

The 10<sup>th</sup> LADM Workshop in conjunction with the 7<sup>th</sup> Croatian Congress on Cadastre  
**Session 2:: Surveying and land administration | B2**

## Investigating the requirements for the ISO 19152 LADM survey encodings

Eftychia KALOGIANNI, TU Delft

Hans-Christoph GRULER, Leica

Amir BAR-MAOR, ESRI

Bruce HAROLD, ESRI

Tim LEMMON, Trimble

Christiaan LEMMEN, ITC Twente

Peter VAN OOSTEROM, TU Delft

# Overview

- I. Introduction & Motivation
- II. ISO 19152:2012 LADM I: **ongoing revision**
- III. LADM Edition II – Part 2: **Survey Model**
- IV. Standards for Infrastructure & Survey & relevant ongoing projects
- V. Requirements to assess the existing survey encodings
- VI. Conclusions & Future Work

# INTRODUCTION | MOTIVATION

AUSTRALIA & NZ

## Problems in Exchanging Digital Cadastral Survey Datasets

- No widely adopted transfer mechanism
- Modest success with LandXML (2D) / ePlan
  - LandXML difficult to implement
  - Significant variations between jurisdictions undermines support from survey software suppliers
  - No capability for 3D digitalexchange



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



[http://www.gdmc.nl/3DCadastres/workshop2021/programme/0\\_KEYNOTE1\\_Ansema\\_HaanenPres.pdf](http://www.gdmc.nl/3DCadastres/workshop2021/programme/0_KEYNOTE1_Ansema_HaanenPres.pdf)



Registered / Licensed Surveyor

For the archiving of the surveys, there is  
**lack of homogeneity** as reported by the 7 EU pilot countries  
that participate in H2020 GISCAD-OV project

EU	Survey Software						
	Croatia	Czech Rep.	Estonia	France	Germany	Italy	Spain
Standard used for encoding of cadastral survey: <b>LandXML</b>	no	no	no	no	no	no	no
Standard used for encoding of cadastral survey: <b>InfraGML</b>	no	no	no	no	no	no	no
Standard used for encoding of cadastral survey: <b>GeoJSON</b>	no	no	no	no	no	no	no
Standard used for encoding of cadastral survey: <b>INTERLIS</b>	no	no	no	no	no	no	no
Standard used for encoding of cadastral survey: <b>Others</b>	no	ČÚZK defines its own exchange format of the information system of cadaster. It is the text file, which contains graphical and descriptive information, where objects, their classes and relationship are defined	ASCII	DXF, EDIGeo, TIFF	ALKIS-Standard	PREGEO	GML INSPIRE



# INTRODUCTION | MOTIVATION

Kingdom of Bahrain  
Between the same country in different organisations & between different countries/ jurisdictions/ cantons:  
From Underground Utilities to As-Built Survey Standards

1. Different type/ amount of information supported/ exchanged
2. Different formats/ encodings used
3. Different workflows developed
4. Different software suppliers' support
5. (2D/ 3D) Topology/ geometry/ attributes support
6. No standardization

[https://www.fig.net/resources/proceedings/fig\\_proceedings/fig2021/papers/ws\\_03.1/WS\\_03.1\\_warnest\\_davies\\_et\\_al\\_11179.pdf](https://www.fig.net/resources/proceedings/fig_proceedings/fig2021/papers/ws_03.1/WS_03.1_warnest_davies_et_al_11179.pdf)

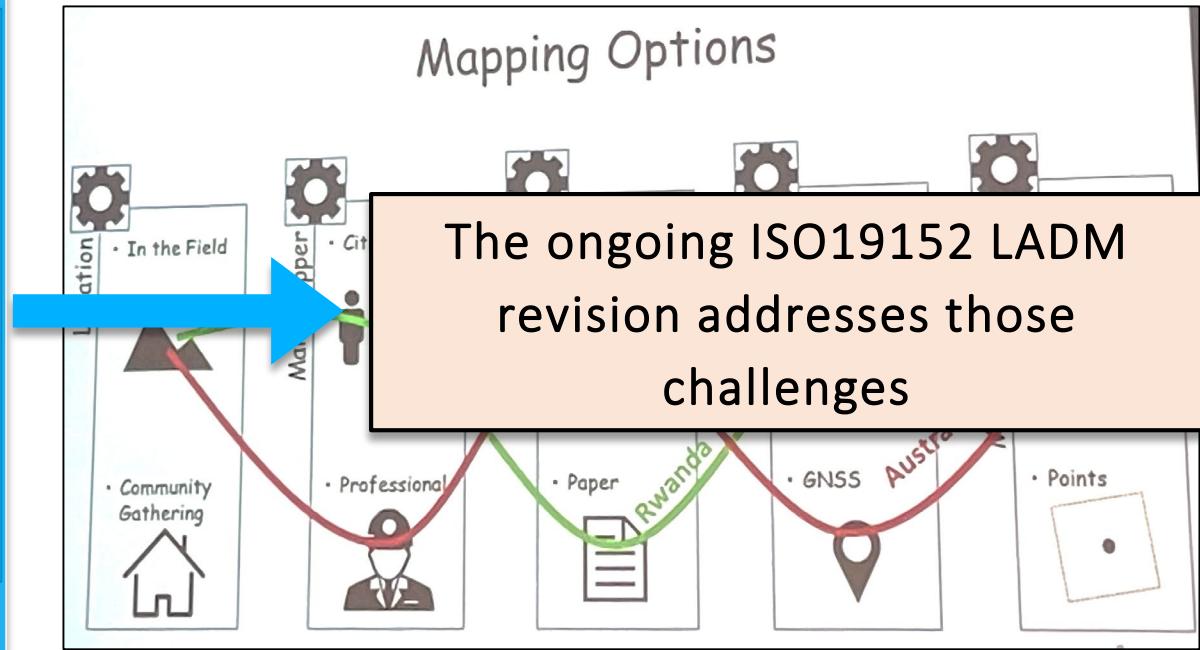


Image from Prof Christiaan Lemmen invited lecture at the opening ceremony LADM 2022

# INTRODUCTION | MOTIVATION

initiate a discussion regarding the **surveying encodings** to be used for the implementation of [LADM Edition II \(Part 6\)](#), bringing together **experts** from the surveying, AECOO and GIS industry, Cadastral Authorities and users/ surveyors

in order to reach conclusions on whether:

1. existing encoding(s) may serve the efficient implementation of the LADM survey part at their current version;
2. existing encoding(s) can be revised to serve the LADM survey part or
3. new encoding(s) should be developed for this reason.



set the requirements for the survey encodings

# ISO 19152:2012

Geographic information – Land Administration Domain Model (LADM)

## LIFE CYCLE

### NOW

PUBLISHED  
ISO 19152:2012

A standard is reviewed every 5 years  
Stage: 90.92 (To be revised) ▾

### WILL BE REPLACED BY

UNDER DEVELOPMENT  
ISO/AWI 19152-1  
Part 1: Fundamentals

UNDER DEVELOPMENT/ SUBMITTED  
ISO/ WI 19152-2  
Part 2: Land Registration

UNDER DEVELOPMENT/ NOT YET SUBMITTED  
ISO/ WI 19152- 3..6

### NOW

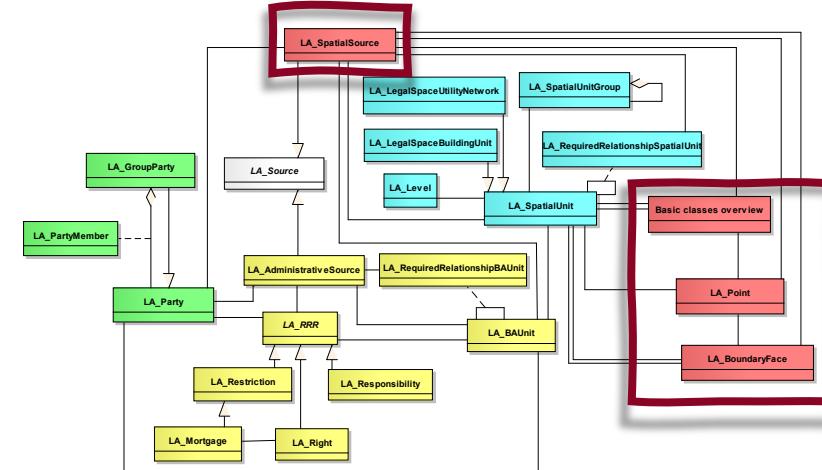
UNDER DEVELOPMENT  
ISO/AWI 19152-1

Stage: 20.00 ~

00 > 10 20 Preparatory ~

20.00	New project registered in TC/SC work program
20.20	Working draft (WD) study initiated
20.60	Close of comment period

20.99	WD approved for registration as CD
-------	------------------------------------



A conceptual model of the refined survey model is expected to be included in Part 2 of the new edition of the standard, while its technical implementation(s) via GML/ JSON formats/ RDF/ INTERLIS/..., covering both 2D and 3D boundaries, will be considered to be included in Part 6

PART 1 – Land Administration Fundamentals

PART 3 – Marine Space

PART 5 – Spatial Planning

PART 6 – Implementations



ISO/TC 211 N 5642

ISO/TC 211 "Geographic information/Geomatics"  
Secretariat: SIS  
Committee Manager: Åhlin Mats Mr



### NP on 19152-2 Geographic information — Land Administration Domain Model (LADM) — Part 2: Land Registration

Document type	Related content	Document date	Expected action
Ballot / Reference document	Project: ISO/PWI 19152-2 Ballot: ISO/PWI 19152-2 (restricted access)	2021-10-26	<b>VOTE</b> by 2022-01-19

#### Description

The ballot of ISO/NP 19152-2 is launched in ISO eBalloting Portal from 2021-10-27 to 2022-01-19. Please note that official balloting is for internal balloters only. Experts and delegates have to reply to the relevant national standards body. O-members and Liaisons can submit comments directly in the ballot, but not vote.

For comments please use the ISO commenting template. There is no need to add the numbering of the comments. When collating all comments by using the ISO compilation tool, the numbering will be there automatically.

# LADM 19152-2

## NWIP submitted



### Form 6: Result of voting on New Work Item Proposal

Date: 2022-01-24	ISO/TC 211 N 5717
Title of TC/SC concerned: Geographic information/Geomatics	

To be completed by the secretariat and sent to the ISO Central Secretariat and to all P- and O-members of the TC or SC concerned, with a copy to the TC secretariat in the case of a subcommittee.

Please attach the results of the NWIP ballot from CIB to this form

ISO/TC 211 N 5642	Circulation 2021-10-27	Deadline 2022-01-20
----------------------	---------------------------	------------------------

Title:  
English title:  
Geographic information — Land Administration Domain Model (LADM) — Part 2: Land registration  
French title:  
Information géographique — Modèle du domaine de l'administration des terres (LADM) — Partie 2: Enregistrement foncier

#### Results (the compilation of results is given as an annex)

The following criteria for acceptance have been met:

- Approval by a 2/3 majority of the voting P-members; and
- a commitment to participate actively in the development of the project by at least 4 P-members in committees with 16 or less P-members and at least 5 P-members in committees with 17 or more P-members (rf ISO/IEC Directives, Part 1 clause 2.3.5) and have nominated an expert
- Justification statements have been checked (all negative votes must be accompanied by a statement justifying the decision, or they shall not be counted. See ISO/IEC Directives Part 1, clause 2.3.4)

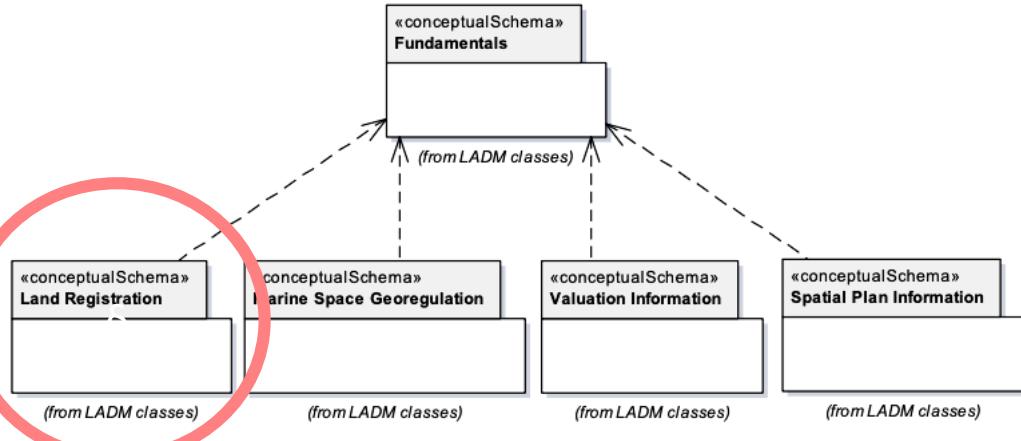
FORM 6 – Result of voting on NWIP  
Version 05/2021

# PREVIOUS VERSIONS OF LADM SURVEY MODEL

1. **LADM Edition 1 – Abstract model based on ISO19156:2011 O&M [2012]**
  1. evolution of technology in the surveying, AECOO and GIS industry,
2. **Integrated Future Data Model for Survey Data and Cadastral Mapping** based on **LADM for the Netherlands [MSc thesis TU Delft, Soffers P., 2017]**
  2. need to provide support to a broad range of surveying & data acquisition approaches and accuracies,
  3. needs addressed through the existing LADM country profiles,
3. **LADM Refined Survey Model v.01 [Shnaidman, A., van Oosterom, P.J.M., Lemmen, C.H.J., 2019]**
  4. support a broad range of spatial unit types,
4. **Work on LADM – OGC LandInfra synergy on the survey functionality [2020 – today]**
  5. facilitate interoperability with other standards,
  6. consider more advanced/ detailed surveying modelling approaches used in other standards; e.g. OGC LandInfra, [Kalogianni, E., Dimopoulou, E., Gruler, H.C., Stubkjær, E., Lemmen, C.H.J., van Oosterom, P.J.M., 2021]
5. **LADM Refined Survey Model v.02 [Kalogianni, E., Dimopoulou, E., Gruler, H.C., Stubkjær, E., Lemmen, C.H.J., van Oosterom, P.J.M., 2021]**
  7. combine spatial and non-spatial sources,
  8. formats/encodings used in practice to store & exchange surveying information.
6. **LADM Refined Survey Model v.03 – under development**

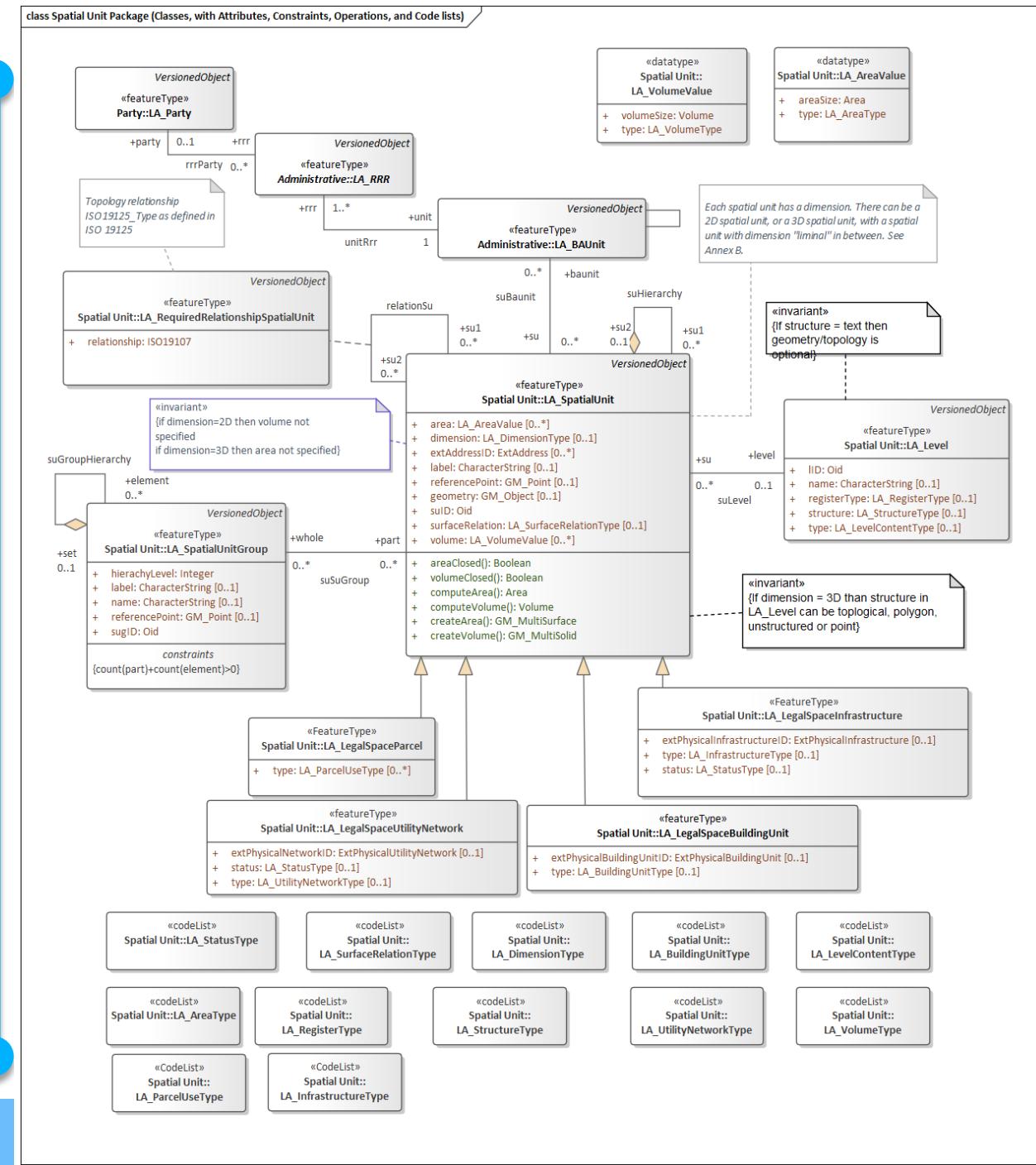
Conceptual

# LADM EDITION III



## Packages overview

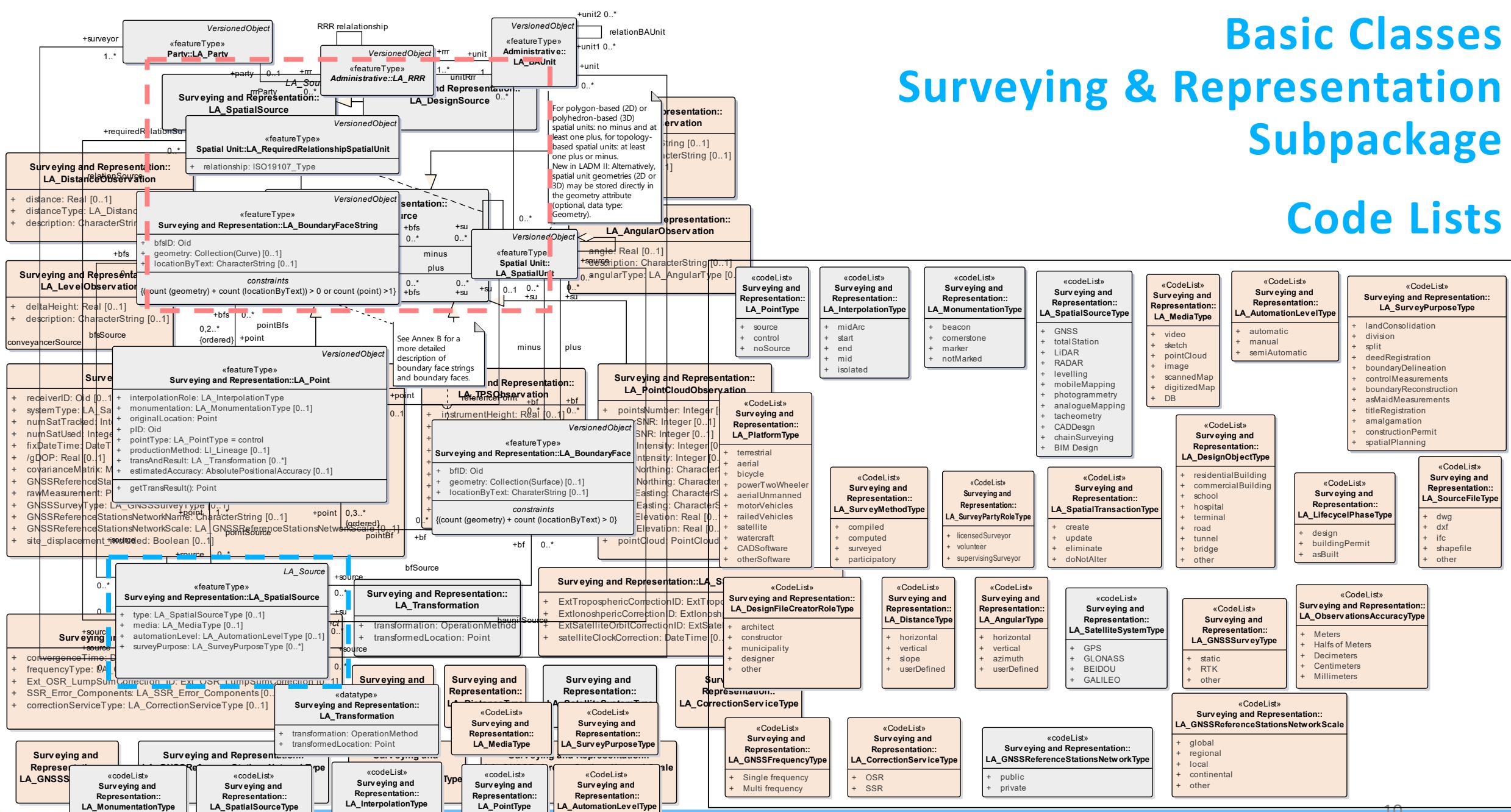
LADM II  
Part 2



# Basic Classes

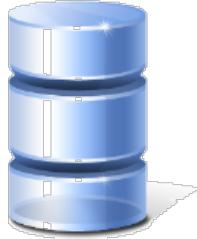
## Surveying & Representation Subpackage

### Code Lists



# LADM EDITION II PART 6 & RELATED STANDARDS

# LADM Edition II Part 6: Implementation



- How?
  - How many?
  - Compatibility?
  - LADM-compliant?
  - ...

# **SURVEY MODEL Implementation**

- OGC LandInfra
  - LandXML
  - (Geo/City)Json
  - XML/GML
  - RDF
  - Dxf/ Dwg
  - Shp
  - BIM/ IFC
  - Xyz
  - INTERLIS
  - ...



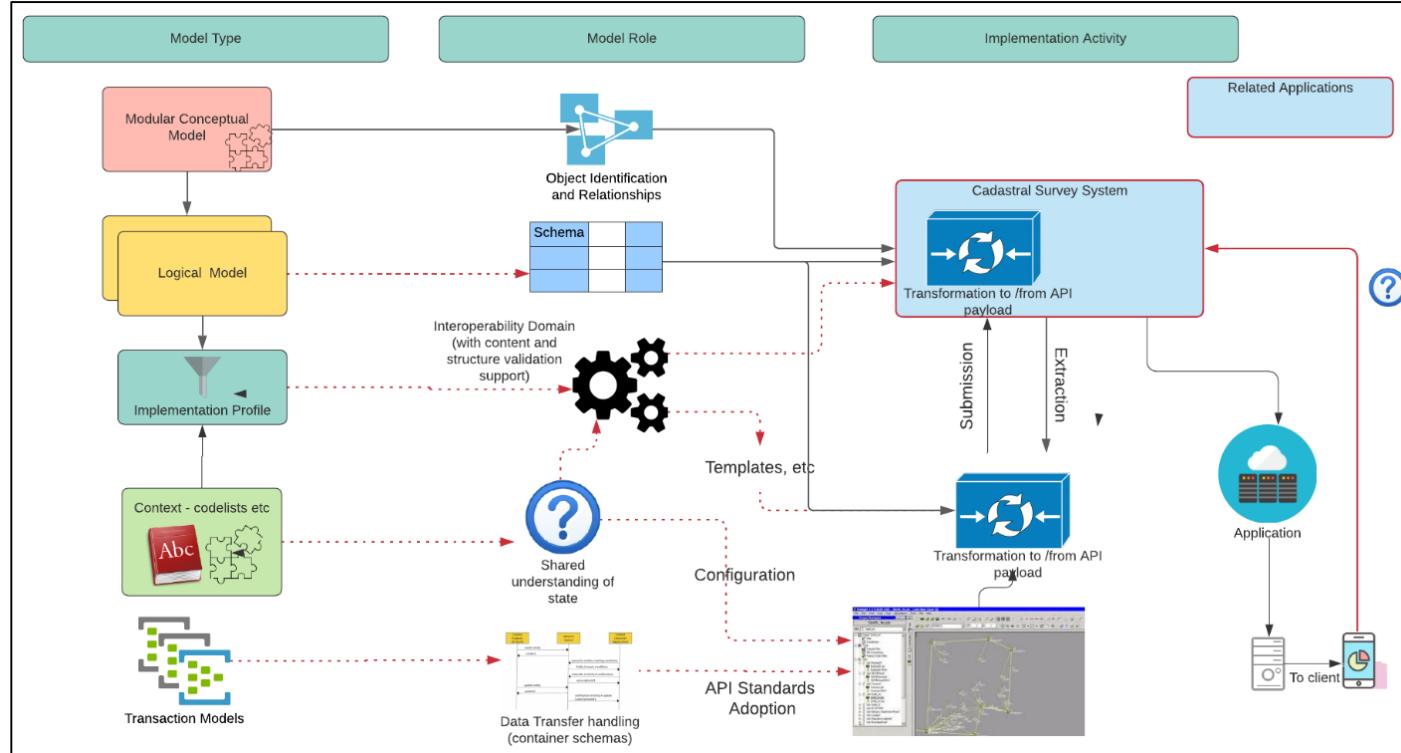
# Open Geospatial Consortium



# INFRASTRUCTURE & SURVEY STANDARDS

Conceptional Model					<a href="#">LandInfra</a>	<a href="#">LADM</a>	<a href="#">CityGML 3.0</a>	<a href="#">iFC 5.0</a>
Description					Conceptional model for the complete live cycle of an infrastructure facility	Land Administration Domain Model	First conceptional Model of <a href="#">CityGML</a>	First conceptional Model of <a href="#">iFC</a>
Actual Version / Released					1.0 / 2016	1.0 / 2012	3.0 / 2021	>2025
Standard Body					OGC	ISO	OGC	bSI
Comments					OGC did an implementation in GML – TU Delft a draft for JSON	Revision for 2.0 ongoing No Standard implementation	OGC did an implementation in GML – TU Delft a draft for JSON	
Implementation	<a href="#">LandXML</a>	<a href="#">HeXML</a>	<a href="#">InfraModel</a>	<a href="#">LandXML MVD</a>	<a href="#">InfraGML</a>		<a href="#">City GML</a>	<a href="#">iFC</a>
Description	1.2	<a href="#">Extension Schema to LandXML 1.2</a>	Copy of LandXML1.2 with some extension and restrictions	bSI <a href="#">ModelViewDefinition sub-schema of LandXML1.2</a>				
Actual Version / Released	1.2 / 2008	1.9 / 2019		0.5 / 2015	1.0 / 2016		2.0 / 2012	4.3 / 2021
Standard Body / Author	LandXML.org	Hexagon	Building Smart Finland	Building Smart international	OGC		OGC	Building Smart international
Implementation Language	XML	XML	XML	XML	GML		GML	STEP / EXPRESS
Comments	2.0 draft since 2016 available		Infrastructure Standard for Finland	Not used in industry	<a href="#">LandJSON</a> – draft JSON implementation of <a href="#">LandInfra</a>	ESRI / use LADM concept – without Standard implementation no interoperability	<a href="#">CityJSON</a> – draft JSON implementation of <a href="#">CityGML CM</a>	

# 3D CADASTRAL SURVEY DATA MODEL AND EXCHANGE PROJECT



\*\* Intergovernmental Committee on Surveying and Mapping (ICSM)





**ICSM**  
ANZLIC COMMITTEE ON  
SURVEYING & MAPPING



**3D Cadastres**

7<sup>th</sup> International FIG Workshop on 3D Cadastres  
11-13 October 2021, New York, USA

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

**Anselm Haanen**  
New Zealand Surveyor-General  
Project Sponsor





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



Development of a new encoding for LADM Survey Model  
or  
use existing one(s)?

# Assessment requirements for survey encodings

Requirements/ Encodings	AutoCAD dxf	AutoCA D dwg	ESRI shp	LandXML	OGC InfraGML	ISO IFC	OGC Geo Package	JSON	GeoJSON
Support both topology and geometry									
Support both 2D & 3D geometry									
Support rasters									
Support of Coordinate Reference System/ Georeference & Units of measurements									
Be simple and compact									
Be human readable									
Automatic conversion from the conceptual survey model									
Imposed by regulations (Cadastral Authority) <i>*jurisdiction dependent</i>									
System/ Georeference & Units of measurements									
Be simple and compact									
Be human readable									
Automatic conversion from the conceptual survey model									
Imposed by regulations (Cadastral Authority) <i>*jurisdiction dependent</i>									

# CONCLUSIONS

- ✓ specification of the requirements for the survey encodings to support LADM Edition II & will be described in Part 6
- ✓ examination of the well-known and widely used encodings/ formats
- ✓ Initial results presented at the OGC March 2022 Meeting @Join Session DWG LA and DWG LandInfra

## FUTURE WORK

- ✓ further involvement of industry suppliers, experts and users' implementation part of the LADM Edition II → relevant workshop to be organized at the next OGC meeting in June 2022
- ✓ reflection on the LADM Survey Model based on the initial requirements specification
- ✓ completion of the comparison matrix → can we reach a '**top-3**' from the assessment ?
- ✓ testing of the 'top-3' encodings using 2D survey examples based on the updated version of the LADM conceptual survey model
- ✓ open the discussion in order to provide useful conclusions on how to efficiently proceed with the LADM Edition II (conceptual model in normative annex Part 2, as well as technical encodings in Part 6).

The 10<sup>th</sup> LADM Workshop in conjunction with the 7<sup>th</sup> Croatian Congress on Cadastre  
**Session 2:: Surveying and land administration | B2**

# Thank you!

[https://wiki.tudelft.nl/pub/Research/ISO19152/LADM2022Workshop/LADM2022\\_paper\\_B2.pdf](https://wiki.tudelft.nl/pub/Research/ISO19152/LADM2022Workshop/LADM2022_paper_B2.pdf)

**Please vote here:**

- <https://app.sli.do/event/k57AgUEGbMVZw5Sy8ycMzw/embed/polls/5a860852-24ab-44ee-86ef-88030cdee22c> or
- Go to: [slido.com](https://slido.com) with #065073