Position paper 1
Urban development / plan information LADM part 5

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1. INTRODUCTION

Anthropogenic processes caused by humans (mainly buildings) are a frequent element of spatial planning and usually have the greatest influence on the landscape and the inhabitants of the territory. It is necessary to reflect and respect the past (history), truthfully portray the present (state) and examine the impact of new developments on the future (intention). This is the only way to meet the needs of the current generation without jeopardizing the conditions of future generations. The use of 3D elements for decision-making in the territory enables a view on the issue from a larger perspective or context, which 2D visualization does not offer. Spatial relationships and connections to the surroundings are essential for decision-making in the territory. With the development of 3D visualizations and applications, it is possible to convincingly model the state of the territory in various scales of detail. It is possible to visualize existing or future design elements into the given models and present the results to experts or the public as part of an online or offline solution (Rucký and Janečka, 2022).

Information about land ownership, land use policy and rights, restrictions and responsibilities (RRRs) are vital in spatial planning, particularly in densely and intensive-use of spaces, particularly in the urban area (Indrajit et al., 2020). Overlapping RRRs in space are however typical for the current built environment. As stated in Kitsakis et al. (2022), the extent and the content of the right of ownership in the various legal systems is significantly affected by legal provisions and restrictions deriving from public law (Public Law Restrictions (PLRs)). Therefore, the 3D LAS should integrate RRRs coming from both land administration and spatial planning processes. The importance of the 3D aspect in spatial plans needs more attention, to show the true size, depth and height of the planned developments in our dense (urban) environments. In addition, the temporal aspects, arranging possible developments over time, and the multi-scale/multiple levels of planning, from national and provincial to detailed zoning plans at the municipality and neighborhood level. Conceptually, the 3D spatial representations combined the temporal and scale aspects result in 5D models.

Considering interoperability between the spatial plan and land administration as a base for urban development, all aspects (legal, organizational and technical) must be explored.

2. STATE OF THE ART

The 3D spatial plan needs to be interoperable for further integration with other data, such as 3D land administration. Lack of interoperability may create unwanted information asymmetry. The international standard under development ISO 19152-5:202X Geographic Information — Land Administration Domain Model (LADM) — Part 5: Spatial plan information is going to provide the general reference model, as a newly added part to the existing core LADM (i.e., ISO 19152-1:202X and 19152-2:202X), for all objects of spatial planning covering land/water and below/on/above surfaces. This standard supports 4D (3D + time) representation of the spatial plans including marine spatial plans. It should be considered as the first basic step to promote interoperability through integration of output spatial planning processes with land registry and cadastre.

The foundations for ISO 19152-5:202X Geographic Information — Land Administration Domain Model (LADM) — Part 5: Spatial plan information are given in Lemmen et al. (2021), Indrajit et al. (2020, 2019) and the EU's Plan4all | Open Geodata for Planning Activities initiative (Murgante et al., 2011); see https://www.plan4all.eu/: *"The idea of creating the Plan4all association arose as a result of the eContentplus project Plan4all (2009-2011). It was established during the FP7 project Plan4business (2012-2014). Plan4all was focused on large scale spatial planning data harmonisation in Europe and provided draft INSPIRE data specifications for five spatial data themes including land use and land cover."*

3. KEY CHALLENGES

- Land registry and planned land use information is today not yet integrated in most countries (van Oosterom et al., 2019). Before 19152-5, these domains were not based on the same conceptual model and it was not possible to be easily used together. The extensible basis for the development of efficient LAS based on a Model Driven Architecture (MDA) and covering the common aspects shared by objects created by spatial plans should be developed.
- Various differences in concepts and vocabulary/terminology for land registry and spatial planning are the practice today. The shared vocabulary is needed.
- Digital representations of physical public utilities and underground infrastructure registration are not a part of the land registry. In some countries (e.g. The Netherlands), the corresponding legal spaces for these utilities are in the land register together with the associated RRRs and parties. As Dželalija and Roić (2023) mention, with rising urbanization, more complex buildings and infrastructure, underground and overground construction, as well as a limited amount of space in such areas, the proper registration of utilities has become more important than ever.
- One of the challenges is how to model the Public Law Restrictions (PLRs), many of them are arising from spatial plans (in LADM part 5), but not all types of PLRs are from spatial plans (in LADM part 2). One could also argue that the plan area's should also be explicitly registered as RRRs (in LADM part 2). Good guidelines are needed here.
- There are huge gaps between the (information) systems used in the land registries and by the spatial planning authorities. This makes it costly to arrive at a minimal level of interoperability to enable the data exchange needed between the two systems. Even worse is the data in the different systems are now properly aligned there will be issues with data inconsistencies (or mistakes).

- There are quite diverse communities of professionals behind the LR and SP systems and processes. They are not talking to each other, and they do not really understand each other, due to their different professional backgrounds and education. This is true both at international level and also in most countries.
- Guaranteed (in terms of source, update and validity of geometries) open 3D data for urban development:
    - 3D legal spaces (3D cadastre / 3D LAS).
    - 3D spatial plans - converting 2D planning objects into 3D planning objects (e.g. maximum allowed building heights).
    - 3D "as built" physical spaces / topography (City Information Modelling (CIM) / GeoCIM and also non-city areas).
    - Building Information Modelling (BIM) - in some countries (e.g. Czechia) seems to be the driving force behind the developments of 3D data.

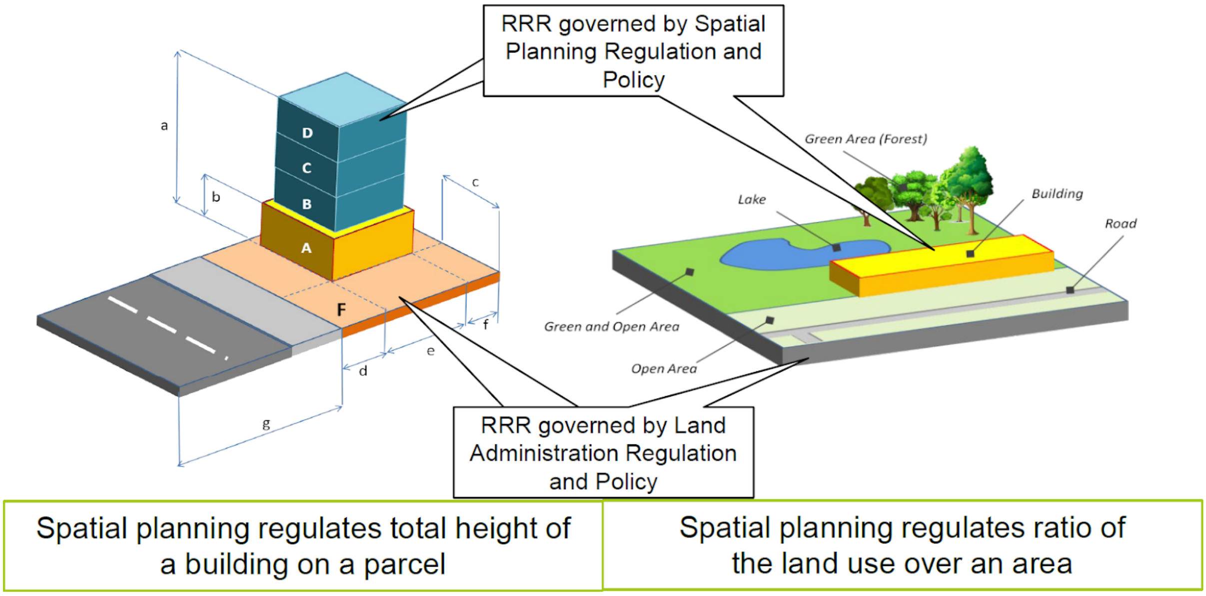
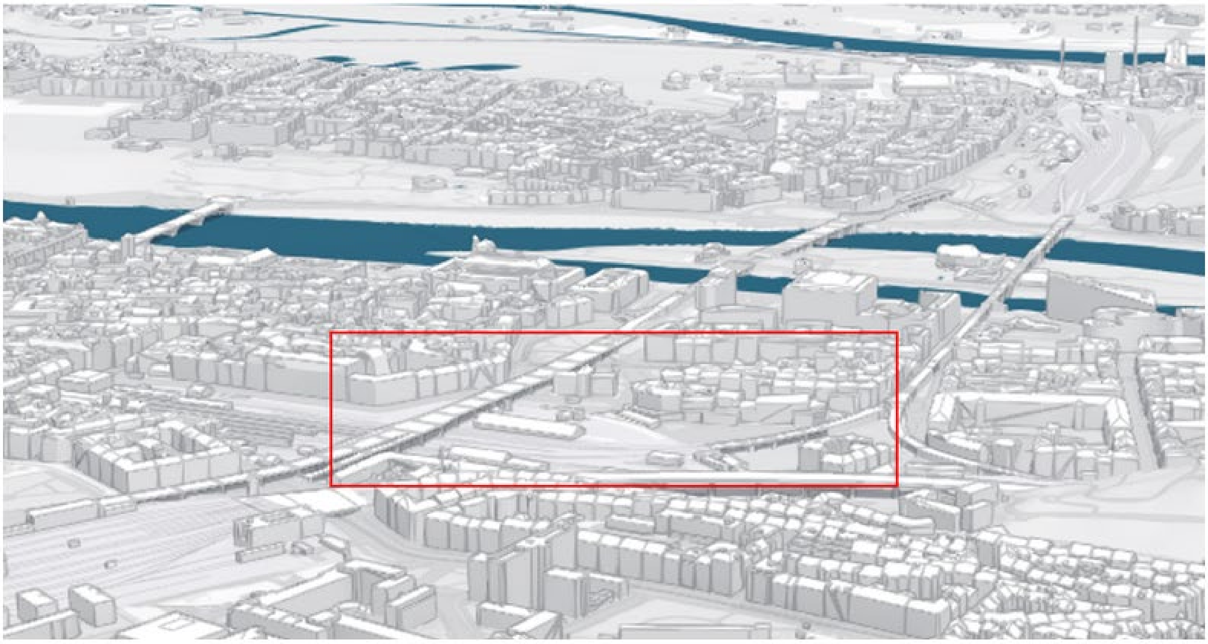


Figure 1. Spatial planning information as part of complete land administration (van Oosterom et al., 2019).

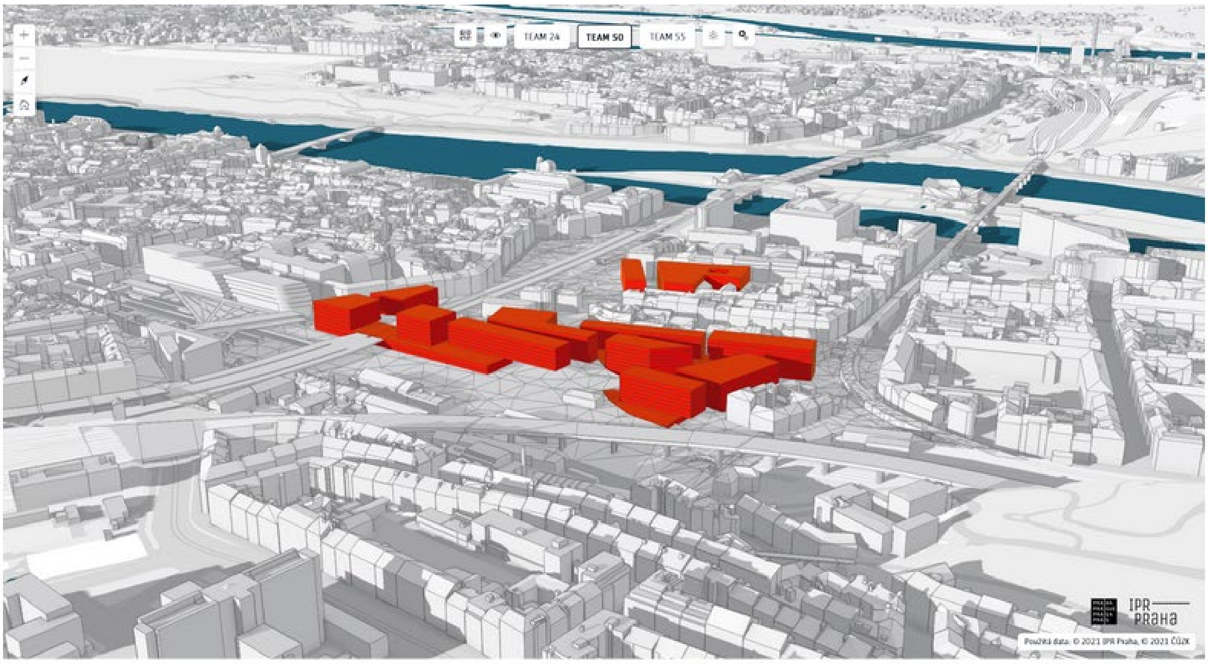
4. POSSIBLE SOLUTIONS

- International standardization. Spatial planning information should be a part of complete land administration (Figure 1).
    - ISO 19152-5:202X enables the combining of land-use planning and development in land administration information from different sources.
    - ISO 19152-5:202X also provides the terminology for spatial plan information as part of the land administration.

- Explore, design and evaluate an integrated land registry and spatial plan information model in one or more countries, i.e. a LADM LR/SP country profile, where these different functions of land administration are traditionally already quite well organized in harmonized workflows, possible within a single organization (e.g. Israel, Malaysia…)
- Perform a cost-benefit analysis in one or more countries comparing the current separate LR/SP systems with an integrated LR/SP system approach. Aspects to be considered: cost of current ad hoc conversions, cost due to mistakes/data inconsistencies, cost of developing integrated system
- The reasonable use cases demonstrating the feasibility and usefulness of such approach, e.g.:
    - Processing panoramic sketches of the plan of the future building complexes (Figure 2). First, the information about the parcels where the new buildings should be built is needed. Next, for example, the maximum height of intended constructions/buildings must meet the height limits given by the spatial plan. Finally, new buildings must not affect historical panoramas.
    - Automatic building permit issuing. To get the building permission, the necessary checks, e.g. checking building designs against building regulations laid down in spatial plans, must be done (a nice example here is the automated permit checking system as recently being in use by Estonia).
    - … and others.
- Utilities and underground infrastructure as part of 3D cadastre /3D LAS, i.e. utilities and underground infrastructure as property.
- Organize joint sessions or even workshops with both the LR and SP communities; e.g. within the FIG Working Weeks (or Conferences) have commissions 7 and 8 tasked with the challenge to enable, stimulate such a joint session or event. Also, the traditional LADM/LR community could/should try to be more involved in SP communities; e.g. PLPR, Plan4all with the recently started follow-up project PLUS Change (Planning Land Use Strategies: Meeting biodiversity, climate and social objectives in a changing world).



(a) The 3D digital model of Prague (IPR, 2023). The intended future building complex should be placed in the area marked by the red rectangle.



(b) The portrayal of the future buildings within the 3D digital model of Prague (ARCDATA, 2022).

Figure 2. Processing panoramic sketches and views of planned building complexes.

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BIOGRAPHICAL NOTES

Karel Janečka has a Ph.D. (2009) in Geomatics, University of West Bohemia in Pilsen and Assoc. Prof. (2020) in Geoinformatics, Technical University of Ostrava. He had been working as a database programmer at the Czech Office for Surveying, Mapping and Cadastre in Section of cadastral central database between 2006 and 2008. Since 2009 he is a researcher at University of West Bohemia, Department of Geomatics. His research activities are spatial data infrastructures (SDI), geographical information systems (GIS), spatial databases, 3D cadastre and building information modelling (BIM). He has experience with coordination of several EU research projects and is also reviewer of several international scientific journals. Since 2012 he is the President of the Czech Association for Geoinformation and member of National Mirror Committee 122 Geographic information/Geomatics. Since 2021 he is the Head of the Department of Geomatics at Faculty of Applied Sciences, University of West Bohemia.

Peter van Oosterom obtained an MSc in Technical Computer Science in 1985 from Delft University of Technology, the Netherlands. In 1990 he received a PhD from Leiden University. From 1985 until 1995 he worked at the TNO-FEL laboratory in The Hague. From 1995 until 2000 he was senior information manager at the Dutch Cadastre, where he was involved in the renewal of the Cadastral (Geographic) database. Since 2000, he is professor at the Delft University of Technology, Faculty of Architecture and the Built Environment, Chair GIS Technology, the Netherlands. He is the current chair of the FIG Working Group on '3D Cadastres'. He is co-editor of the International Standard for the Land Administration Domain, ISO 19152.

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