



Requirements and Opportunities for Web-Based 3D Visualization and Dissemination of Property Valuation Information

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Content of the presentation

- Visualization and dissemination of valuation information: Why it is necessary? / Research questions
- Requirements for 3D visualization and dissemination of valuation information
 - Similar requirements to 3D cadastral visualization
 - Specific requirements for visualization of valuation information
 - Opportunities for data sources, schema for storage and geoweb viewer
- Developed prototype
- Conclusion and future work





Immovable property value is a key component of land administration systems (UN-Habitat 2021), as it is important for **effective land acquisition**, **taxation**, **transaction**, **consolidation**, **readjustment**, **transformation** and so on.

World Bank Policy Research Working Paper: Urban transformation is most efficient when land markets are grounded in strong institutions that enable public dissemination of property values across uses (Lozano-Gracia et al., 2013).

New Urban Agenda (2016):

- Property values and land and housing price records needed to assess changes in values should be recorded and shared (cf. Clause 104).
- Visualization opportunities for dissemination of timely and reliable valuation information should be utilized (cf. Clause 156, 157, and 159).





Visualization and dissemination of valuation information



In the Netherlands, **assessed values** together with **valuation dates** and some characteristics (e.g. **construction year**, **property function/type**, **floor size**) of **residential properties** are **publicly disseminated** through **footprints of apartment buildings** ('WOZ-waardeloket' - <u>https://www.wozwaardeloket.nl/</u>).





However, 3D visualization of valuation units is required in order to disseminate valuation information more effectively and efficiently \rightarrow to see and identify what is really valued, effective communication with users, etc.

In fact, some of recently developed **3D cadastral prototype** models include **value as a characteristic** of property units.

Can they be seen as an effective tool to disseminate valuation information?

<u>Research questions</u>: Can an identical or a modified version of a 3D cadastral visualization prototype be considered as an effective tool for dissemination of valuation information?

What are the requirements and opportunities for web-based 3D visualization and dissemination of valuation information?





In valuation processes, **legal** and **physical** property characteristics (and many more: transaction prices, locational characteristics) are used as input data to calculate property values.

Which space should be visualized?

Legal space or physical space or both \rightarrow which is more appropriate for value dissemination?

According to International Association of Assessing Officers (IAAO), Land and building property **rights to be valued** is the **fundamental** information for valuation (IAAO, 2014).

Therefore, **land registry and cadastre can be considered as the main data sources for both valuation processes and visualization of valuation units**, as they record the rights, restrictions and responsibilities (RRRs) and their associated spatial units.





Requirements for 3D visualization and dissemination of valuation information: valuation objects

Can an identical or a modified version of a 3D cadastral visualization prototype be used to disseminate valuation information?



Case 1: If basic legal unit is **identical** to basic valuation unit \rightarrow with some additional characteristics and functionalities Case 2: If basic legal unit **differs** from basic valuation unit \rightarrow some geometrical modifications are required, e.g. aggregation of legal units





In both cases, the **experience gained from the studies that developed a 3D cadastral visualization prototype** can be utilized for 3D visualization of valuation units.

In this study, the following studies are examined to determine similar requirements: Shojaei et al., 2013, 2015, 2018; Wang, 2015; Pouliot et al., 2018; Cemellini et al., 2020.

Similar categories given in Pouliot et al. (2018) (3D Cadastre Best Practices) are used to group requirements:

- (1) users and users' requirements,
- (2) data sources, schema for storage and semiotics,
- (3) appropriate geoweb viewer (visualization platform)





These requirements are also valid for 3D visualization of valuation units

Users	 Lawyers, notaries, real estate agents, general public, etc.
User requirements	- Descriptions of 3D geometric boundaries of property units (e.g. legal spaces and boundaries) can be included and identified
	- Private and common parts in 3D co-ownership in apartment buildings can be distinguished and represented
	- 3D measurements can be performed and processed
	- Interactive 3D user interface is available
Data	 Descriptive and/or legal documentation (e.g. data sources) can be included Temporal aspects of property rights can be managed
Data source	- Survey plans, floor plans (architectural drawings), BIM data, city models
Data schema	- LADM country profile, an extended BIM schema, etc.
Semiotics	- Setting graphic visualization is supported (e.g. colour and transparency)

- Functionality of the platform include zoom in/out, pan, symbol, colour, thickness, transparency, navigation, attribute query, spatial analysis, underground view, handling massive data

- Web Graphics Library (WebGL) platforms: iTowns, CesiumJS, OSM Buildings, WebGL Earth, GeoBrowser 3D, ESRI CityEngine





Specific requirements for 3D visualization and dissemination of valuation information

In valuation case, main users are considered the **appraisers** performing private or public valuations and the **customers of these valuations**, e.g. general public.

The required characteristics

- Property value and valuation date (value in different dates temporal aspect) should be shared with users.
- Several **different value types** (e.g. tax value, registered value) may be shared with users.
- For transparency and accuracy purposes, input valuation data can also be shared: building age, floor area, parcel size, accessory part type (e.g. garage space), neighbourhood characteristics.
- Similar **data sources** can be utilized (e.g. survey plan, floor plan, BIM data) to visualize valuation units in 3D.





As **data schema** to store both legal spaces of valuation units and valuation information, **LADM Valuation Information Model** can be consumed because (1) it includes not only valuation information but also corresponding legal spaces (2) it can be extended to include country specific situations.

Functionality requirements for visualization prototype:

Valuation units can be aggregated according to **use type** (e.g. residential, commercial, retail, etc.) and **valuation unit group type** (e.g. single unit, building, street, neighbourhood, city district, and city).

Aggregating valuation units into groups can be considered as the implementation of the **level of detail concept in visualization of valuation information**.





Aggregation of valuation units into valuation units groups

- Different characterisics may be required for each level.
- In street level, the minimum, maximum and average values of valuation unit groups (e.g. buildings, parcels) can be shared.
- In apartment building level, total or avarage value of apartments can be shared.







Aggregation of valuation units into valuation units groups

- In city level, avarage values of valuation units that has different use type (e.g. residential, commercial, retail, etc.) can be shared.
- Similar to sharing sales statistics but in this case valuation information is shared with its spatial component.
- Note that LADM Valuation Information Model supports recording valuation information in different levels.







Functionality requirements for valuation information prototype

- Perform dynamic 3D view and distance analyses,
- Support for thematic mapping and animations to enable effective dissemination of valuation information,
- Support for visualizing below surface properties to identify valuation units below ground level,



- Provide solutions for occlusion to identify valuation units in complex buildings,
- Support for **3D Tiles** to stream massive amounts of data.





Selecting appropriate visualization platform (geoweb viewer)

- Only WebGL based tools are evaluated in this stage (e.g. CesiumJS, OSM Buildings, ESRI CityEngine, iTowns, 3DTilesRendererJS) as the aim of this research is to find an appropriate, web-based solution for visualization and dissemination of valuation information.
- According to the requirements, two geoweb viewers came forward: CesiumJS and NASA-AMMOS/3DTilesRendererJS. In our case, CesiumJS was selected for visualization and dissemination of valuation information since:
- it provides opportunities for 3D analysis tools: distance and area measurement and visibility analysis,
- it supports time dynamic visualization by means of the CZML format,
- it is **widely used in the domain of land administration**, it is used by a large group of users,
- **3D Tiles formats** are also developed by the same group.





Developed prototype – Condominium level



http://3d.araziyonetimi.org/

- Legal spaces can be identifed and selected.
- When hovering over a condominium unit, the colour of the accessory part of it (in this case a garage) is automatically changing.

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Building

Single Unit

Developed prototype – valuation information related to parcel







Developed prototype – valuation information related to building







Developed prototype – Neighbourhood level visualization



The values coloured are according to average values of all condominium units in one condominium building.





Conclusion and Future Works

Concluding remarks

- Developing a web-based system for visualization and dissemination of 3D valuation units and their characteristics is a challenging task.
- An identical and/or modified version of a 3D cadastral prototype can be used for dissemination of valuation information with some additional characteristics and functionalities. On the other hand, it should be stated that having option to visualize both legal and physical spaces of valuation units in the same prototype system would further support effective dissemination.
- The developed prototype shows that the LADM Valuation Information Model compliant schema can be used for data storage which can be used as basis for visualization.
- The **aggregation of valuation units into groups** to share valuation information may be good approach to implement. This suggestion may improve the **communication** with users.

Future works

- This is an **ongoing work**. The developed prototype is not completed yet and there is a lot still to be done. For example, the prototype system should be enriched with some functionalities (thematic mapping, 3D measurements). It needs to be tested with a more complete dataset.
- Obstacle: it is very hard to find condominium level information even in a neighbourhood. Therefore, a methodology to derive relevant spaces will be considered.







Thank you!



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21