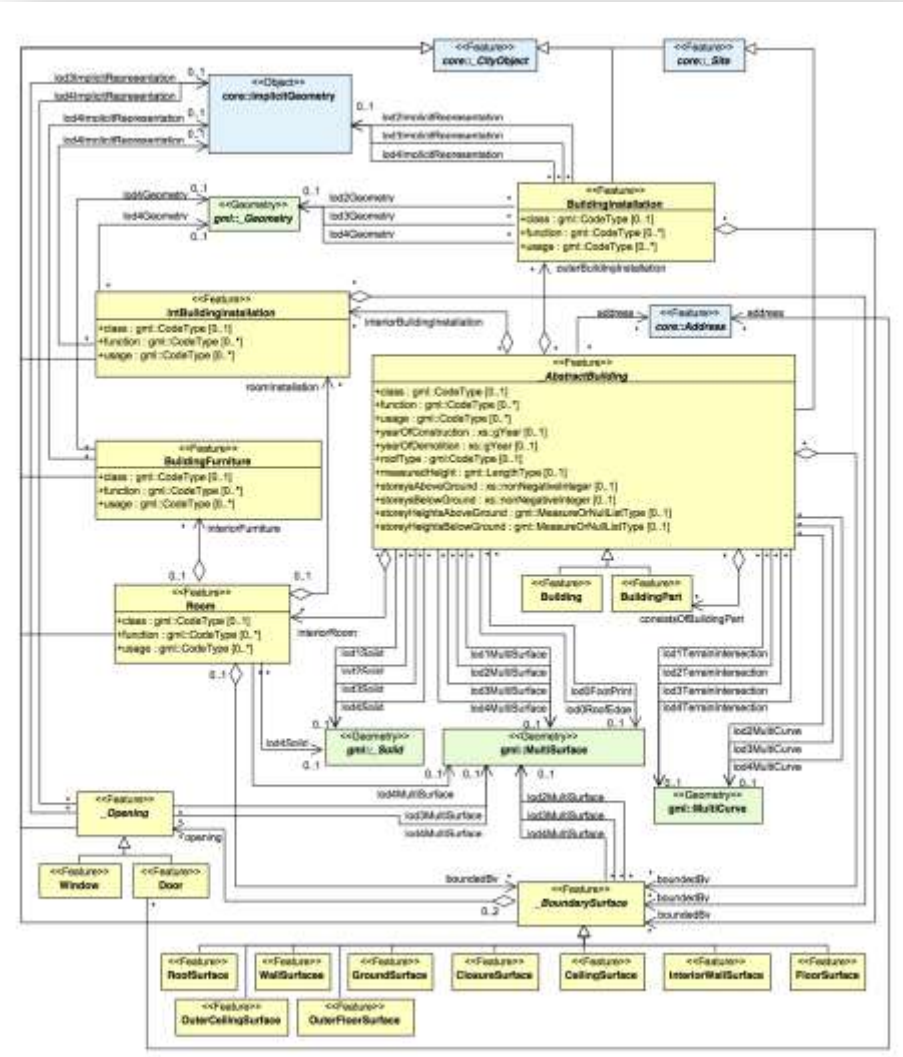
## OGC CityGML

CityGML is an XML-based format for the storage and exchange of virtual 3D city models.

CityGML's **Building** module specifies **buildings, building parts, and their physical features**, such as **installations** (chimneys, stairs, balconies), **rooms** and **interior installations** (stairs, railings, radiators).

## OGC IndoorGML

IndoorGML specifies indoor space (e.g. rooms, corridors) bounded by architectural components (e.g. roofs, walls) from geometric, cartographic, and semantic viewpoints.

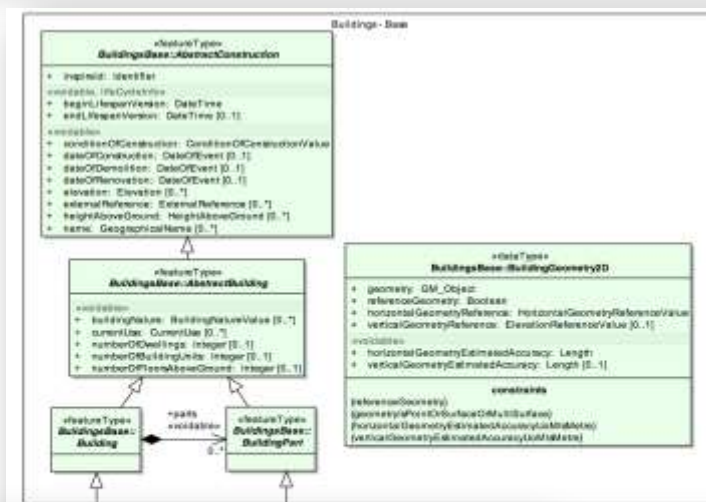




# Stage 3 - Evaluation of geographic information standards

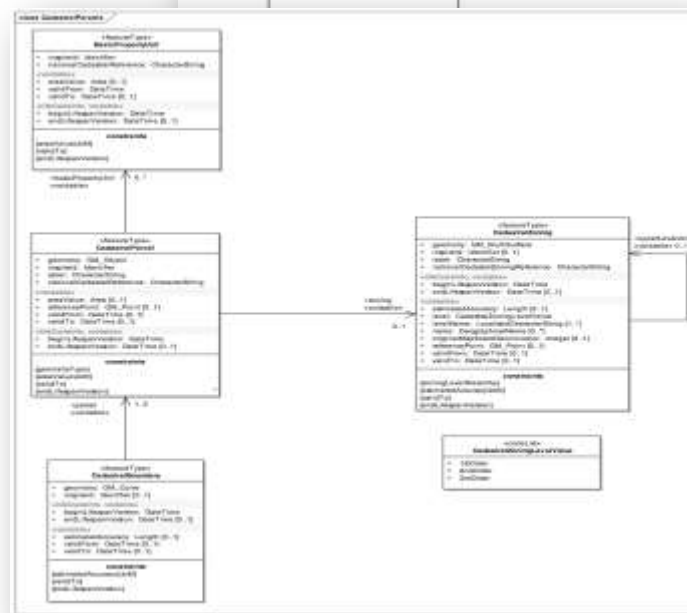
## INSPIRE Data Specification on Buildings (INSPIRE BU)

INSPIRE BU provides four profiles for representations of **constructions, buildings, building parts**, and **their features** with different levels of detail in geometry and semantics.



## INSPIRE Data Specification on Cadastral parcel (INSPIRE CP)

INSPIRE CP is concerned with the spatial aspect of immovable properties, including **basic property units** and **cadastral parcels**.



# Stage 3 - Evaluation of geographic information standards

## Main property characteristics commonly used in valuation processes (derived from international valuation standards)

<b>Land (parcel) characteristics</b>	Parcel area
	Topography
	Land use
	Private law restrictions (e.g. easement )
	Public law restrictions
<b>Improvements (e.g. building, building unit, other construction) characteristics</b>	Size
	Living area
	Age
	Effective age
	Use type
	Number of stories or floors
	Construction materials
	Construction type
	Construction quality
	Available utilities
	Building features (e.g. air-conditioning, fireplace, garage, pool)
	Energy efficiency
<b>Locational characteristics</b>	Neighborhood
	Risks of natural disasters
	Closeness to point of interests
	External nuisances (e.g. heavy traffic, airport noise)
	View

# Stage 3 - Evaluation of geographic information standards

## Representation of valuation units in geographic information standards

Valuation unit	Copponents	LADM	LandInfra	CityGML	INSPIRE
<b>Land</b>	Parcel	LA_SpatialUnit	LandParcel	-	CadastralParcel (CP)
<b>Improvements</b>	Building	LA_SpatialUnit ExtPhysicalBuildingUnit	Building CondominiumBuilding	_AbstractBuilding Building	AbstractBuilding (BU)
	Building unit	LA_SpatialUnit ExtPhysicalBuildingUnit	BuildingPart	BuildingPart Room	BuildingPart (BU) AbstractBuildingUnit (BU) Room (BU)
	Other constructions	LA_SpatialUnit ExtPhysicalBuildingUnit	SuperficieObject	-	AbstractConstruction (BU) AbstractOtherConstruction (BU)
<b>Land and improvements together as Land Property</b>	Land property	LA_BAUnit	PropertyUnit	-	BasicPropertyUnit (CP)
<b>Land and improvements together as Condominium Property</b>	Condominium main parts	LA_LegalSpaceBuildingUnit	CondominiumUnit	-	-
	Joint facilities	LA_LegalSpaceBuildingUnit	BuildingPartType	-	-
	Accessory parts	LA_LegalSpaceBuildingUnit	BuildingPartType	-	-

# Stage 3 - Evaluation of geographic information standards

## Representation of land characteristics in geographic information standards

Land characteristics	LADM	LandInfra	INSPIRE
Area	area (LA_SpatialUnit)	parcelArea (LandParcel)	areaValue (CadastralParcel) (CP)
Land use	type (ExtLandUse)	plannedLandUse (LandParcel) currentLandUse (LandParcel)	-
Easement	LA_RRR LA_Restriction	Easement	-
Public restrictions	LA_RRR LA_Restriction	Easement	Data Specification on Area Management Restriction, Regulation Zones and Reporting Units Data Specification on Land Use
Topography	-	LandElement	Data Specification on Elevation

# Stage 3 - Evaluation of geographic information standards

## Representation of improvement characteristics in geographic information standards

Improvement characteristics	LADM	LandInfra	CityGML	INSPIRE BU
<b>Size</b>	area (LA_SpatialUnit)	floorArea (BuildingPart)	-	officialArea, officialVolume (BuildingAndBuildingUnitInfo)
<b>Living area</b>	-	-	-	-
<b>Chronologic age</b>	-	-	yearOfConstruction yearOfDemolition ( _AbstractBuilding)	dateOfConstruction, dateOfDemolition (AbstractConstruction)
<b>Effective age</b>	-	-	-	dateOfRenovation (AbstractConstruction) conditionOfConstruction (AbstractConstruction)
<b>Economic life</b>	-	-	-	-
<b>Remaining economic life</b>	-	-	-	-
<b>Number of stories</b>	-	floorNumber (BuildingPart)	storeysAboveGround storeysBelowGround ( _AbstractBuilding)	numberOfFloorsAboveGround (AbstractBuilding) numberOfFloorsBelowGround (BuildingInfo)
<b>Construction materials</b>	-	-	-	materialOfStructure, materialOfFacade, materialOfRoof (BuildingInfo)
<b>Construction technique</b>	-	-	-	materialOfStructure (BuildingInfo)
<b>Construction quality</b>	-	-	-	-
<b>Available utilities</b>	utilityNetworkType (LA_LegalSpaceUtilityNetwork)  ExtPhysicalUtilityNetwork	type (FacilityPart)	/UtilityNetworkADE	connectionToElectricity, connectionToGas, connectionToSewage, connectionToWater (BuildingAndBuildingUnitInfo)
<b>Other features</b>	-	-	BuildingInstallation Room BuildingFurniture IntBuildingInstallations	numberOfDwellings, numberOfBuildingUnits (AbstractBuilding) Installation AbstractInstallation Room InteriorInstallation AbstractBuildingUnit

# Stage 3 - Evaluation of geographic information standards

## Evaluation

- LADM and LandInfra specify of all types of valuation units with different designations. They have limited attributes for the physical aspects of valuation objects.
- LandInfra is not concerned with database storage. It focuses on surveying aspect, not recording of property rights and right holders unlike LADM.
- INSPIRE applies a minimalistic approach for the specification of cadastral parcels, but exhaustive for the physical description of buildings.
- INSPIRE CP is consistent with LADM and LandInfra, but does not cover the property rights aspect.
- CityGML provides a comprehensive information model for buildings for 3D visualization purposes. Like INSPIRE BU, it has a rich set of attributes for representing physical characteristics for the buildings.
- IndoorGML has limited capabilities for the representation of valuation objects, since the focus is to provide description of indoor space for indoor navigation. It is considered out of scope for further investigation.

# Stage 3 - Evaluation of geographic information standards

## Result

LADM provides the most relevant basis for the development of a valuation information model.

## Because ...

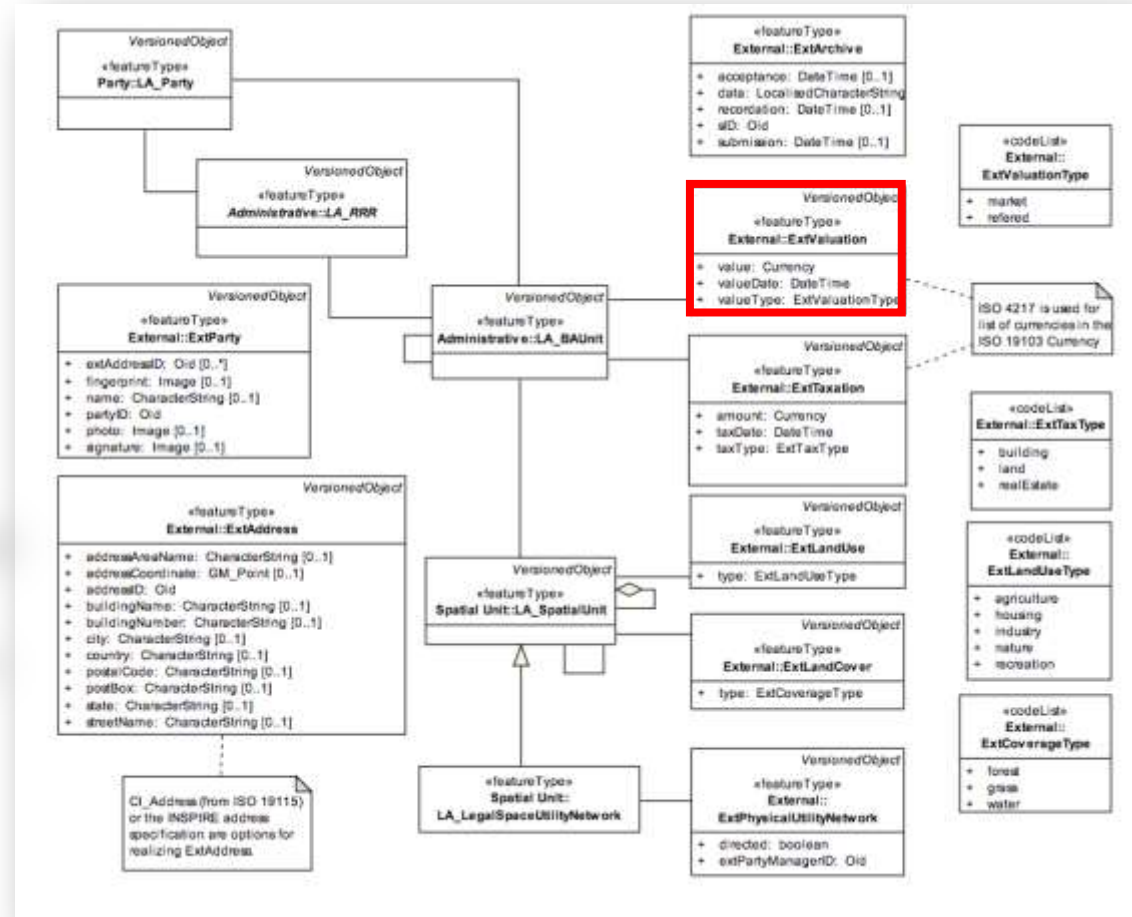
- It is an ISO standard for the domain of land administration, which is related to *management of information concerning the ownership, **value** and use of land*.
- It emphasizes the relationship to other property related databases (e.g. valuation).
- Its abstract structure provides a flexible frame for development of country specific information models.

# Stage 4 - Research statement

**Purpose:** Extend LADM from the fiscal point of view to provide an information model for valuation databases.

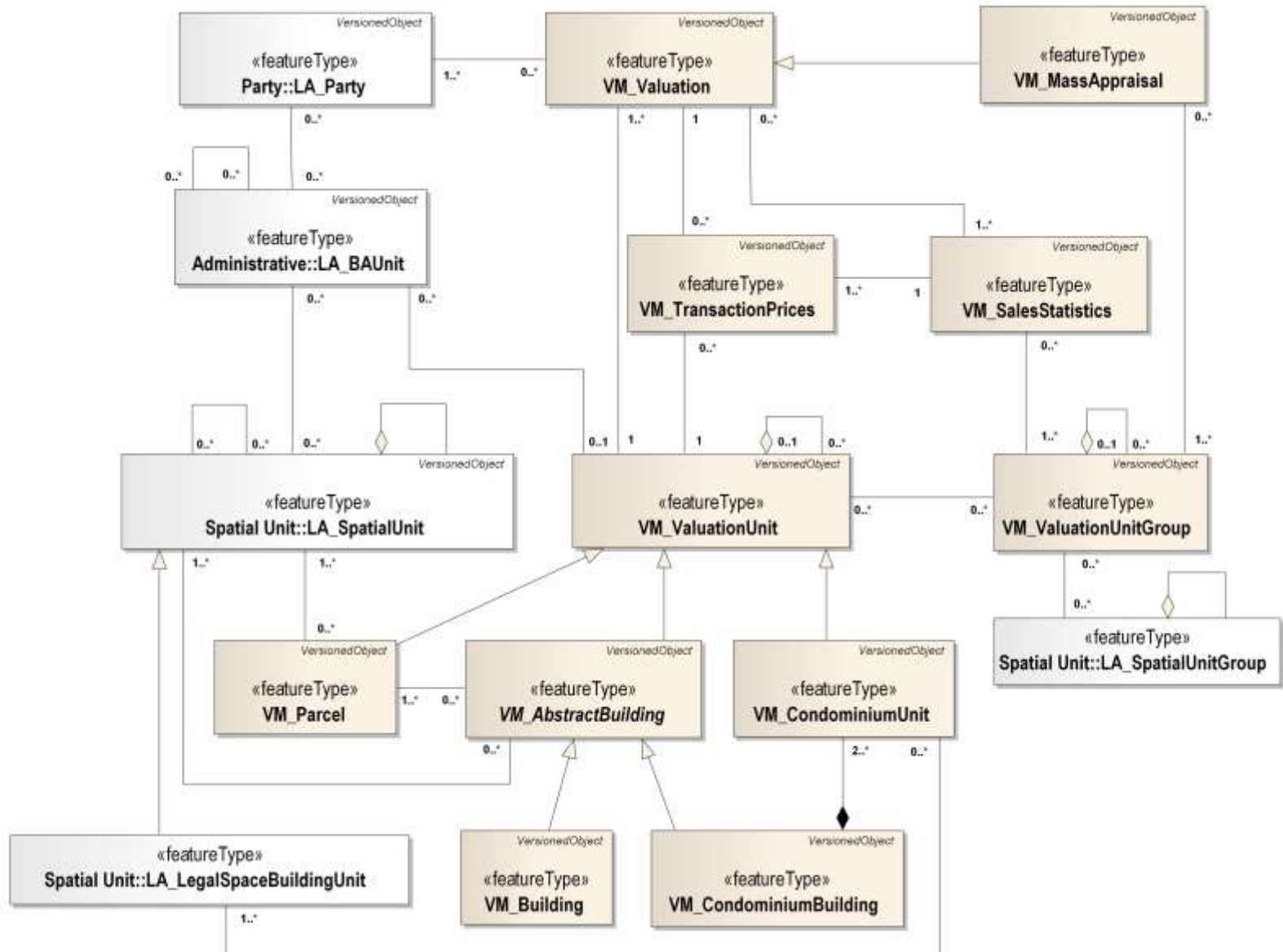
**Scope:** Administrative valuations applied for recurrently levied property taxes.

**Methodology:** Supply LADM with new classes, attributes and relationships from developed thesaurus, country applications and existing geoinformation standards.





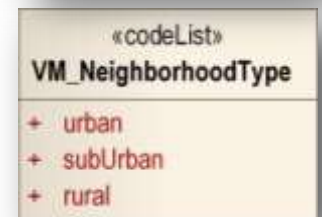
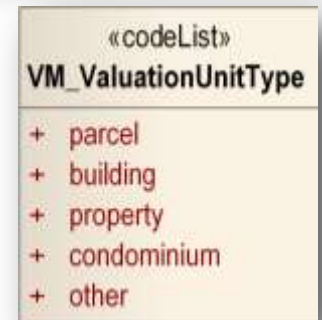
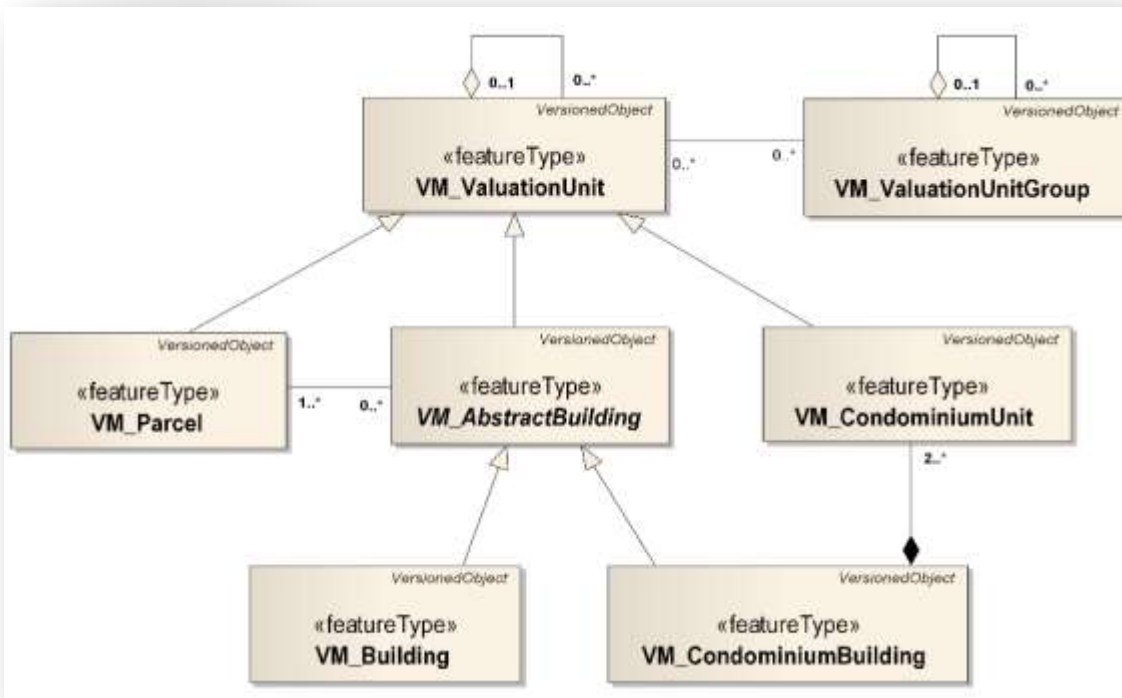
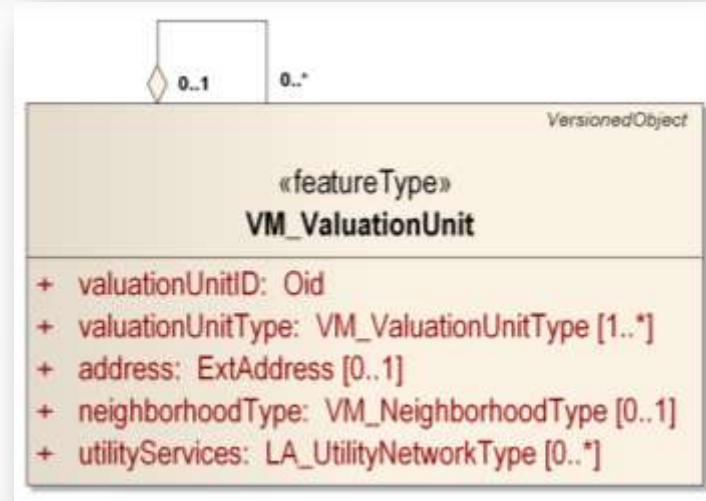
# Stage 4 – Valuation information model – Overview



# Stage 4 – Valuation information model – Valuation objects

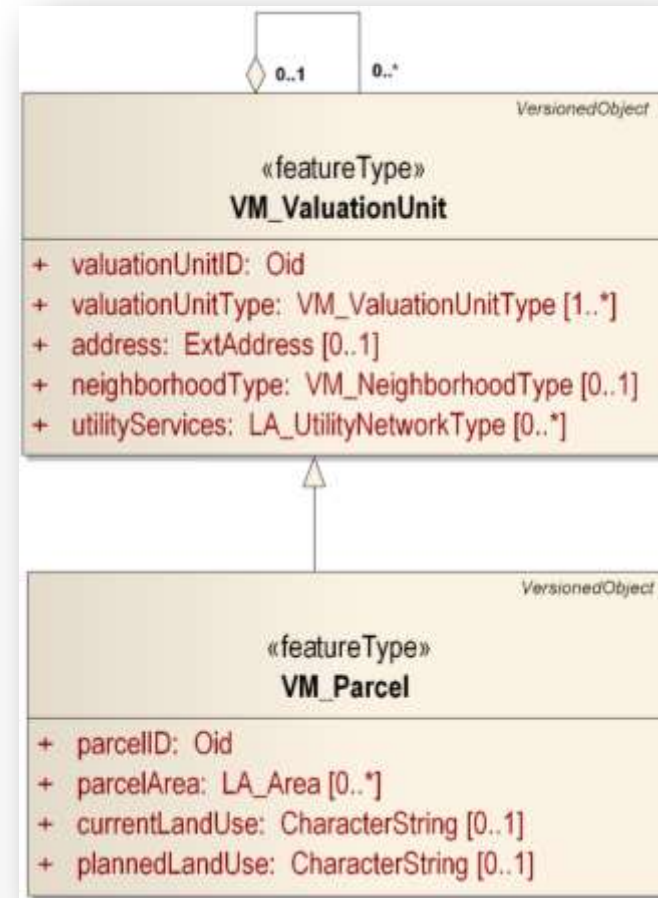
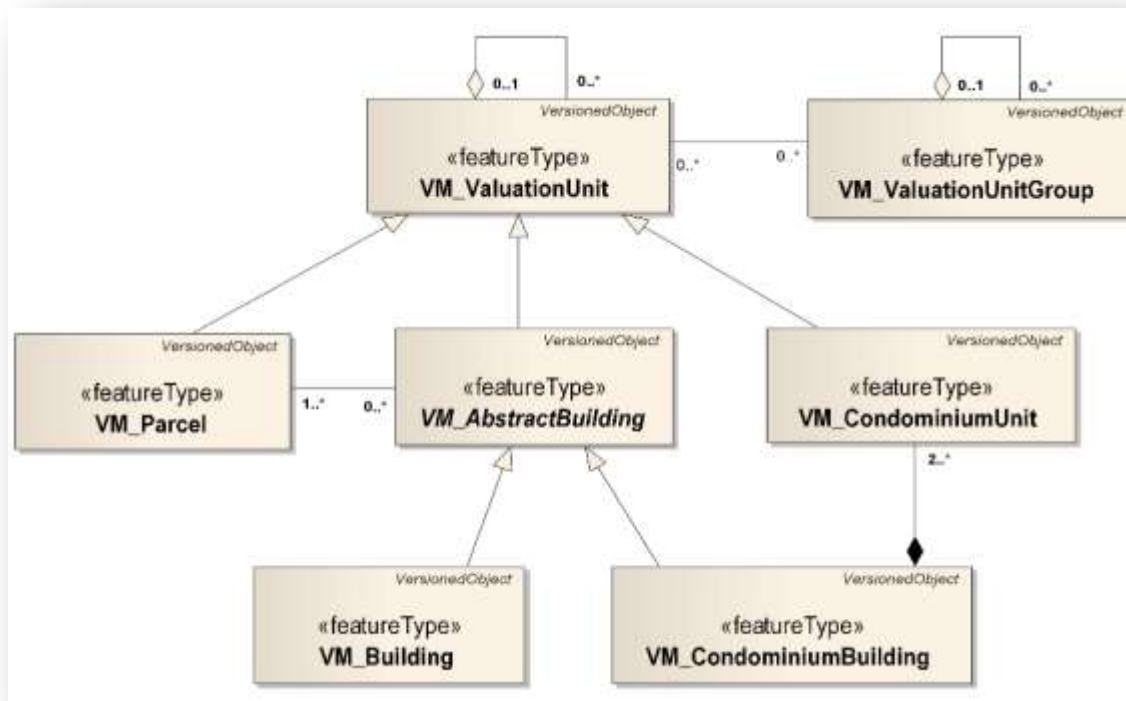
**VM\_ValuationUnit** represents basic recording units of valuation databases, such as

- Only land (e.g. parcel),
- Only improvements (e.g. buildings),
- Land and improvements together as land property,
- Land and improvements together as condominium property



# Stage 4 – Valuation information model – Valuation objects

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

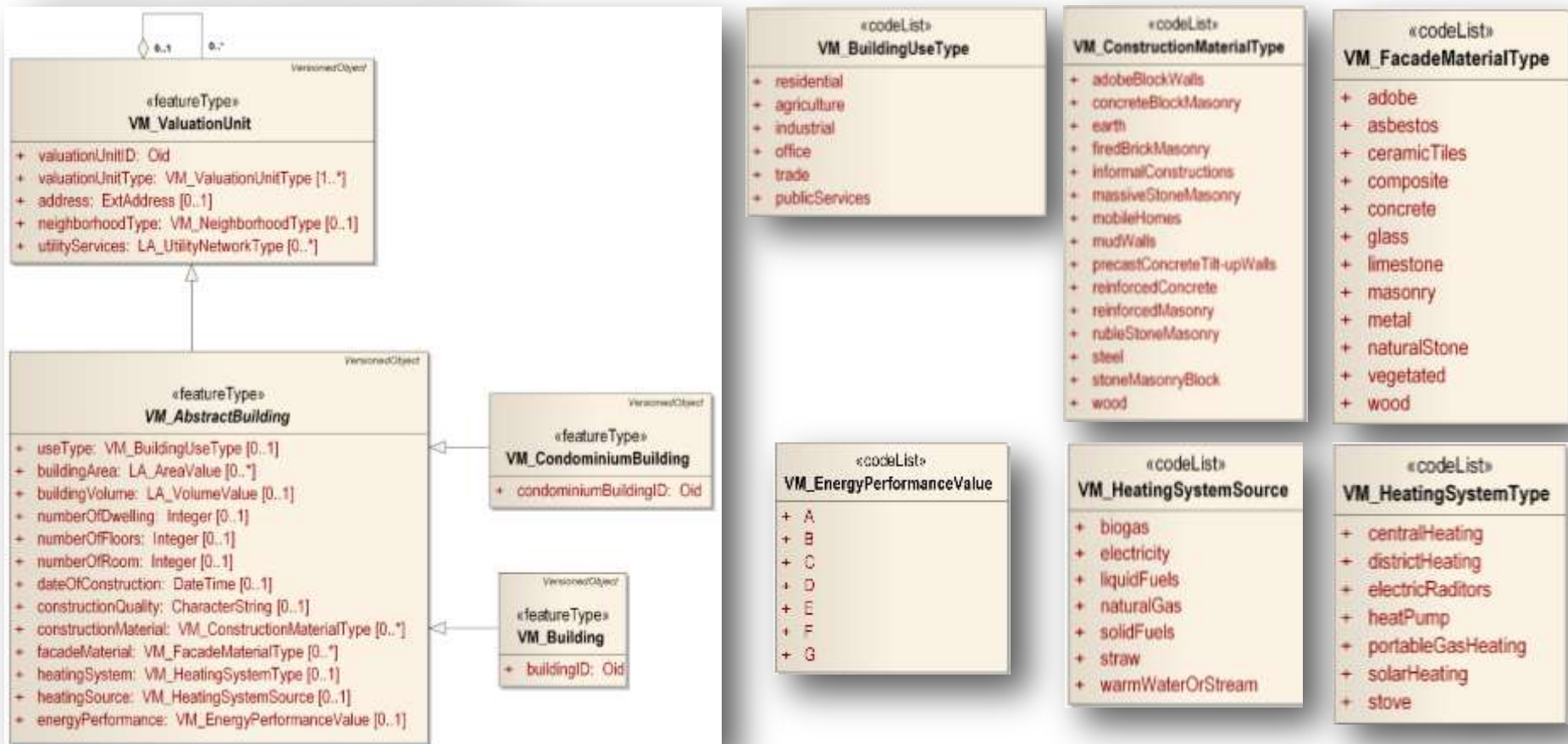


# Stage 4 – Valuation information model – Valuation objects

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

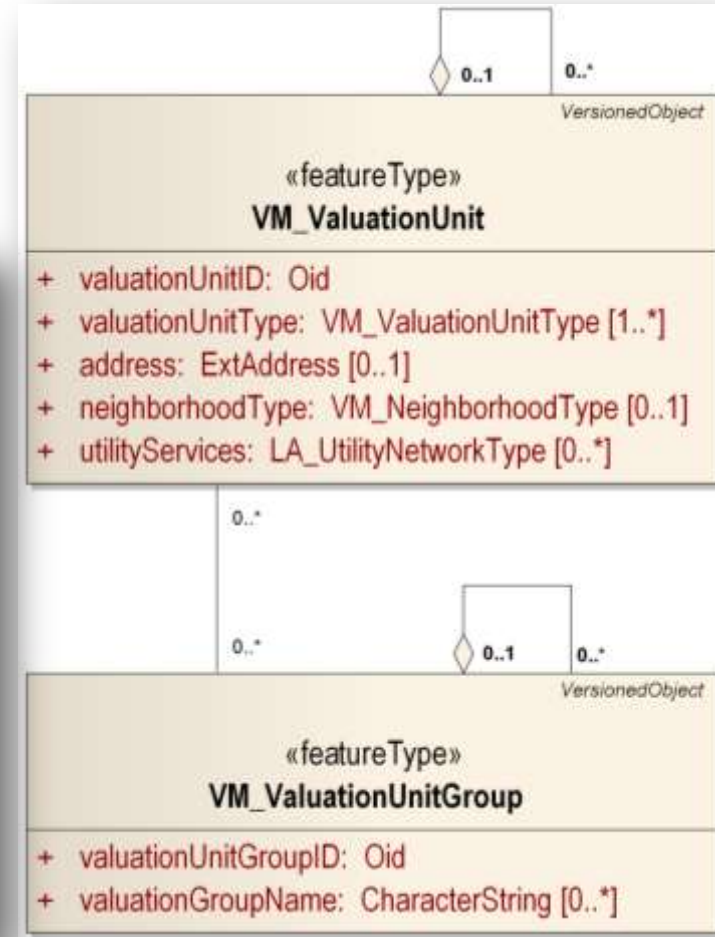
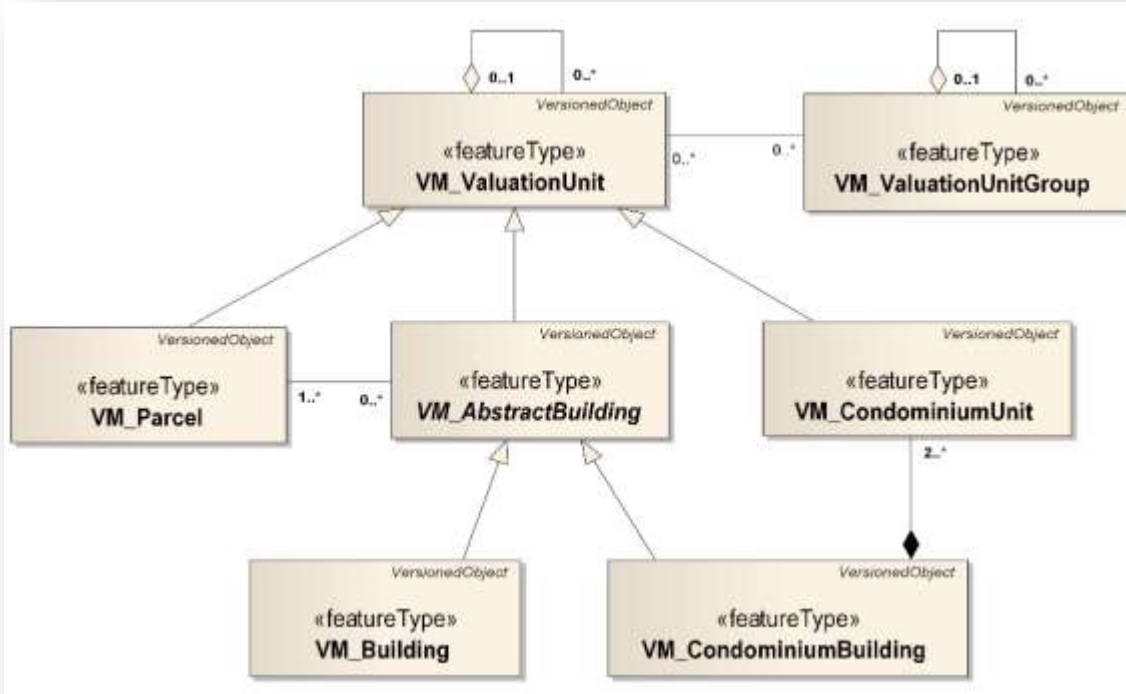
**VM\_Building** represents buildings that are considered as complementary parts of property units, which also may be taxed or valued separately from the parcels.

**VM\_CondominiumBuilding** specifies buildings that contain main condominium units, joint facilities and accessory parts.



# Stage 4 – Valuation information model – Valuation objects

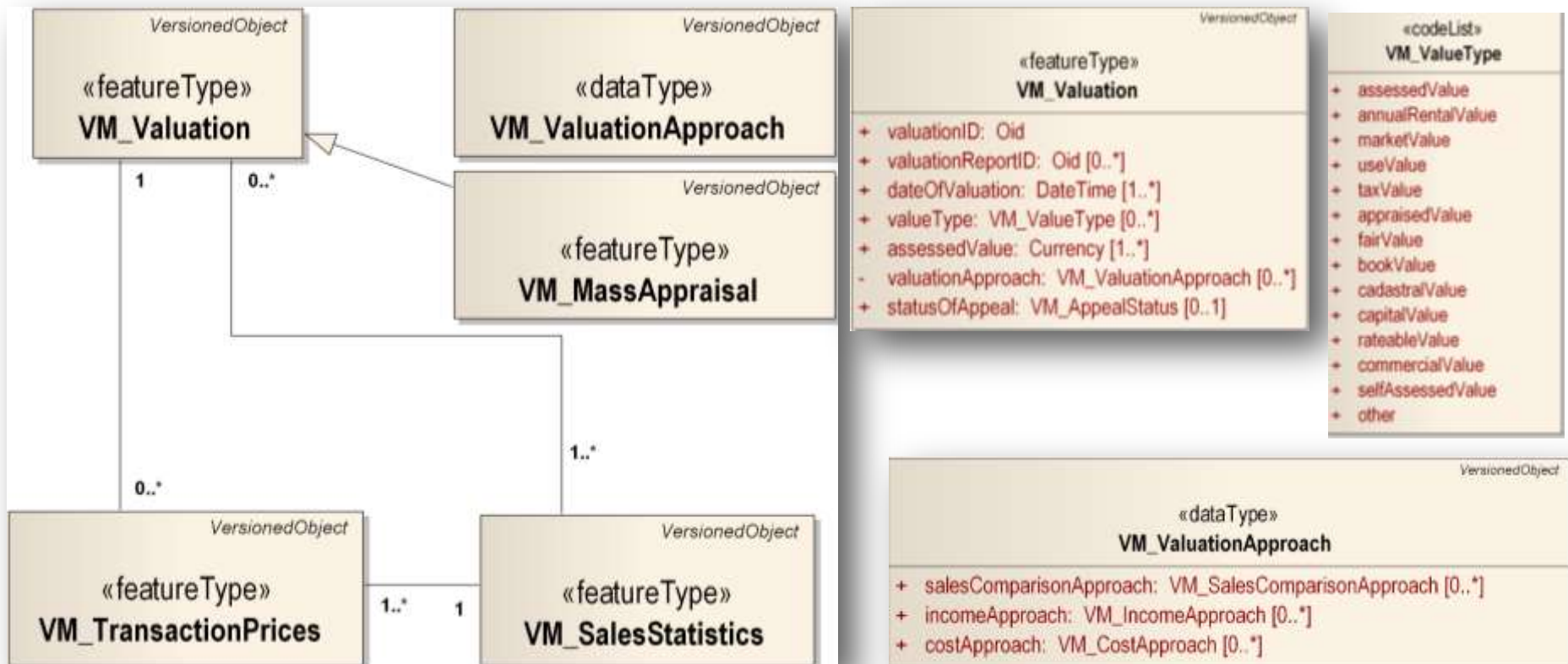
**VM\_ValuationUnitGroup** clusters valuation objects according to zones (e.g. administrative divisions, value zones) or type of valuation objects (e.g. commercial, residential) that have similar functional characteristics.



# Stage 4 – 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.

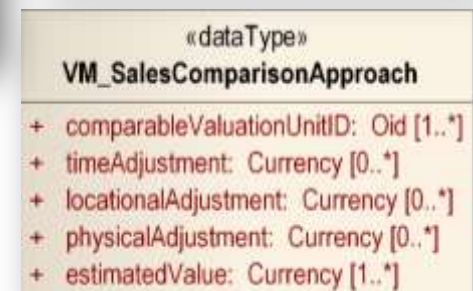
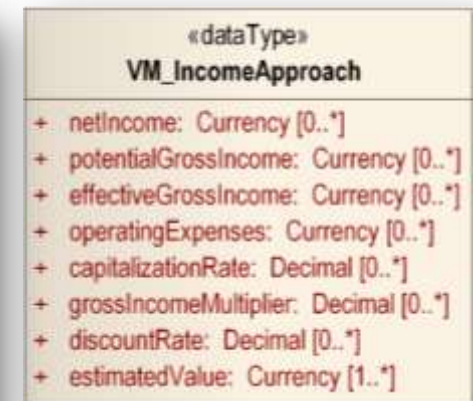
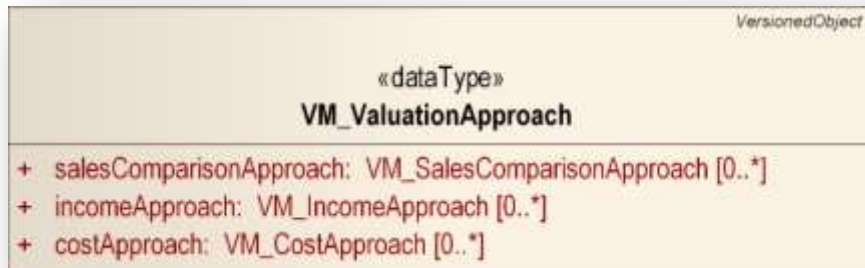


# Stage 4 – Valuation information model – Valuation approach

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

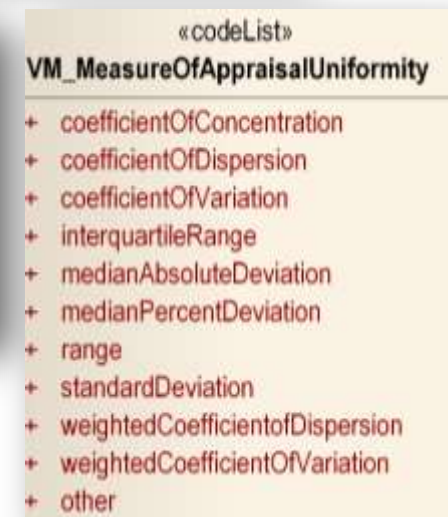
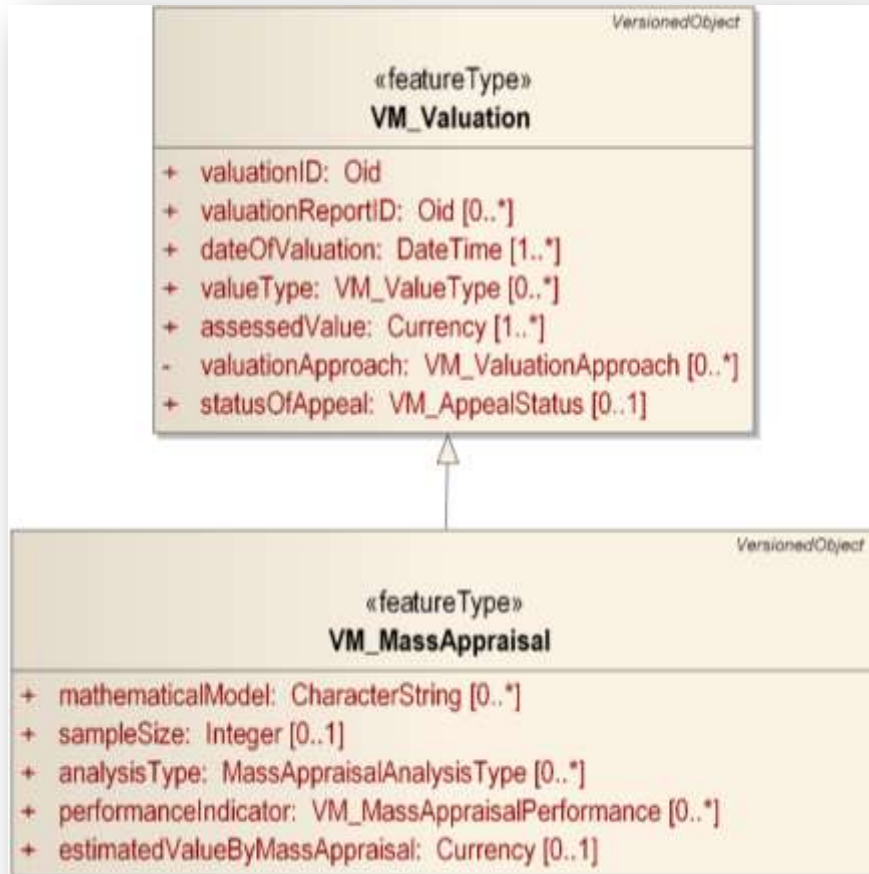
**VM\_CostMethod** organizes cost method related data, such as type of cost, age of improvements and depreciations.

**VM\_IncomeMethod** renders information used in direct and yield capitalization approaches, such as gross and net incomes, capitalization rates, gross rent multipliers.



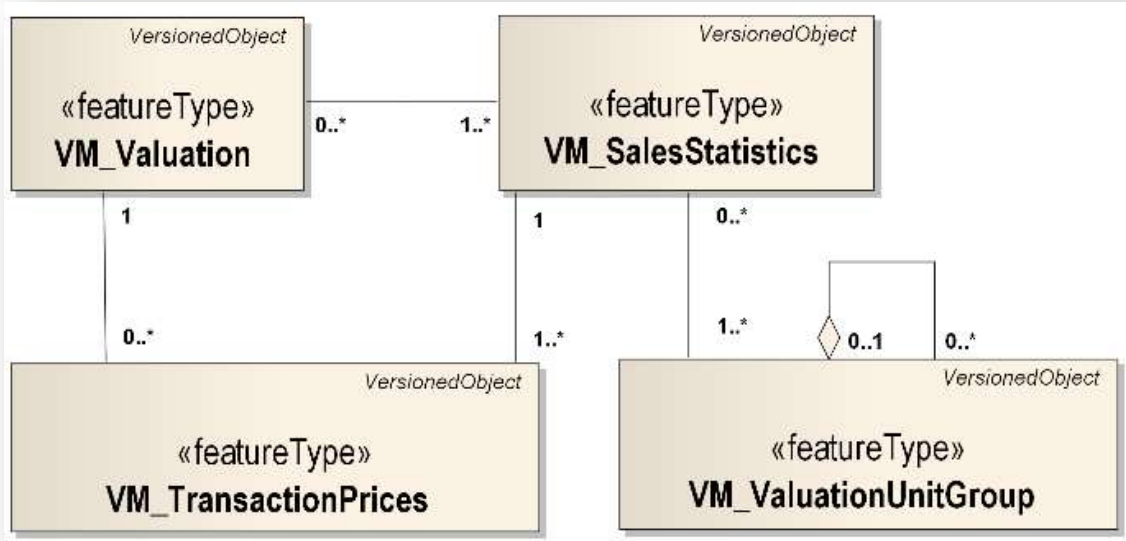
# Stage 4 – Valuation information model – Mass appraisal

**VM\_MassAppraisal** specifies mass appraisal-related information, such as model type (e.g. additive) and analysis type (e.g. multiple regression), and accuracy of mass appraisal.



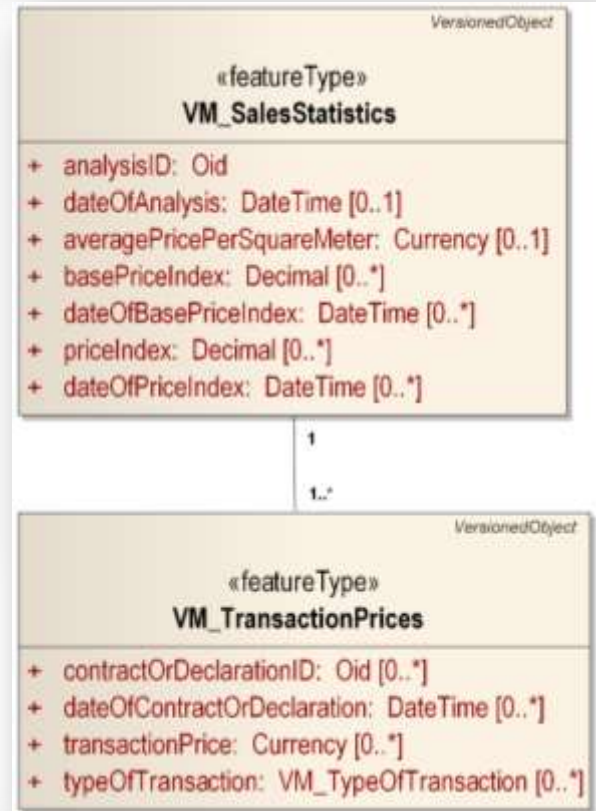


# Stage 4 – Valuation information model – Sales statistics

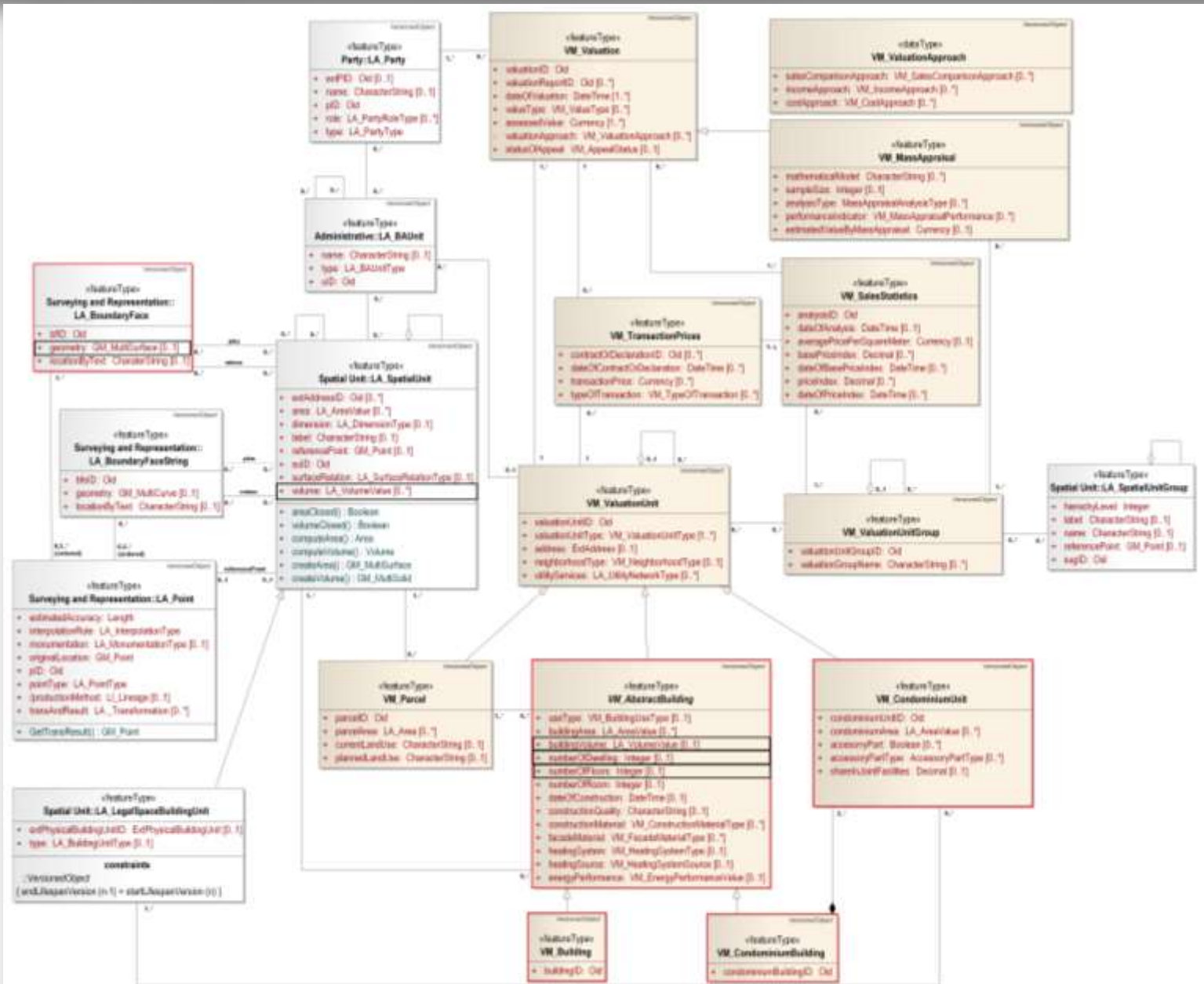


**VM\_TransactionPrices** defines information content of transaction contracts or declarations provided by parties.

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



# Stage 4 – Valuation information model



# Conclusions – Future works

## Concluding remarks

- Valuation is a central theme in the LADM context, but so far not addressed.
- Comparison with related geographic information standards confirms LADM as the basis.
- A basic structure, based on outcome of semantic analysis, is developed in some detail.

## Future works

- Refinement/ amendments based on analysis of questionnaires.
- Database implementation and test of the model.
- Formal standard approval process.

Questions / Comments ?

# Stage 4 – Valuation information model – Overview

