

3D Cadastres and LADM II / ISO

Peter van Oosterom

On behalf of LADM core team: Chrit Lemmen, Peter Aukes, Abdullah Alattas, Agung Indrajit, Eftychia Kalogianni, Abdullah Kara, Anna Shnaidman

FIG Commission 7 Annual Meeting
21 September 2021



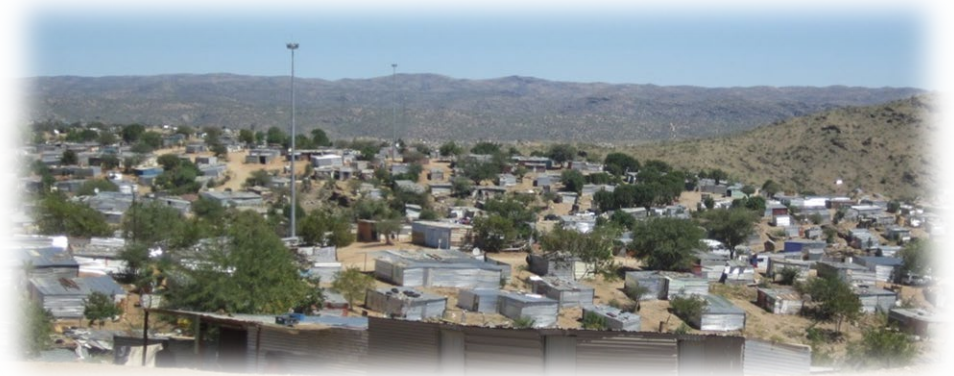
Overview

- Land Administration Domain Model, Edition II
- 3D Land Registration
- 3D Marine Space Georegulation
- 3D Valuation Information
- 3D Spatial Plan Information
- FIG Working Group 3D Cadastres
- Conclusion

UN definition (1996, UN-ECE report)

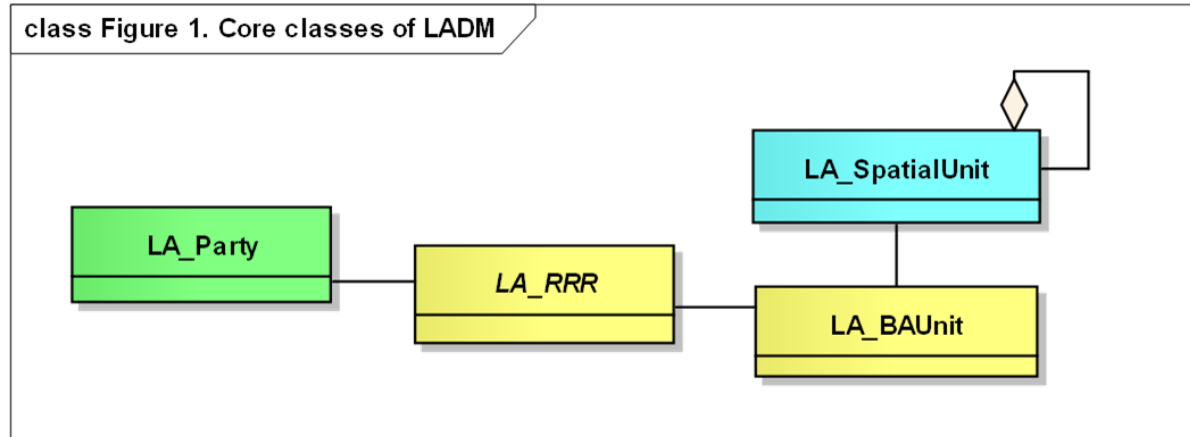
Land administration

- “.. the processes of recording and disseminating information about
- the **ownership**,
 - **value**
 - and **use** of land and its associated resources”

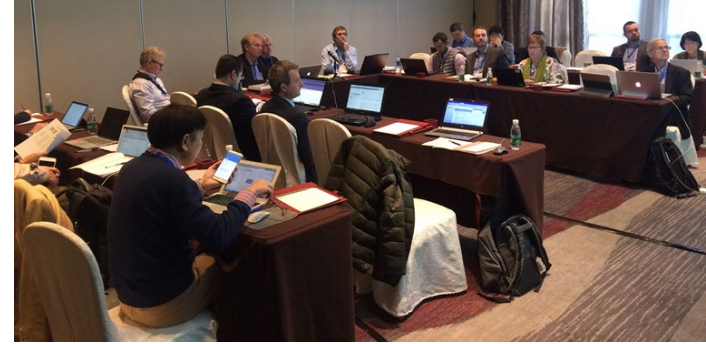


Land Administration Domain Model ISO 19152:2012 (LADM)

- It is an information model, at **conceptual** level
- It includes:
 - Spatial part (geometry, topology)
 - Extensible framework for legal/administrative part

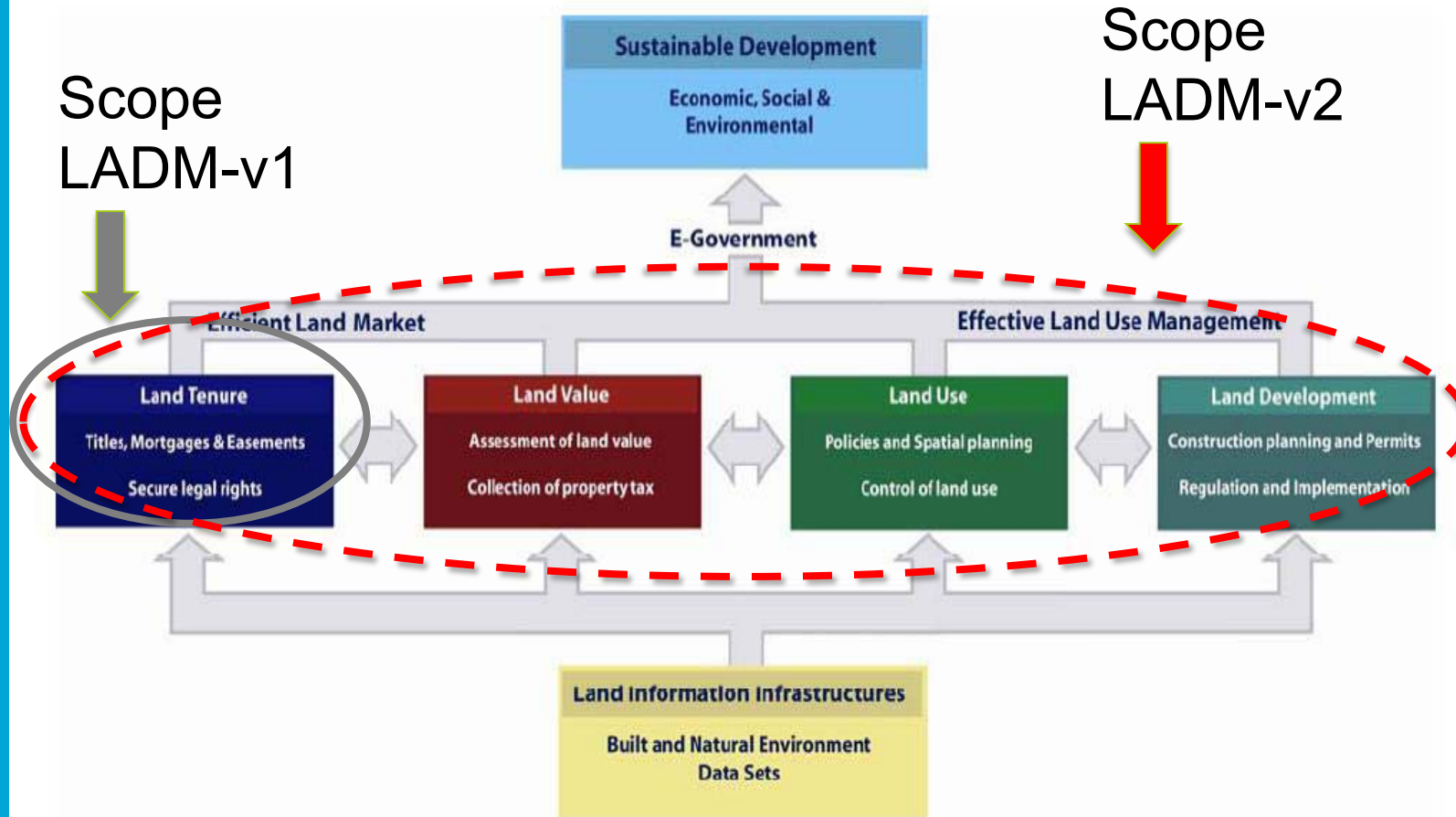


LADM revision



- Proposal to revise LADM 2017 after UN GGIM EGM and FIG LADM Workshop in Delft NL
- LADM Workshops in Zagreb 2018, Kuala Lumpur 2019, and FIG eWW 2021 (LADM/3D LA)
- ISO/TC 211 Meetings Copenhagen 2018, Wuhan 2018, Maribor 2019, Omiya 2019, and on-line meetings 2020/2021
- Initiate Stage 0 to gathered all requirements from a diverse group of organisations

Enemark (2006)

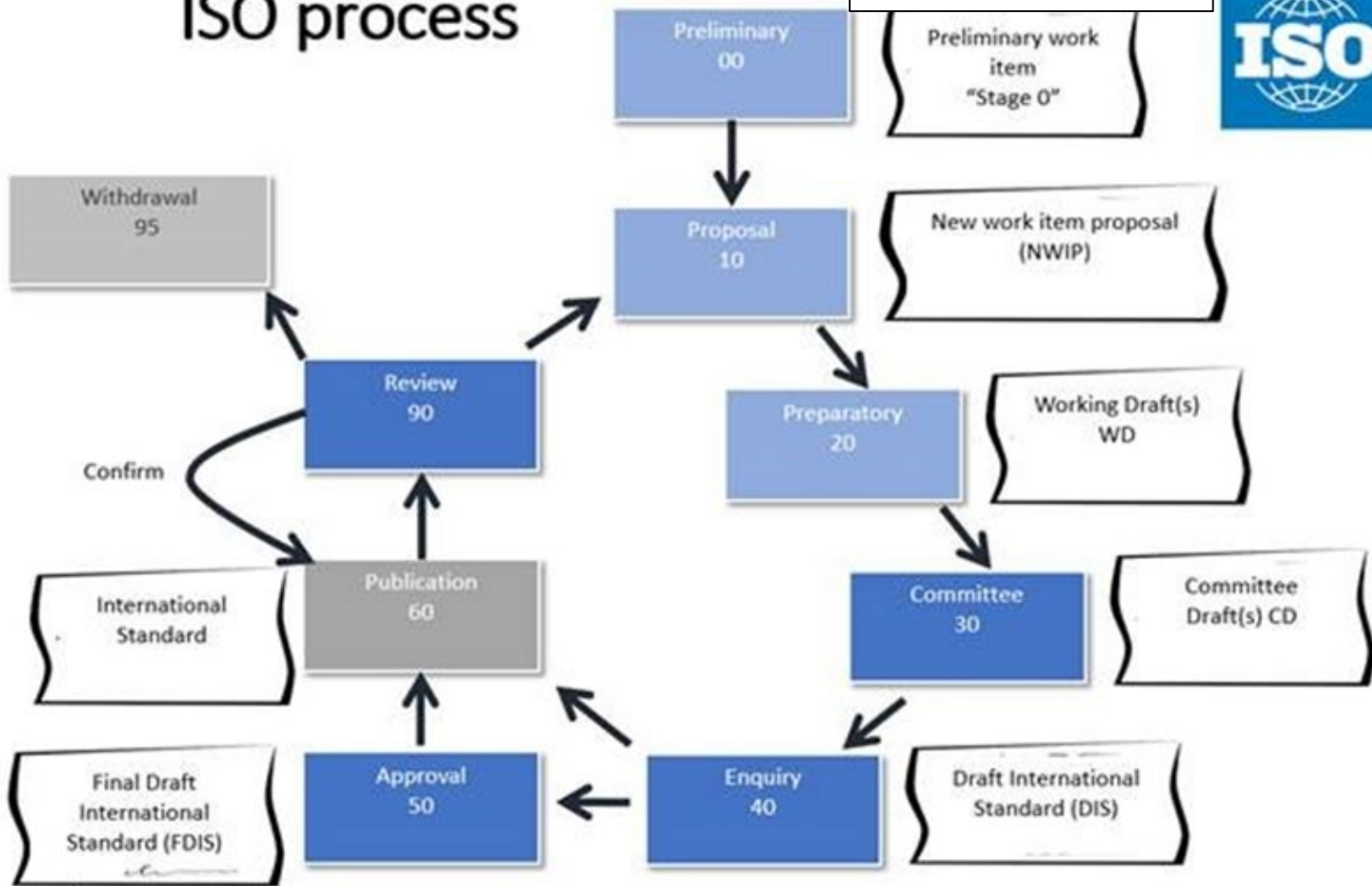


LADM revision, Edition II will be multipart

- Part 1 Fundamentals
- Part 2 Land Registration
- Part 3 Marine Space Georegulation
- Part 4 Valuation Information
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- Part 6 Implementation



ISO process



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Air Rights

22 July'19
NY Times

3D parcel

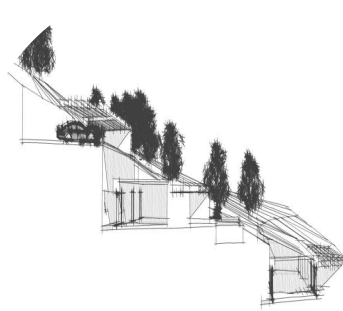
The New York Times

How Much Is a View Worth in Manhattan? Try \$11 Million

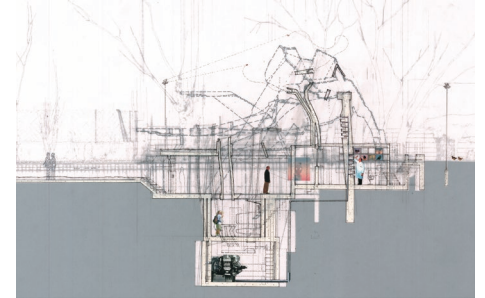
When a group of loft owners were confronted with a proposed tower that would have blotted out their views, they gave a developer \$11 million to not build.



Classification of spatial unit types



<http://www.asmechbg.com/projects.html>



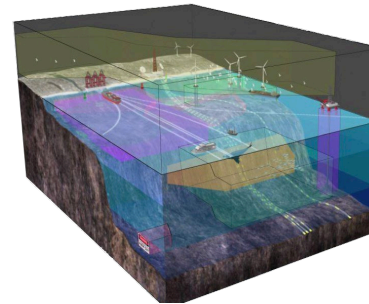
<https://www.pinterest.com/Storpweber/>



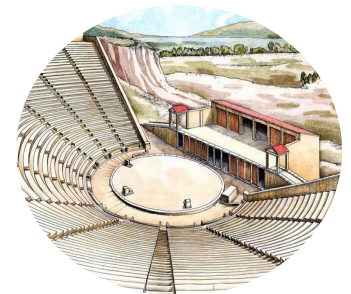
<https://www.tap-ag.com/>



Kitsakis and Dimopoulou, 2014



<https://marinecadastre.gov/>

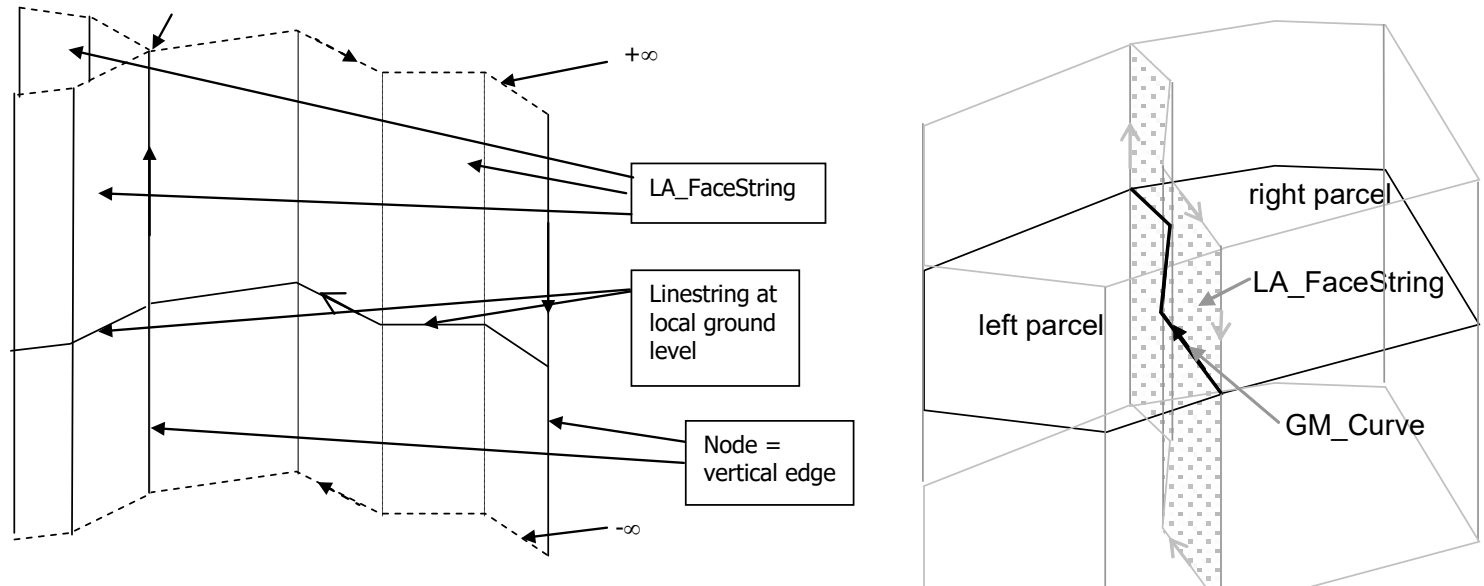


Spatial Units in 3D

- Extend the equivalent concept from 2D to 3D
→ 3D parcels are in areas of highest land values
- Sharing of boundary surfaces between 3D parcels where boundary lines would be shared in 2D (topology)
- point-line-area becomes point-line-area-volume
- **Challenges:**
 1. Majority of parcels is in 2D and should not be lost
→ integrate 2D/3D
 2. 3D parcels can be unbounded (up/down) according to National law
→ does not fit in ISO 19107 (spatial schema), therefore alternative needed

2D parcels and their 3D interpretation

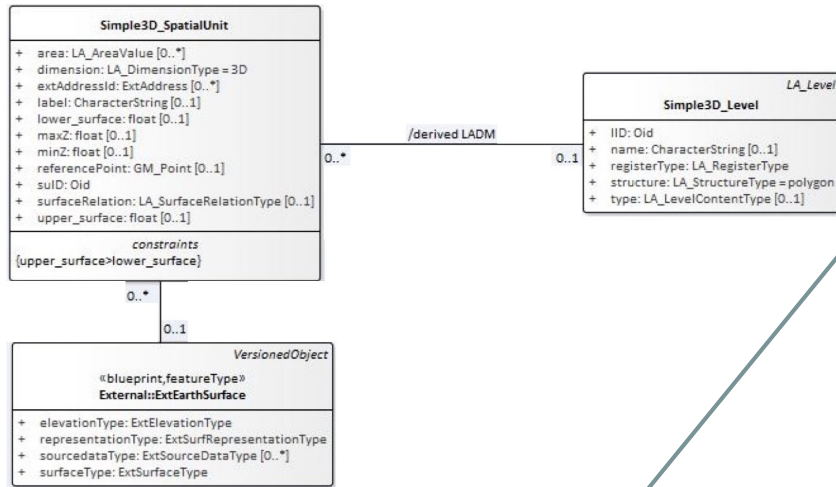
- Observation: 2D description implies 3D prismatic volume
- 2D polyline (GM_curve) implies string of vertical faces



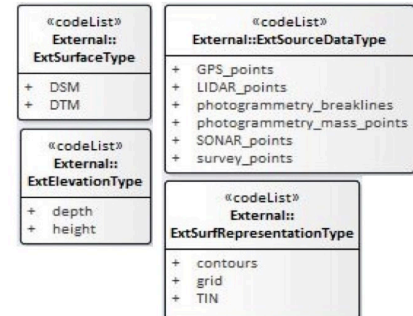
Spatial Units & Spatial Profiles

1. Simple 3D Spatial Profile: polygonal slice & semi-open spatial units

The Simple_3D profile describes 3D parcels that are encoded as 2D parcels, restricted between two horizontal, single-valued surfaces, which must not intersect or touch. Polygonal slice and semi-open spatial units can be modelled within this. It adds two attributes at the Simple3D_SpatialUnit class to define the values/heights of the upper and lower surfaces that form the polygon. New default values are used and associated constraints are imposed.



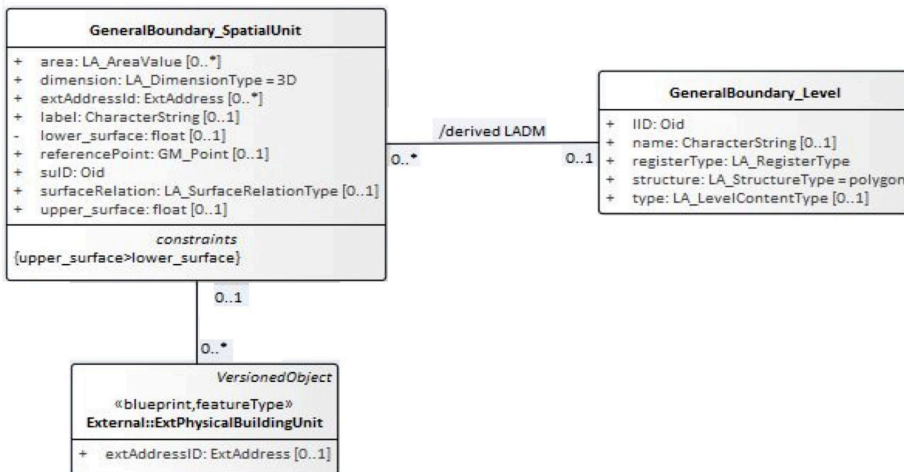
Proposed code lists
for External Class:: ExtEarthSurface*



*following the concept of the Elevation Theme of INSPIRE

2. General Boundary 3D Spatial Profile: Building/Construction format spatial units

The General Boundary Spatial Unit profile describes 3D parcels that are legally defined by the extents of an existing or planned structure that contains/will contain the unit. There are two ways to describe and spatially represent the spatial unit: by referring to a building format or by defining its actual shape by geometrical types. New attributes and default values are used and associated constraints are imposed.



A building/ construction format spatial unit is legally defined by the extents of an existing or planned structure that contains/will contain the unit.

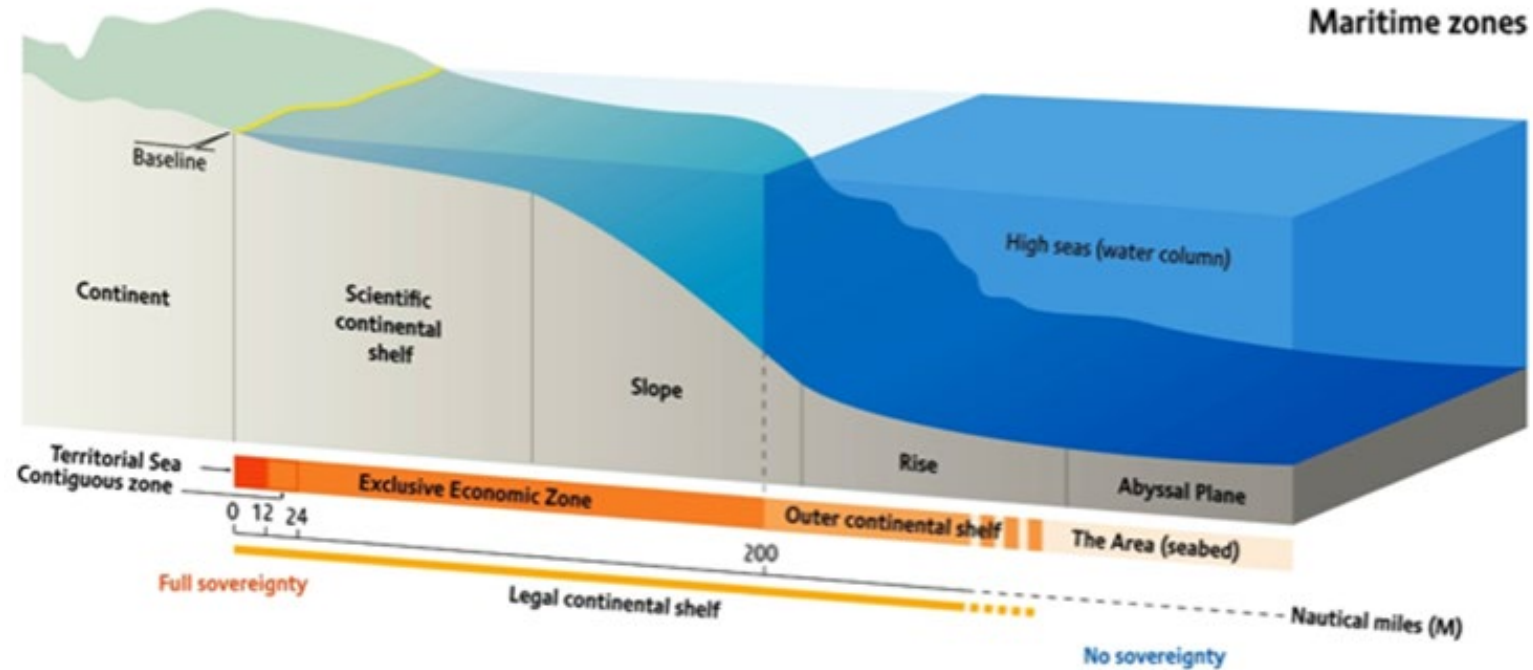
It can be described and spatially represented by:

- referring to a building format (e.g. BIM/IFC) or
- defining its actual shape by geometrical types

Overview

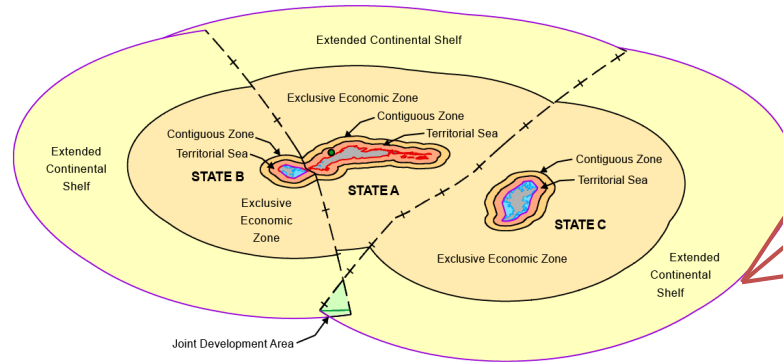
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LADM and IHO S-121



IHO S-121

S-121 DATA MODEL



USE CASES

Navigation & Enforcement

Legal Declaration

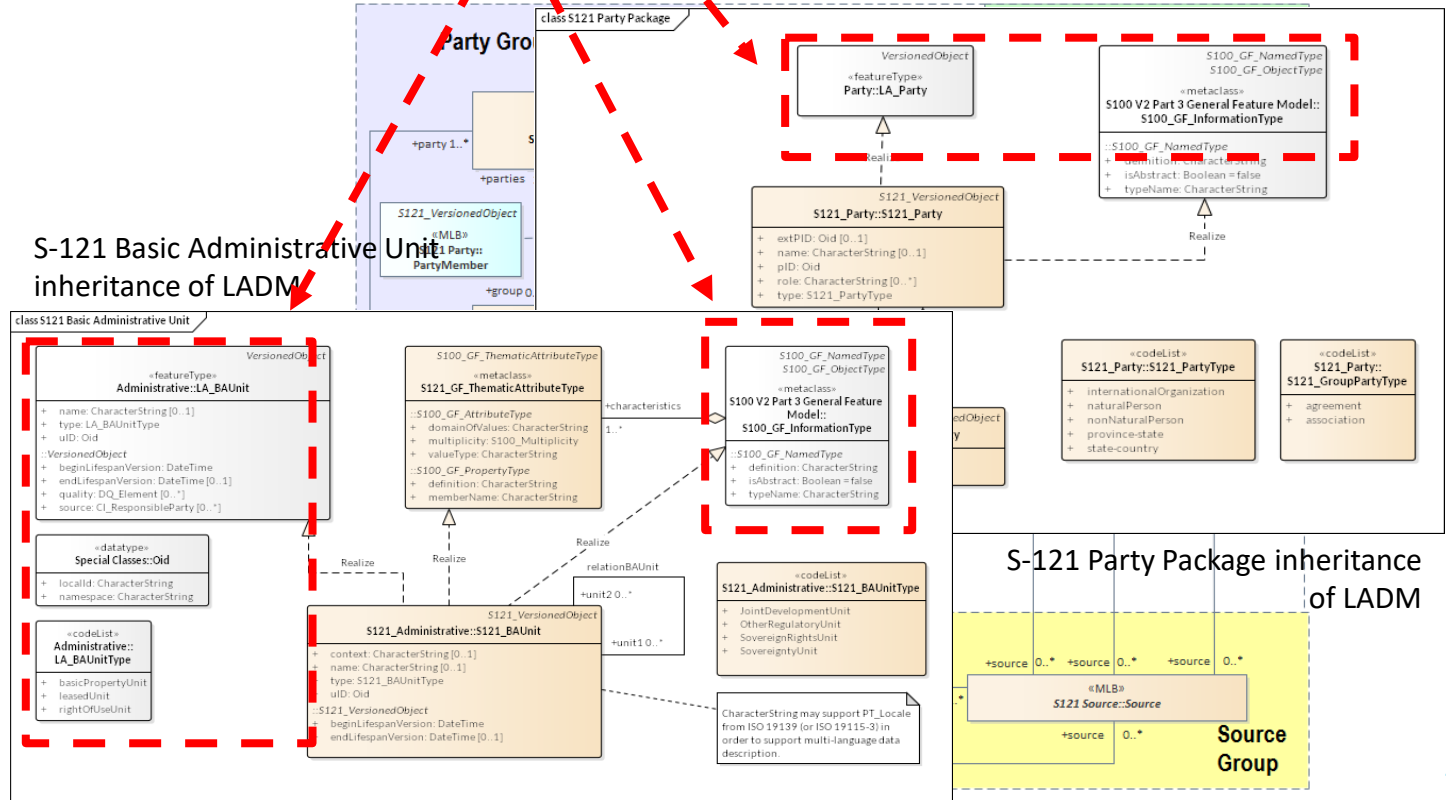
Authoritative Public Data

- Description and digital representation any type of **Marine Limits and Boundaries**
- ISO 19152 and S-121 are both built on the ISO TC211 suite of Geographic Information standards
- Appendix E of IHO S-121 describes how the LADM related classes are integrated into S-121

Some of the class diagrams

S-121 inherits from both
LADM & S100

S-121 Basic Administrative Unit
inheritance of LADM



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Property Valuation Information Model

VM_Valuation defines input and output data used and produced within single or mass appraisal processes such as valuation method, value type.

VM_MassAppraisal specifies mass appraisal-related information (e.g. statistical method, analysis type).

VM_ValuationUnit represents basic recording units of valuation registries (e.g. land, building, condominium unit).

VM_ValuationUnitGroup clusters valuation units according to zones.

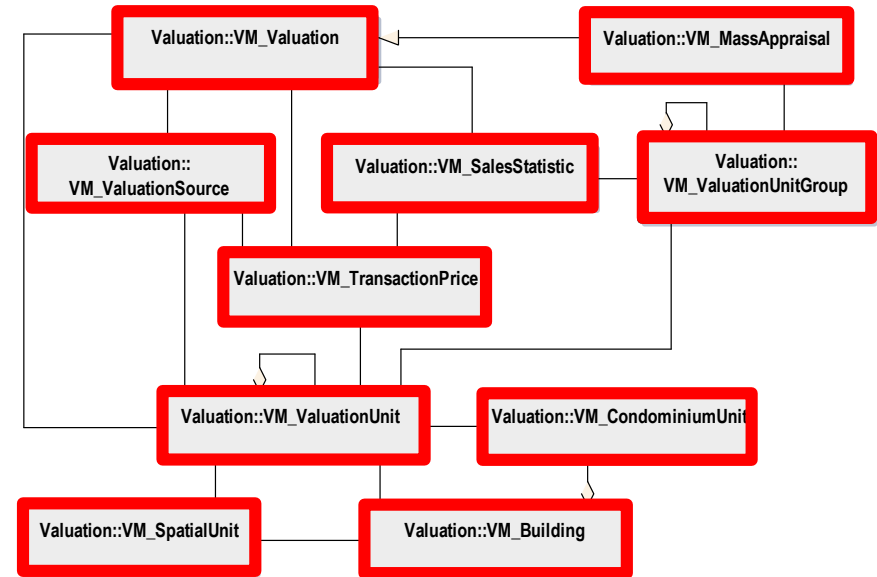
VM_SpatialUnit specifies cadastral parcels, and sub-parcels (collection of a number of parcels and their land use types).

VM_Building, **VM_CondominiumUnit** specifies physical aspects of buildings, building parts (condominium units).

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.

VM_ValuationSource includes sources of valuation (e.g. valuation reports or declaration documents)



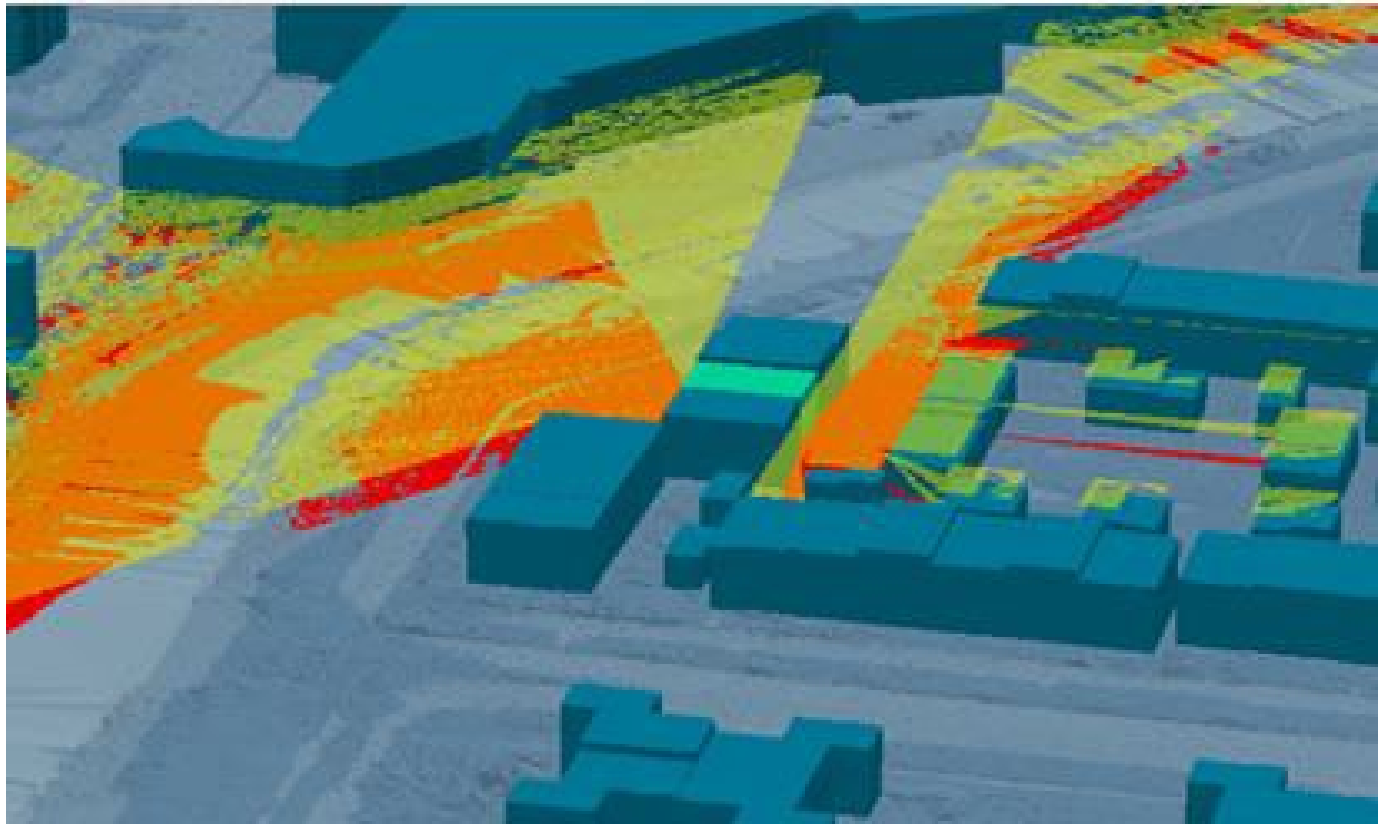
LADM_VM extension consists of 10 main classes, 7 data types and 19 code lists.

Existing standards are maximally reused when developing the model's thesaurus (IPMS, IVSC, TEGoVA and IAAO)

3D for property valuation

- 3D RRRs (legal) and 3D physical objects
- **3D view analysis** (lake, ocean, golf and mountain view)
- 3D noise analysis (e.g. airport and neighborhood noise) (Wilhelmsson, 2000; Cohen and Coughlin, 2008)
- 3D hazard analysis (Ghanbarpour et al., 2014)
- 3D crime analysis (Wolff and Asche, 2009)
- 3D insolation analysis (sunlight and daylight analyse) (Helbich et al., 2013)
- 3D distance to points of interest (central business district, metro station, busy road, beach, waste, school, ...)

Viewshed polygons for two levels: yellow=top, red=one level lower



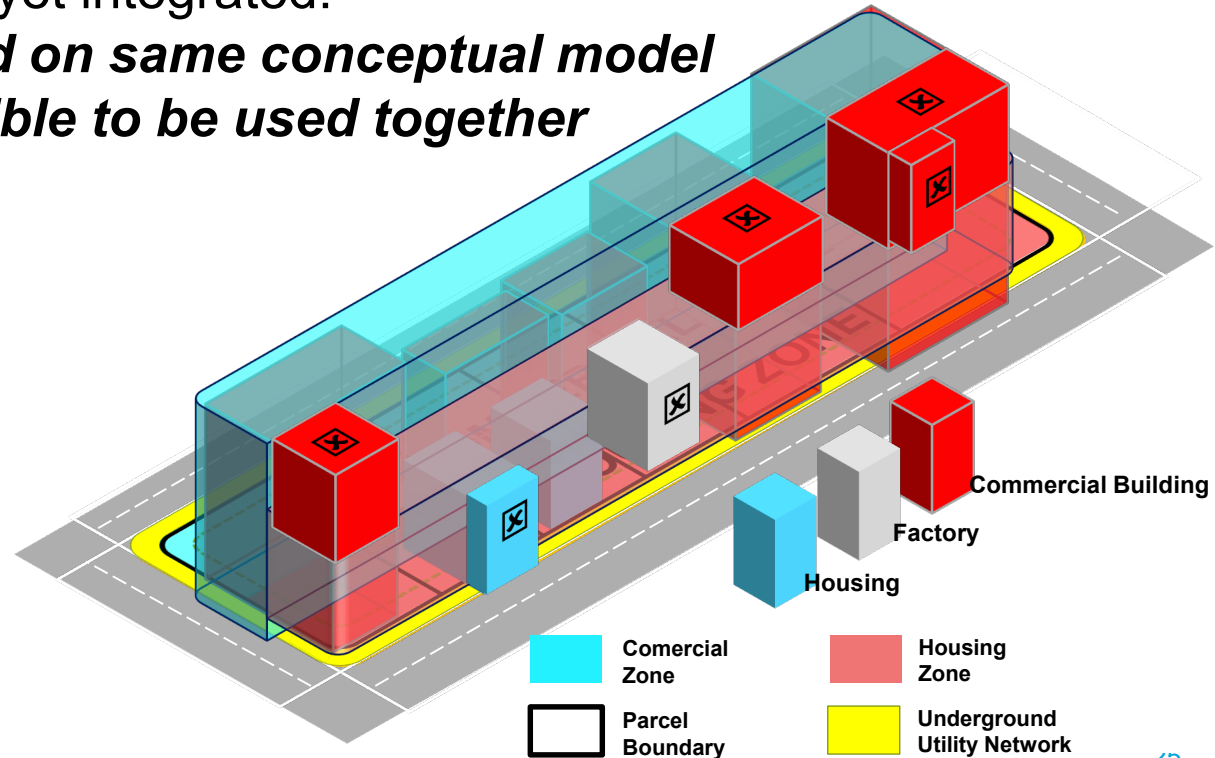
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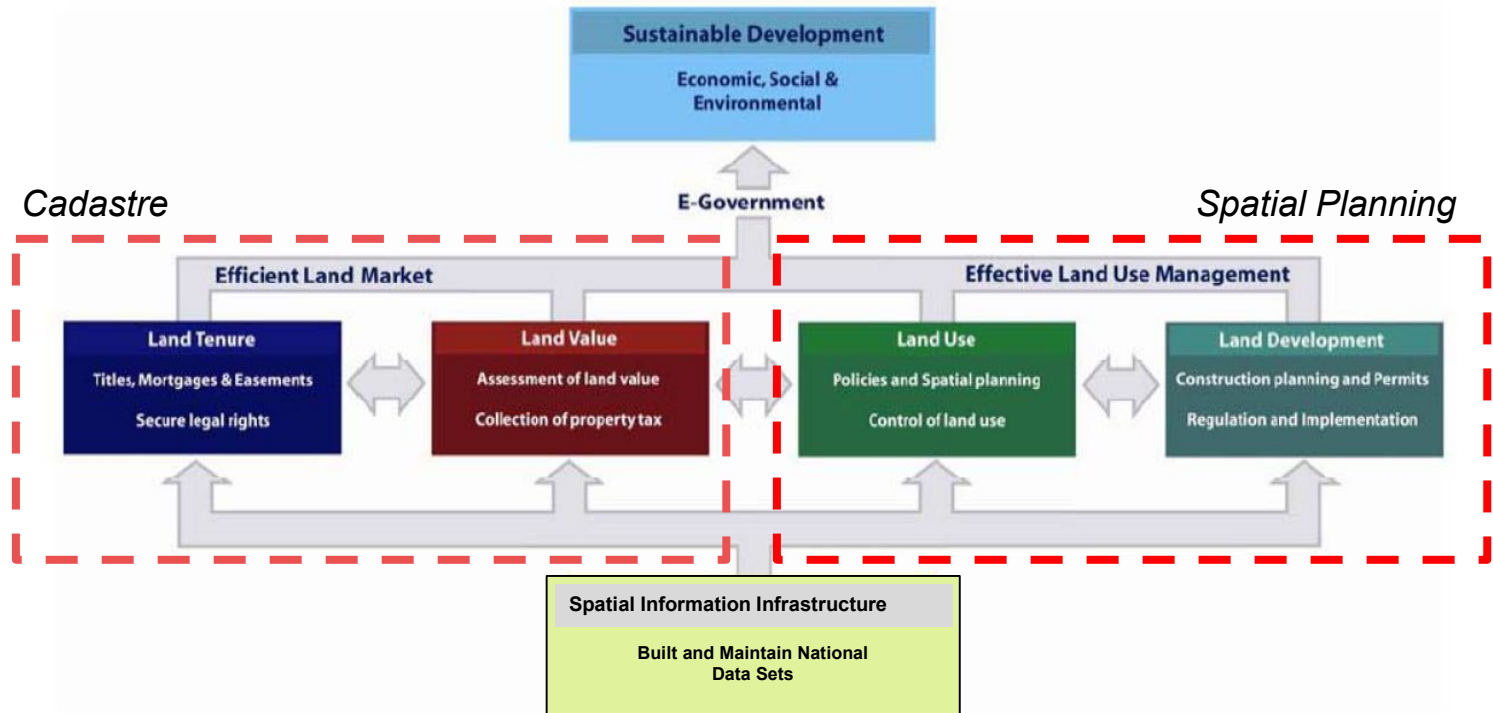
Today's mismatch

Land registry and planned land use information is today not yet integrated:

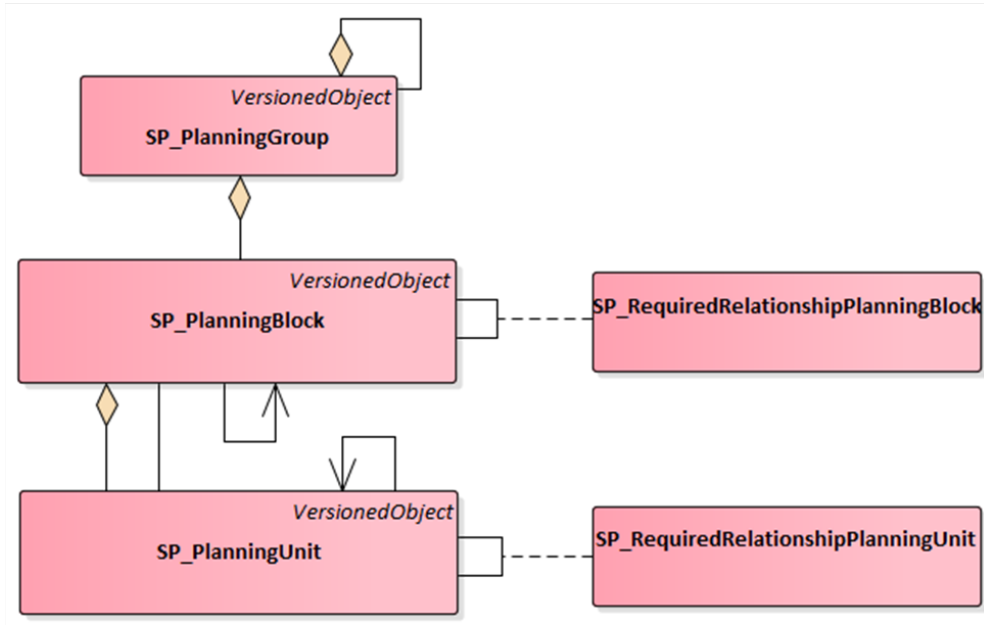
- 1. not based on same conceptual model***
- 2. not possible to be used together***



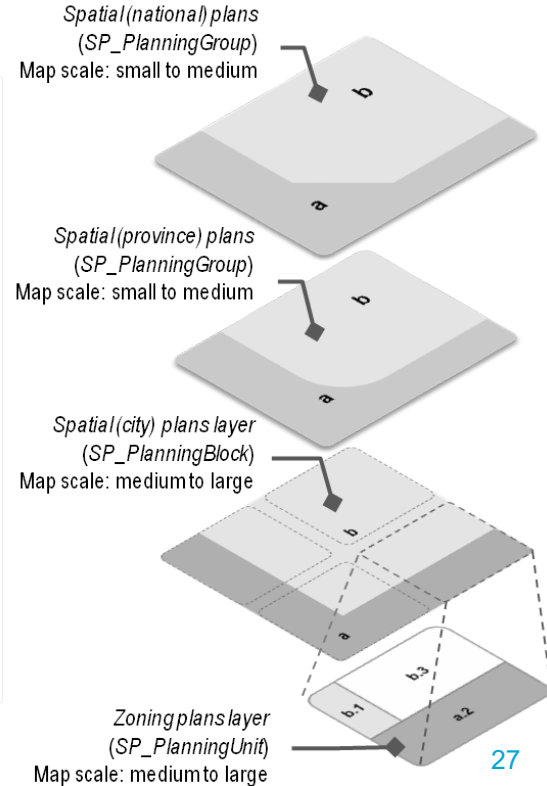
Integrated Information is needed



Added to LADM-v2: Spatial Planning Information Package



Adapted from Indrajit et al. (2018)



Definitions of new concepts

Proposed Classes (Modified from INSPIRE and Plan4All Project)	
<i>SP_PlannngBlock</i>	Represents Planned Land Use (PLU) that corresponds to spatial plans, defined by spatial planning authorities, depicting the possible utilization of the land in the future. Planned land use is regulated by spatial planning documents elaborated at various levels of administration. Land Use regulation over a geographical area is in general composed of an overall strategic orientation, a textual regulation and a cartographic representation.
<i>SP_PlannngUnit</i>	A featuretype that consist of polygons that is mutually exclusive. The SP_PlanningUnit is part of SP_PlanningBlock that represents zoning arrangement with regulation regarding the Potential Land Use development. SP_PlanningBlock contains the SP_PlanningUnit to express the planned land use defined by the authority via SP_SpaceFunction attribute. SP_PlanningUnit have several specific attributes to accomodate Rights, Restrictions and Responsibilities.
<i>SP_PlannngGroup</i>	The administrative hierarchy of spatial planning.
<i>SP_RequiredRelationshipPlanningUnit</i>	Represents instances of relationship between two or more zoning plans according to location or time
<i>SP_RequiredRelationshipPlanningBlock</i>	Represents instances of relationships between spatial plans.
<i>LA_LegalOpenSpaceUnit</i>	The class represent spaces within a land parcel that are not allowed to be built on.

Modified from INSPIRE (2013) and Cerba & Task Force 4.2 (2010)

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FIG Working Group 3D Cadastres

The logo for the FIG Working Group 3D Cadastres features a stylized 3D representation of a building or structure with a red top section, a blue middle section, and a green base, all resting on a white platform. The text '3D' is in a large, blue, sans-serif font, and 'Cadastres' is in a smaller, blue, serif font to the right.

- Joint comm. 3 and 7 WG
- First term 2004-2008
chairs Hendrik Ploeger/Yerach Doytsher
- Current term 2018-2022
chairs Peter van Oosterom/Alias Abdul Rahman
- Next workshop 11-13 oct'21 (on-line)
- 22-24 full papers and 2 keynotes
- Proposed new name for next term:
3D Land Administration

A 3D rendered city model with buildings in shades of grey and white, set against a dark blue background. The buildings are arranged in a dense urban pattern, with some taller structures on the left side.

THE 16TH 3D GEOINFO CONFERENCE

in conjunction with 3D Cadastres

October 11-14, 2021, Virtual

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<http://www.gdmc.nl/3DCadastres>

Keynotes



The Australia / New Zealand 3D Cadastral Survey Data Model and Exchange Project

by Anselm Haanen, Surveyor-General at Land Information New Zealand



Utilising current and new Galileo Services for 3D Surveys

by Peter Buist, European Agency for the Space Programme, responsible for the Galileo Reference Centre

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Status LADM revision

- Part 1 Fundamentals → NWIP+WD submitted, comments processed, ready for CD
- Part 2 Land Registration → NWIP+WD submitted
- Part 3 Marine Space Georegulation → NWIP submitted by (IHO/SA)
- Part 4 Valuation Information → NWIP+WD submitted
- Part 5 Spatial Plan Information → NWIP+WD submitted
- Part 6 Implementation → meetings

Work in Progress

- Sustainable development goals (SDG) Land Indicators
- Refined LADM Survey model
- Semantically rich code lists
- More on LA processes; e.g. transactions in blockchain ISO TC307
- Methodology for developing country profile
- Guidelines for implementation (informative)
- Technical models / encodings (INTERLIS, RDF, GeoJSON, BIM/IFC, InfraGML, CityGML,...)
- Correct small errors/typo's LADM Edition I; see <http://isoladm.org/StandardMaintenance>

Conclusion

- Scope LADM-II covers complete land administration domain
- Land administration is the foundation of the **Geo-Information Infrastructure**
- Creating, using and maintaining links between 3D Legal spaces/ physical objects (BIM) by multiple organizations
- Cooperation of many different disciplines: law, surveying, valuation, spatial planning, ICT, etc.
- International standards bring global experience, benefits of scale, and basis for harmonization
- **LADM II as Information Model for the Smart Society: 3D Land Registration, 3D Marine Georegulation, 3D Valuation Information and 3D Spatial Plan Information and more!**