An LADM-based approach to developing and implementing national 3D cadastre: A case study of Malaysia

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Introduction to the Project

- The motivation of this project is to discuss the current initiative of Malaysian government to develop and implement an LADM-based 3D cadastral system in alignment with jurisdictional settings of Malaysia.

- It focuses on data migration from existing database to open source data base and upgrading application modules for implementation of 3D cadastral database.

- The project investigates how the current 2D NDCDB should be upgraded to a 3D one and how the current workflows and associated data to be modified to support the realisation of the 3D cadastral system.

Current Challenges

- Measurements and data storage issues: NDCDB that is a 2D-based database (X, Y), in the form of 2-dimensions (X, Y) planimetric coordinates but reality is 3D.

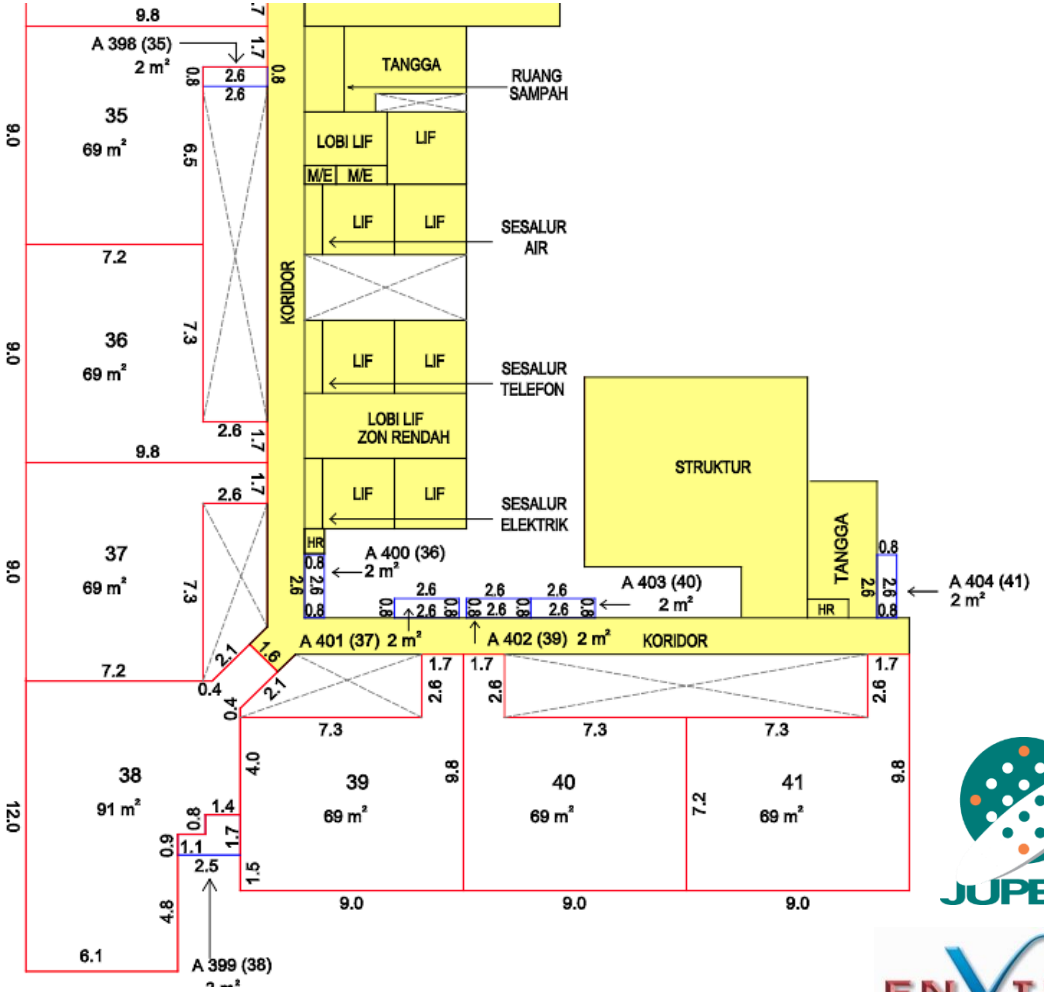
- Determining the accuracy of height measurements is challenging

- Concerns about the methods of data collection and adjustment of existing survey to generate 3D spatial information (X, Y, Z).

- The development of a comprehensive Land Administration System that supports 2D and 3D cadastral registration in an integrated database.

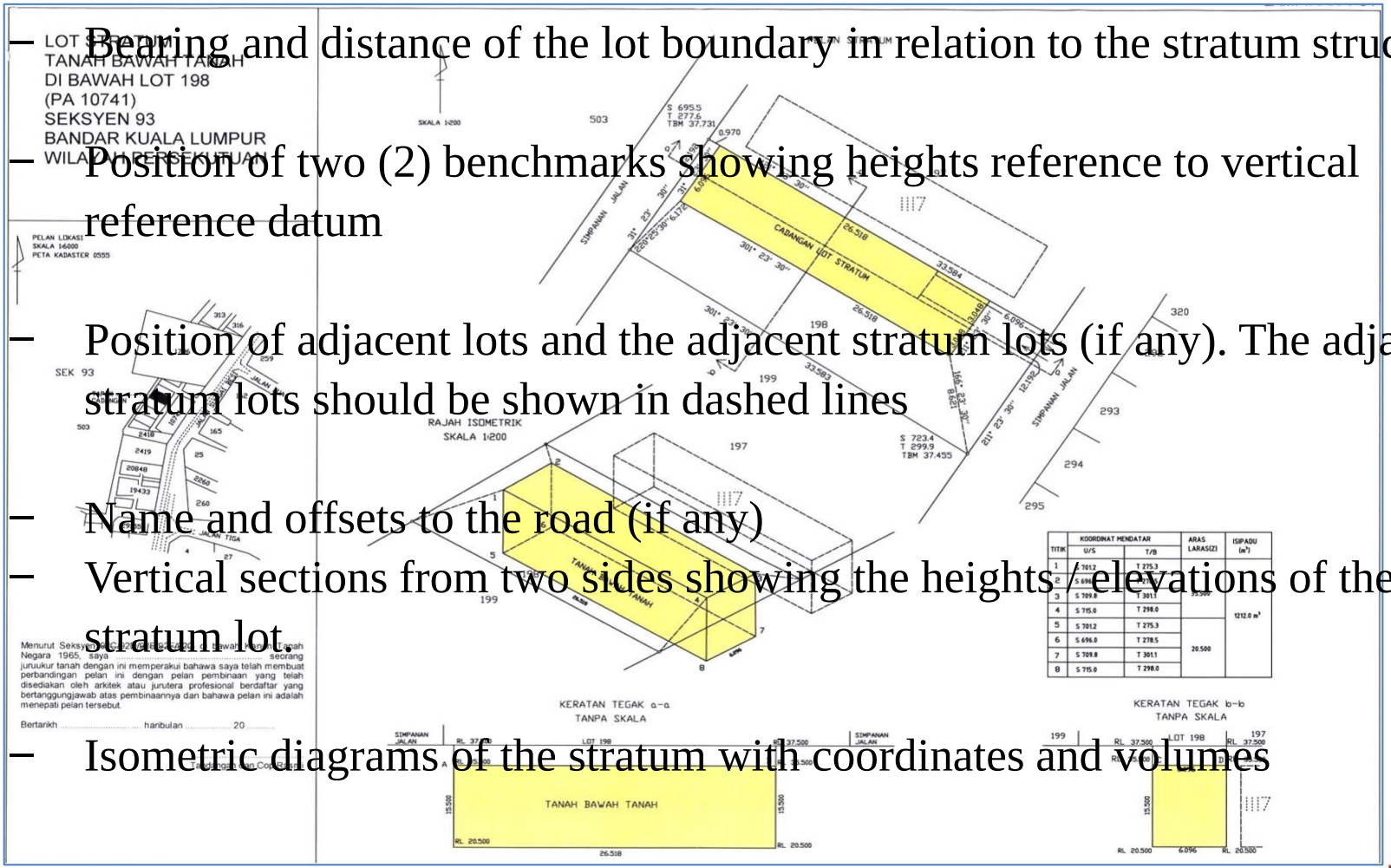
Current 3D cadastral registration in Malaysia

- Strata plans for aboveground properties
  - Land parcel
  - Parcel unit
  - Common property
  - Accessory unit
  - Mainly median boundaries



Current 3D cadastral registration in Malaysia

- Stratum plans for underground properties



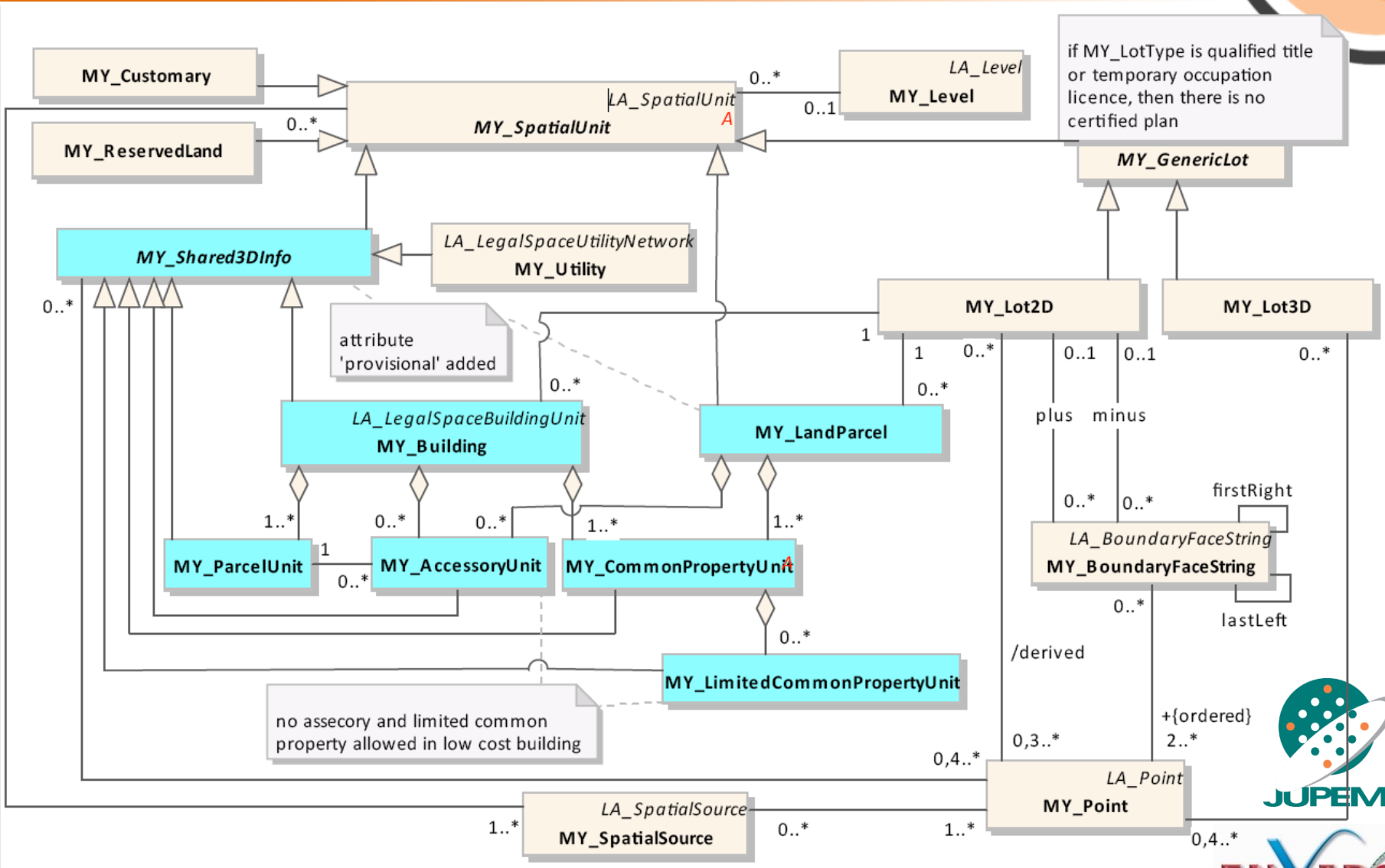
- Bearing and distance of the lot boundary in relation to the stratum structure
- Position of two (2) benchmarks showing heights reference to vertical reference datum
- Position of adjacent lots and the adjacent stratum lots (if any). The adjacent stratum lots should be shown in dashed lines
- Name and offsets to the road (if any)
- Vertical sections from two sides showing the heights / elevations of the stratum lot.
- Isometric diagrams of the stratum with coordinates and volumes

An overview of LADM Standard

- Three packages, namely Party, Administrative, and Spatial Unit, and one sub package, Surveying and Spatial Representation, constitute conceptual schema of LADM (Lemmen et al. 2015, p. 538).

- The concept of spatial units is overarching and includes various spatial representations of ownership interests defined inside any jurisdiction. These representations can be textual descriptions, sketch maps, points, unstructured set of lines, areal and volumetric legal objects

Malaysian LADM profile (Spatial)



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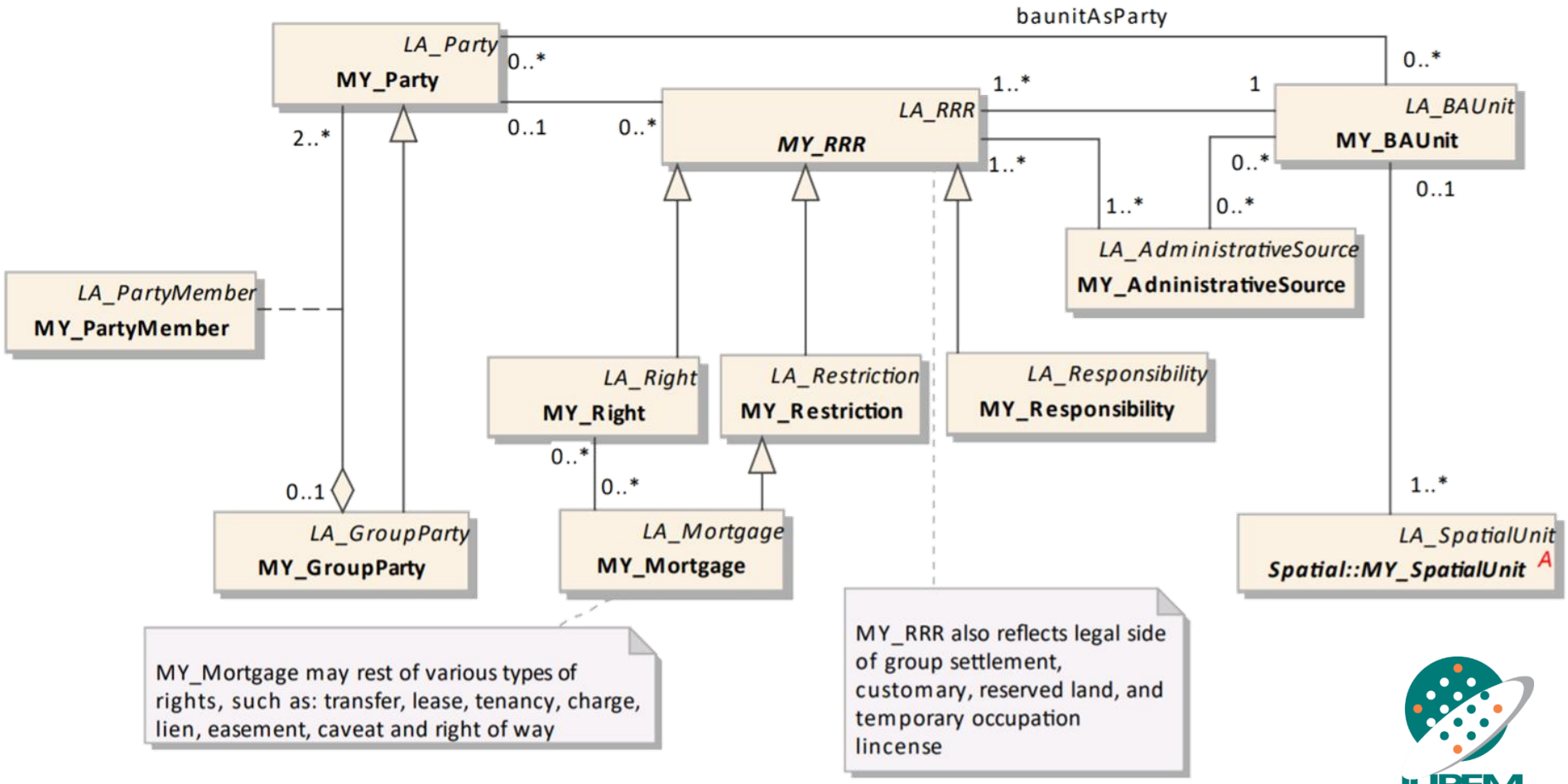
Malaysian LADM profile (Administrative)



Source: https://wiki.tudelft.nl/bin/view/Research/ISO19152/CountryProfiles

Available Technologies in Support of LADM

A prototype system has been developed in Kenya using free and open source software (FOSS) (Kuria et al., 2016)

Zulkifli et al. (2014) presented an LADM prototype system in Malaysia with some sample data from JUPEM and land office.

Database: Oracle spatial.
Frontend development: Bentley Microstation

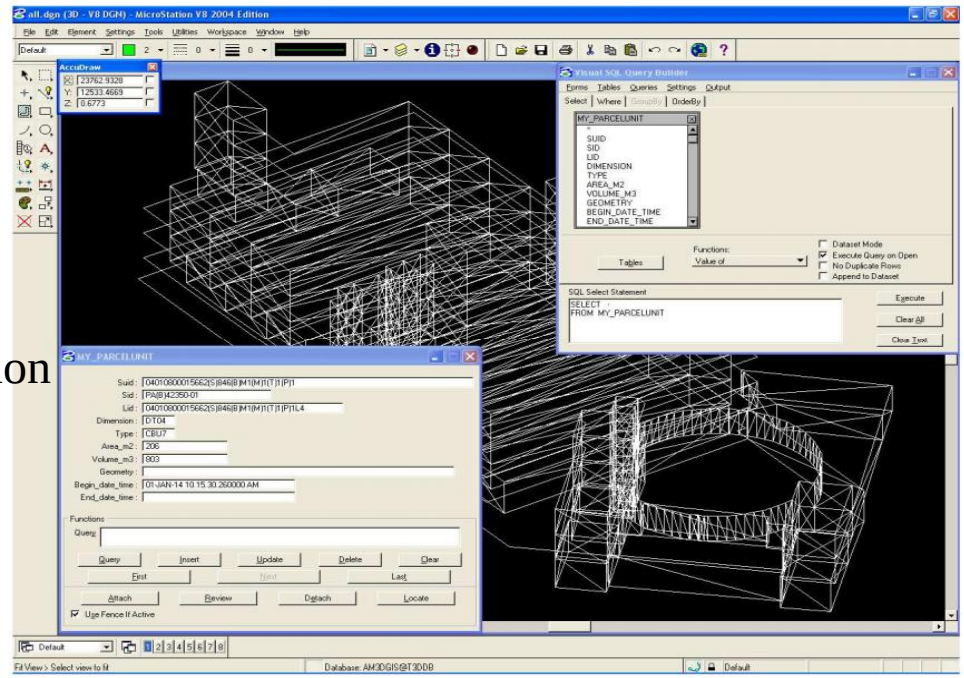
UML Modeling
- Dia, Visual Paradigm

Database development & management
- PostgreSQL and PostGIS

GIS Data Preparation, Cleaning & Management
- Quantum GIS (QGIS)

Integrated Development Environment
- liClipse

Web Application Development
- Python, Mapnik, geodjango & django



Available Technologies in Support of LADM

- Lemmen et al. (2016) proposed the Service Oriented Architecture (SOA) as an enterprise architecture for developing fit-for-purpose land administration systems in less developed countries to secure tenure.

- LADM has also been formulated in INTERLIS and the result is a layered INTERLIS data model. Using INTERLIS tools, databases such as Oracle and PostgreSQL to develop a data exchange format for a specific LADM country.

Improved Land Management Using LADM In Malaysia

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Advantages of using LADM for 3D cadastral registration in Malaysia are:

- LADM can provide 3D digital representation of legal space associated with each property located in urban developments.

- As current strata and stratum subdivision practices in Malaysian jurisdictions are based on 2D-based analogue plans, adopting an LADM-based approach could potentially advance current subdivision practices into 3D digital, intelligent and dynamic data environments.

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- Re-using cadastral information from current 2D-based subdivisions plans is quite cumbersome since the data environment is analogue. However, LADM-based 3D digital cadastral information can be re-used.

- The approach will propose the integration of complementary modules, especially for 3D spatial data input, 3D adjustment and validation of 3D spatial data.

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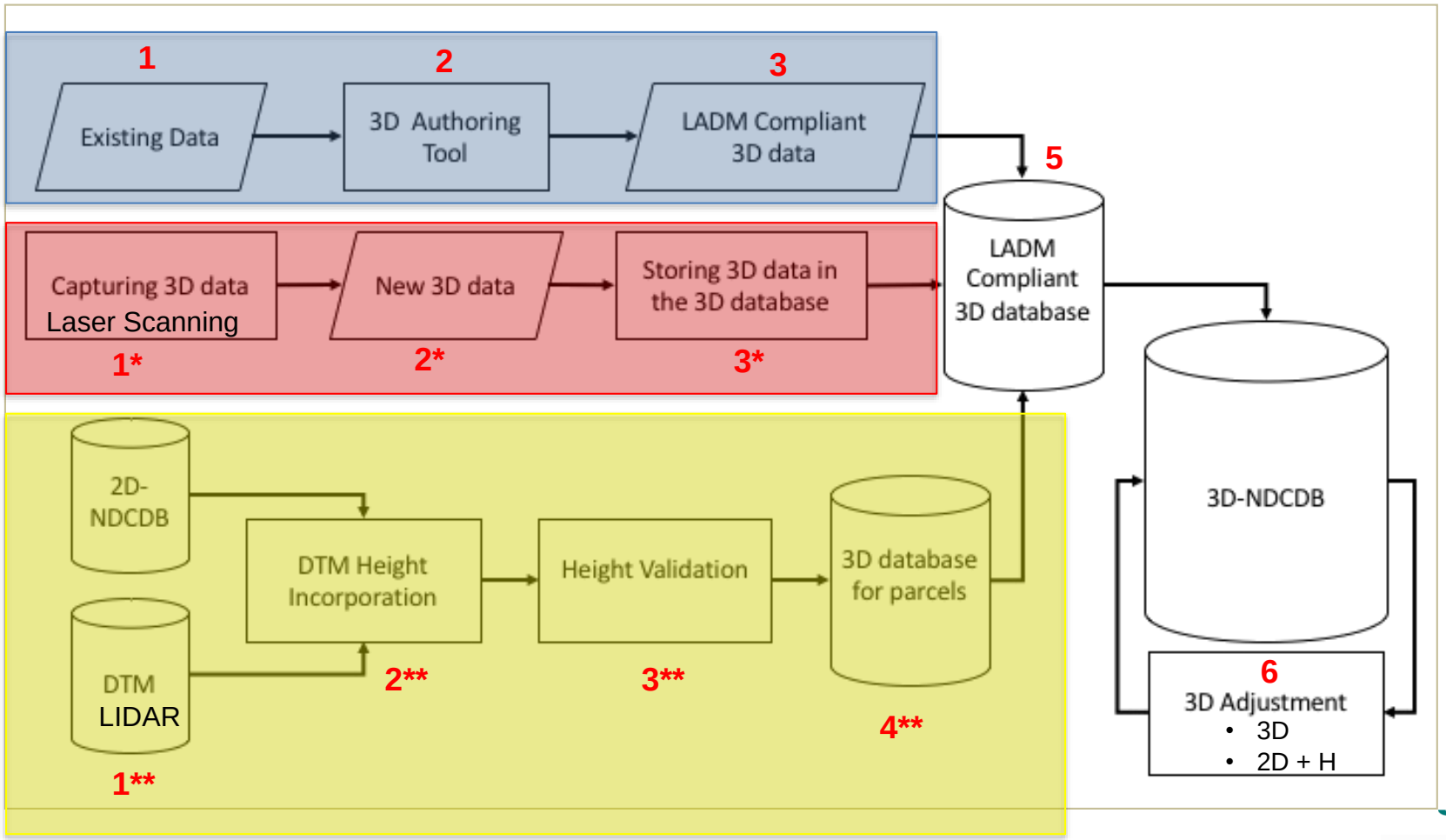
Implementation of 3D-NDCDB



Discussion and Final Remarks

- **Harmonising land tenure data at the national level:**

Internal operations of land offices for recording and using land administration data varies from one jurisdiction to another in Malaysia. This has resulted in database systems that are different in structure and schema. LADM provides an opportunity for harmonising the data when there is a need to integrate the databases for national interests.

- **Introducing 3D cadastres from three perspectives:**

➢ Upgrading the strata plan system to a fully 3D digital plan

➢ Advancing the paper-based stratum plans to 3D digital volumetric lots

➢ Transforming 2D data collection system of land surveying in Malaysia into a 3D data collection regime (e.g. Laser scanning)

Discussion and Final Remarks

- If the government of Malaysia adopts LADM, it will put itself at forefront of international land administration reform. The leadership will assist with the initiative such as SDGs that have a longstanding impact on the social stability, economic prosperity and environmental sustainability.

- The adoption of LADM will also benefit the tax payer of Malaysia as it reduces the resources required to make the land tenure data consistent in the country.

- Reforming the land administration of Malaysia to a system that incorporates the 3rd dimension of height into the cadastral surveying and titling systems, needs a benchmarking system such as LADM

Questions?

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