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Towards 3D Cadastral Level of Detail - CLOD

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Content

- Introduction
- Cadastre Ecosystem
- LOD (CityGML, IndoorGML, LandInfra, BIM/IFC)
- CLOD – Cadastral Level of Detail
- Conclusions

Introduction

Project: *Testbed for Smart planning, construction, management and use processes over the entire life cycle (III) - tests in new processes, funded by the Swedish strategic innovation programme - Smart Built Environment.*

The concepts Level of Detail (LOD) in GIS and Level of Development (LOD) in BIM cannot define a complex 3D cadastre representation with both legal and geometrical levels of detail.



How to represent cadastral legal and geometric granularity for satisfying practical needs from different cadastral actors/stakeholders?

Aim

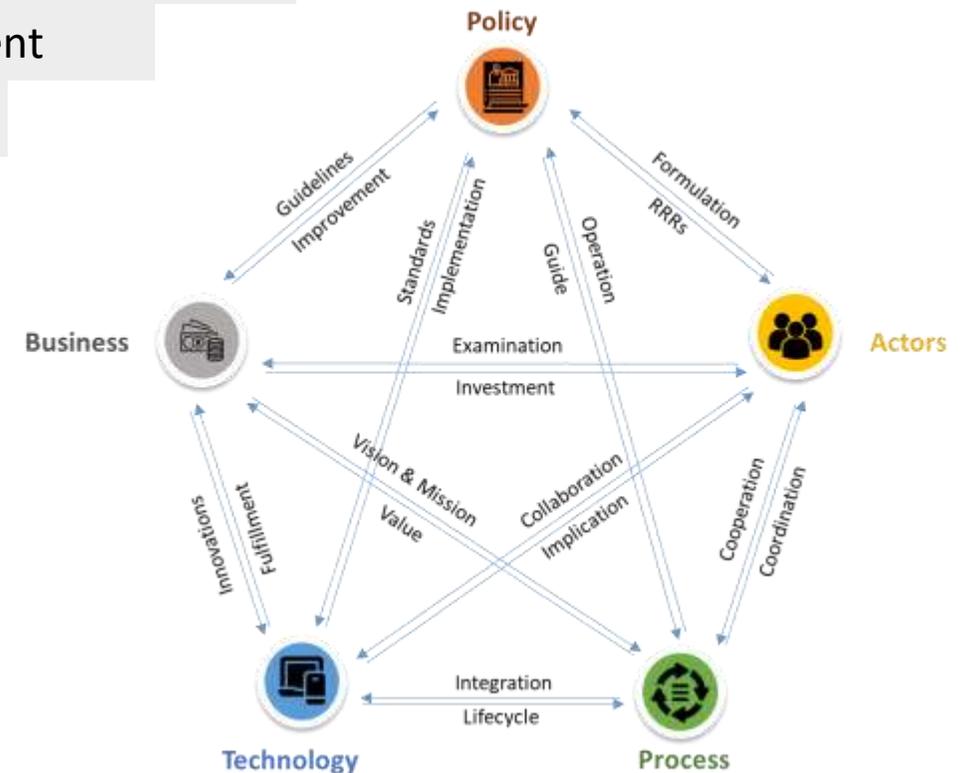
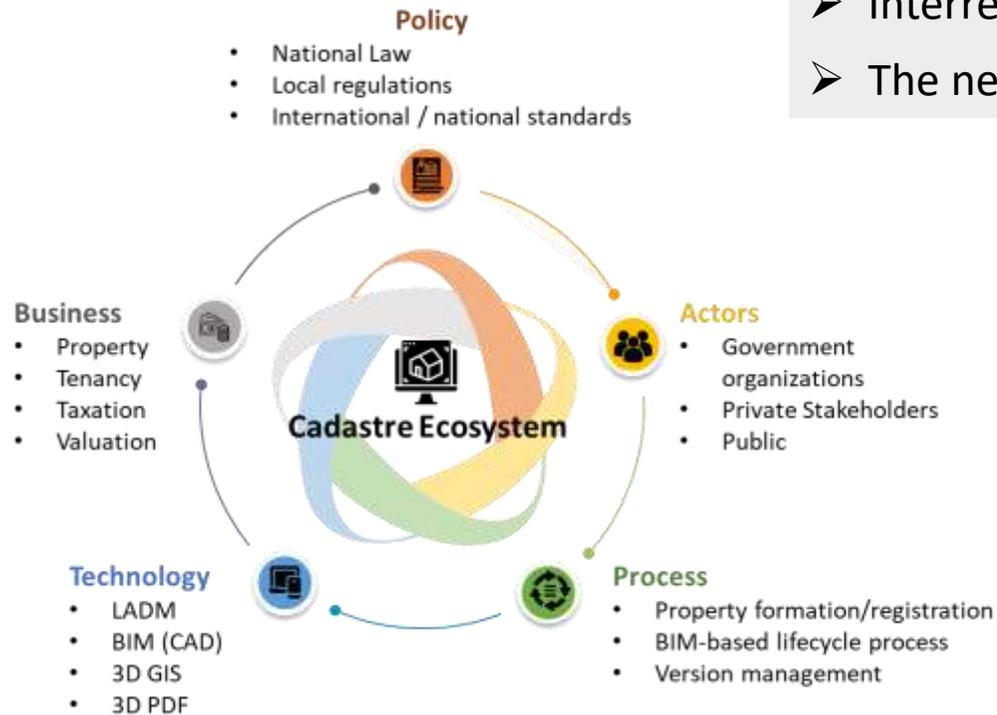
- To satisfy the cadastral geometry and legal requirements
- To save time and cost for further development of efficient and effective information retrieval
- To address the gap for harmonizing the cadastre, BIM and GIS database



Implement in the cadastre ecosystem.

Cadastre Ecosystem

- Five ecosystem components at a generalized level
- Link dynamically to each other
- Interrelated and interdependent
- The network of relationships



Towards 3D Cadastral Level of Detail

Cadastral Ecosystem

reflects that 3D cadastral management is complex and dynamic

Requires close coordination and collaboration among different actors for ensuring the efficient and effective process of land and property management to support economic development.

From technical points of view, the cadastre domain needs a well-defined hierarchical data structure and level of detail to provide cadastral data specifications clearly.

The risk of spatial representation with legal information being misunderstood will be reduced

Towards 3D Cadastral Level of Detail

LOD - Level of Detail (CityGML, IndoorGML, LandInfra)

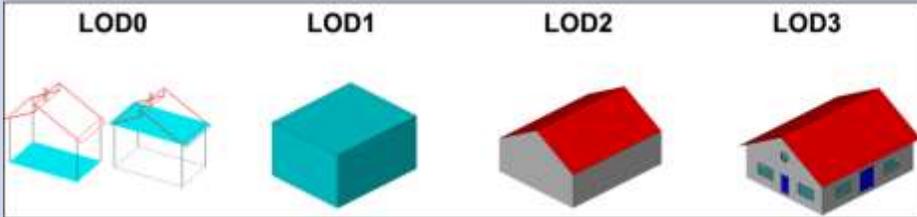
LOD	Classification (spatial representations)	Purpose
CityGML	 <p>CityGML 2.0</p>	<p>To represent different levels of detail for urban objects of the same real world such as buildings, trees, and roads.</p> <ul style="list-style-type: none"> • LOD0 (highly generalized model) • LOD1 (block model / extrusion objects) • LOD2 (realistic, but still generalized model) • LOD3 (highly detailed model)
	 <p>CityGML 3.0</p>	
IndoorGML	Similar to CityGML from LOD0 to LOD3	Modeling indoor spaces for navigation
LandInfra	An open conceptual data standard LODs are not supported in LandInfra	Designed as a connecting bridge, integrating concepts from CAD, BIM, and GIS

Figure: adapted from Biljecki et al., 2016, and Kolbe et al., 2021

LOD - Level of Development (BIM/IFC)

- Applied to geometry of building elements, but mainly only describes the graphical content of models.
- An LOD defines both the required geometric detail (also denoted as Level of Geometry – LOG) as well as the required alphanumeric information (also denoted as Level of Information – LOI).
- The degree to which the element’s geometry and attached information has been thought through

LOD - Level of Detail

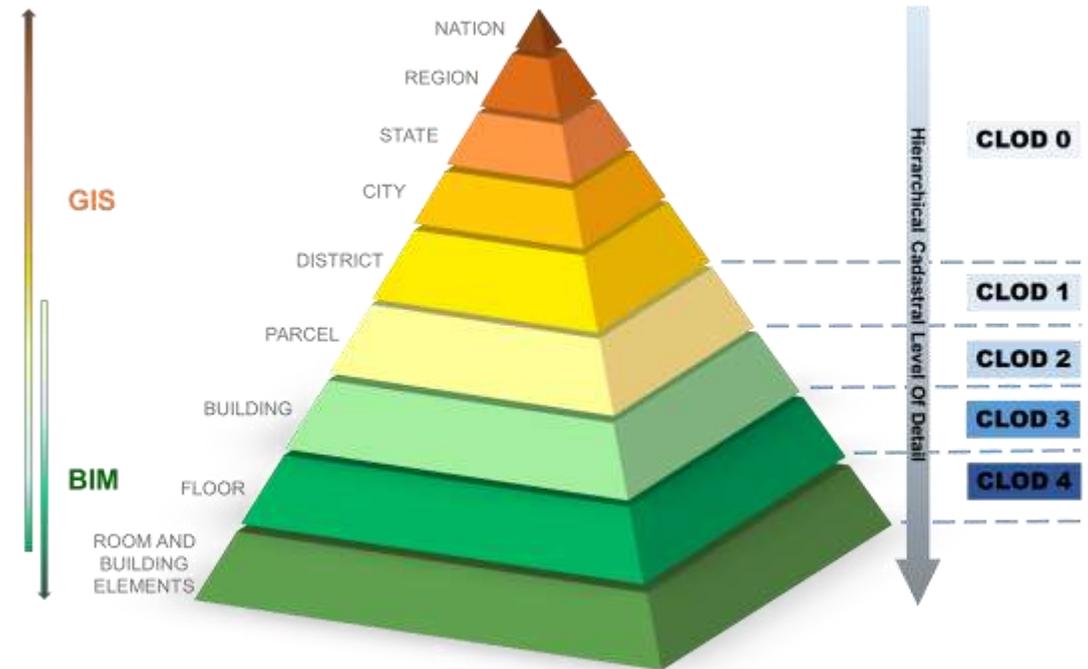
- Concerns the geometric information of urban objects.
- In other words, the Level of Detail is essentially how much detail is included in the model element.



CADASTRAL LEVEL OF DETAIL – CLOD

- ❖ Describe different levels of legal granularity and geometry accuracy of 3D cadastral models in a hierarchical way.
- ❖ Suitable for all types of cadastral properties, for example buildings and infrastructures.
- ❖ Five classifications
- ❖ The geometry aspect of CLOD refers to LOD (Level of Detail) in 3D GIS rather than LOD (Level of Development) in BIM.

Purpose: to reinforce the legal aspects in each level of detail associated with cadastral properties regardless of data structures such as IFC, CityGML or LandInfra.



Hierarchical Cadastral Level of Detail

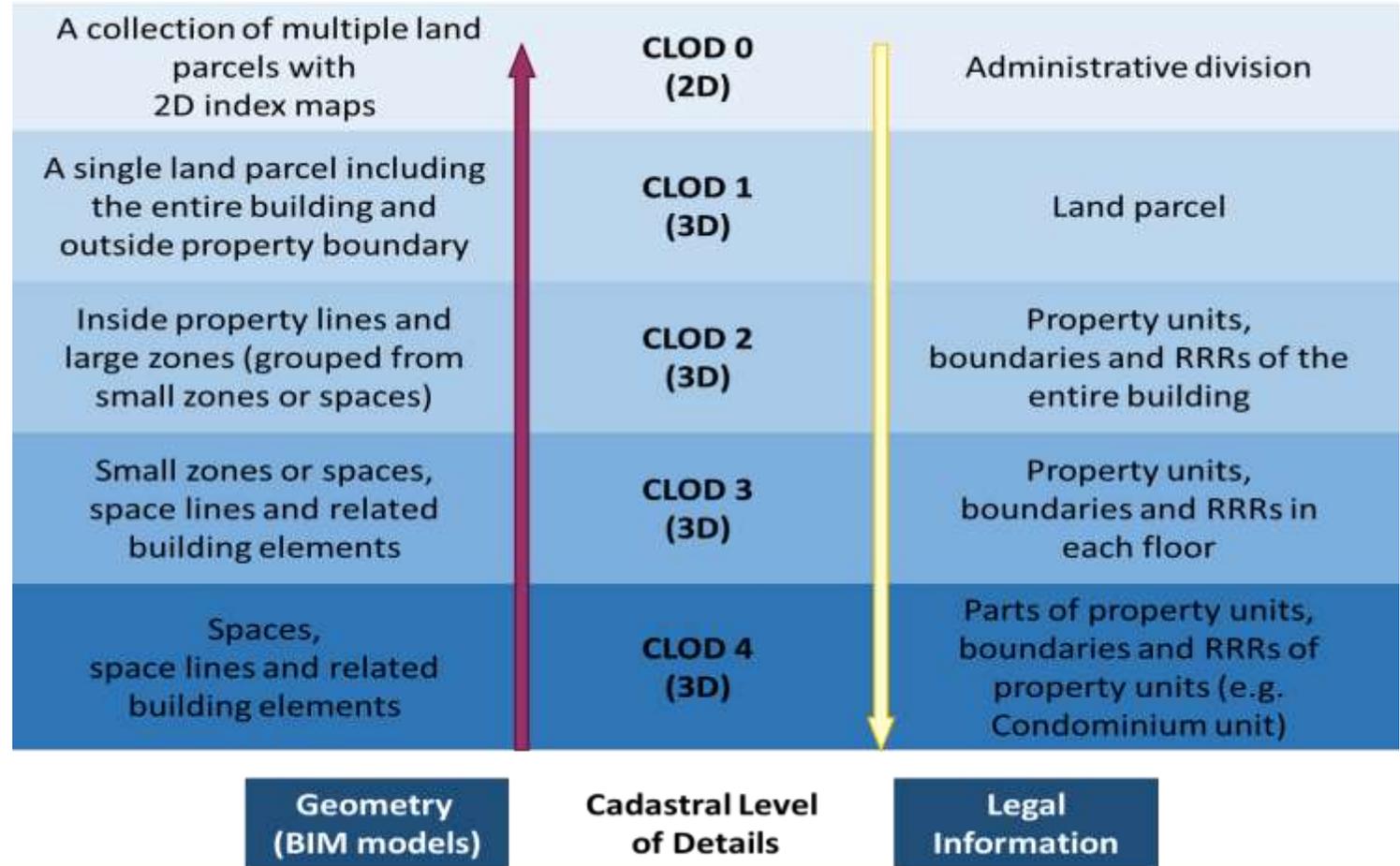
Towards 3D Cadastral Level of Detail

Classification of the CLODs

- Each level of detail specifies both legal information and geometry in the 3D cadastral models.
- The **GEOMETRY** level-of-detail specification of CLOD classifications is referring to LOD, but is different from LOD:
 - To ensure that the CLOD can meet practical cadastral requirements of different stakeholders;
 - To support different data structures e.g. BIM/IFC models, CityGML or LandInfra as 3D cadastral physical models to represent cadastral geometric granularity.
- The **LEGAL** level-of-detail specification corresponds to the LADM standard with associated classes, e.g. *LA_Party*, *LA_RRR*, *LA_BAUnit* and *LA_SpatialUnit* in the classifications of CLOD to represent legal information in associated relationships hierarchically.

Classification of the CLODs

- Ranging from CLOD0 to CLOD4
- Using BIM/IFC models as physical models for explanations
- Easements and their RRRs can be included in different classifications, from CLOD1 to CLOD4. The representation of legal and geometric specification of easements will follow the general requirements in every classification.
- In some specific situations, CLOD4 may be the same as CLOD3.



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Conclusions

CLODs could provide detailed information about the geometric and legal context of properties.

It is possible to select an appropriate CLOD for a given purpose to ensure that the 3D cadastral model could meet the requirements from different actors.

Contribution

The main contribution is to provide a basic prerequisite to develop a link between different datasets and pathways to implement the Cadastre Ecosystem.

Limitations

In this paper, we only focus on representation of CLODs in buildings.

Case studies with different situations will be implemented in further research.

The concept of CLOD for infrastructure will be refined in future work.

Thanks!

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