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Database Design and Development of 3D Cadastral Registration based on LADM

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Introduction

- An appropriate cadastral data model plays an important role to ensure a successful development of the cadastral system.
- LADM - ISO 19152 standard and most recognisable data model in land administration discourse.
- Standardization makes your data model flexible and that makes working with your data much easier.
- Having a standard is one important step, but the implementation forms the next required step in practice.

Review of Cadastral Data Models

- Since land administration requirements differ among the jurisdictions, various cadastral data models have been developed around the world.
- 4 basic issues are common to them all:
  - They do not facilitate efficient representation and analysis of 3D cadastral object
  - They are not semantically enriched
  - They do not integrate physical and legal objects into cadastral data models
  - They do not based on standards

Review of Cadastral Data Models (cont..)

- 6 cadastral data models have been reviewed:-
  - Core Cadastral Data Model
  - FGDC Standard Reference Model
  - Legal Property Object Model
  - ePlan Model
  - Land Administration Domain Model (LADM)
  - 3D Cadastral Data Model
- These data models were assessed and compared based on selected criteria.

Conceptual Model of Strata Objects

- The development of the conceptual model of strata objects is based on the LADM standard.
- Basically, the conceptual strata model is part of the Malaysian LADM Country Profile.
- The developed model was evaluated and verified by the DSMM and Land Office.
- Unified Modelling Language (UML) is used to develop the conceptual model.

Conceptual Model of Strata Objects (cont..)

- The development of the strata model supports wide range of objects:
  - parcel unit
  - accessory unit
  - common property unit
  - limited common property unit
  - land parcel

Conceptual Model of Strata Objects (cont..)

- The strata objects model also would be useful for Malaysia and countries with similar land administration systems.
- The conceptual model of strata object is divided by two parts:-
  - Spatial
  - Administrative

Converting Strata XML to LADM

- Some sample data from JUPEM (i.e strata XML and building plan) are converted into the model.
- The study area is at Perdana Parkcity project in the state of Kuala Lumpur.
- Perdana Parkcity project contains:-
  - 1 condominium with 27storey
  - 76 land parcels with 3 storey houses

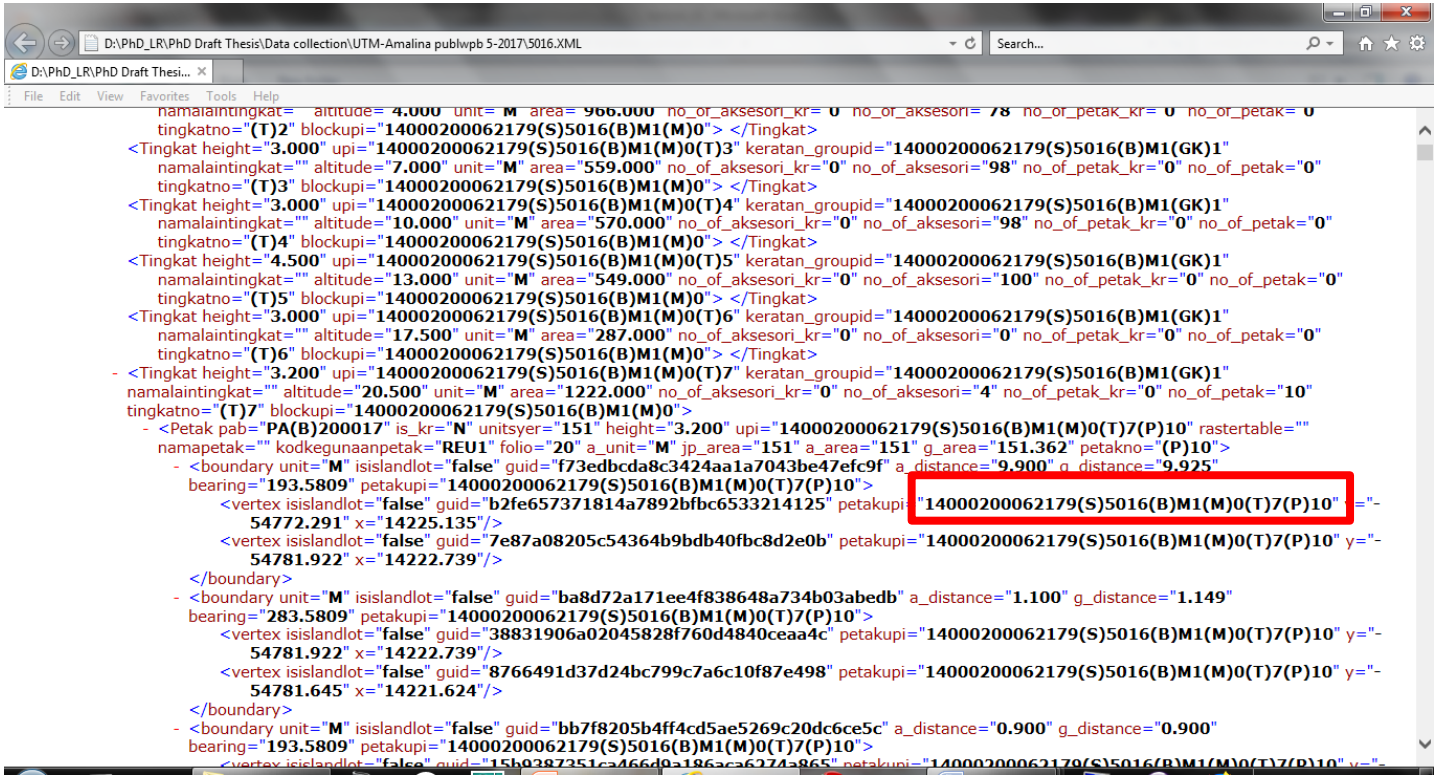
Converting Strata XML to LADM (cont..)

Study area

Converting Strata XML to LADM (cont..)

- Current XML strata data contains the following information: schema, block, '*tingkat*' or floor, parcel, accessory, common area and land parcel.
- Based on the developed strata objects model, block is refer to *MY_Building* class, parcel refer *MY_ParcelUnit* class, accessory refer to *MY_AccessoryUnit* class, common area refer to *MY_CommonPropertyUnit* class and land parcel refer to *MY_LandParcel* class.
- Two strata objects are missing (i.e. scheme and floor).
- However, it can be derived using Unique Parcel Identifier (UPI).

Converting Strata XML to LADM (cont..)

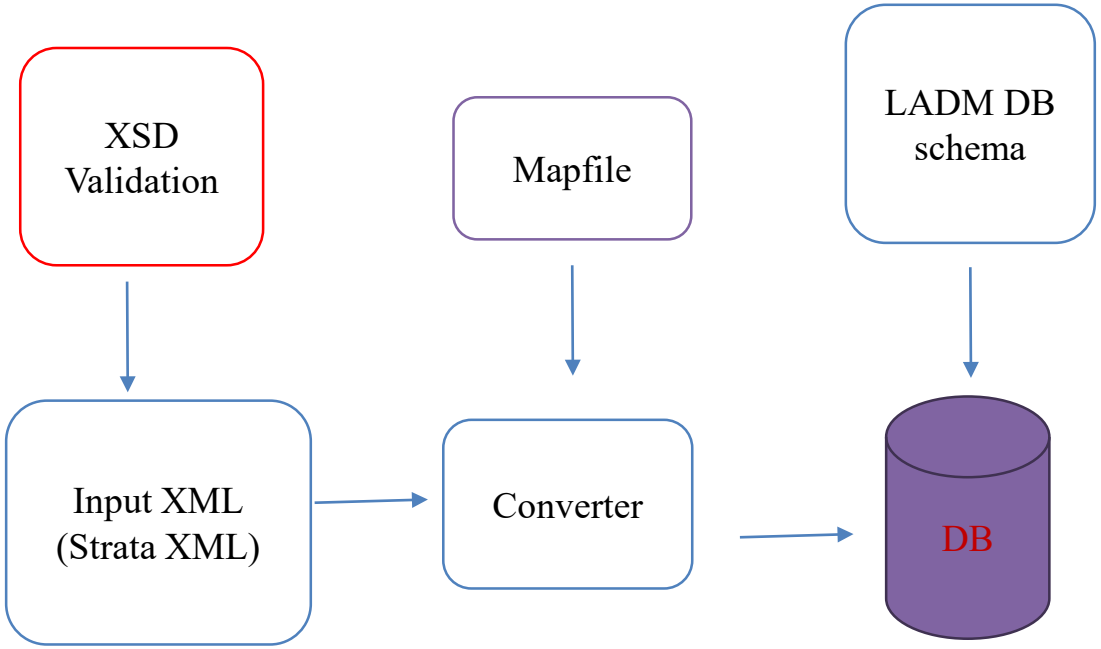


Strata XML

Converting Strata XML to LADM (cont..)

- The Strata XML format used in this experiment is formatted in version 7.6
- The conversion from Strata XML to LADM is done by implementing an intermediate mapfile, which contains information from origin terminology (XML) to destination (LADM).
- The mapfile also contains information such as parent and child which is important in LADM schema.
- The output of the converter is then used to import into database.

Converting Strata XML to LADM (cont..)



The workflow diagram of the conversation

Converting Strata XML to LADM (cont..)

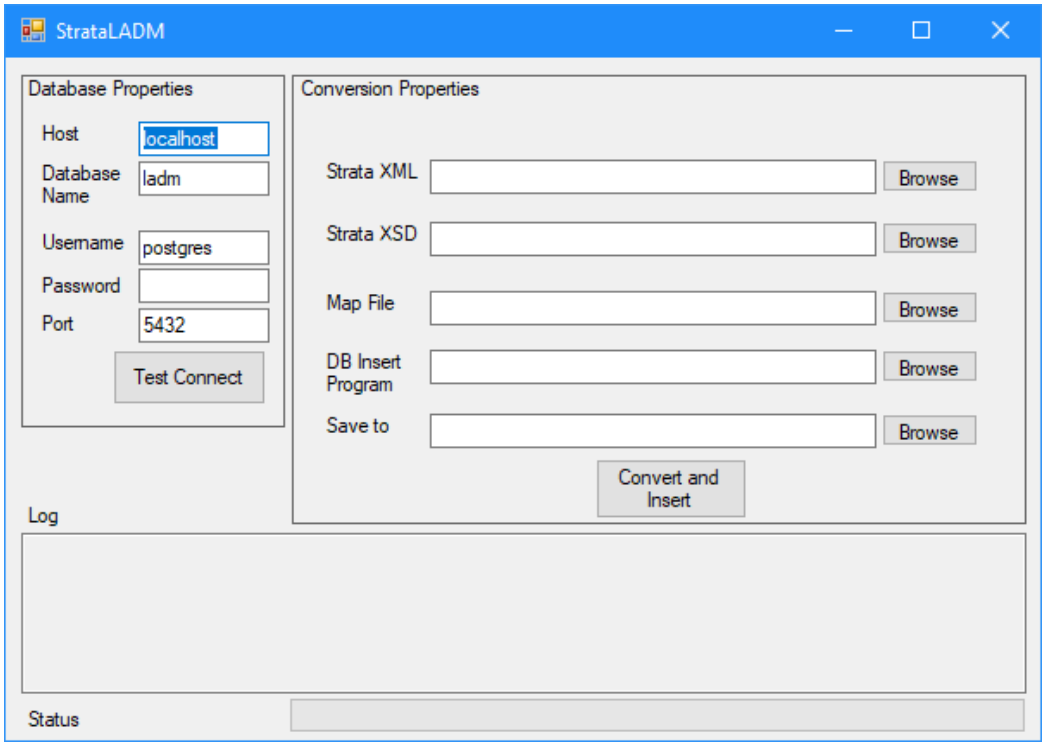
- The program is developed using C# NetCore initialized with desktop form.
- Mapfile is also loaded into the program and conversion process is initialized based on the XML structure, which is from top to bottom.
- Noted that the database is already loaded with LADM compliant tables or schemas, which will be used to store the converted output.
- The mapfile determines the parent and child, the appropriate LADM container as well as its attributes.

Converting Strata XML to LADM (cont..)

```
1   <?xml version="1.0"?>
2
3   <Map>
4
5
6   <Scheme container="MY_Lot2D">
7
8   <Negeri subElement="state" container="MY_Lot2D"/>
9
10  <Daerah subElement="district" container="MY_Lot2D"/>
11
12  <Mukim subElement="mukim" container="MY_Lot2D"/>
13
14  <Seksyen subElement="section" container="MY_Lot2D"/>
```

The mapfile snippet

Converting Strata XML to LADM (cont..)

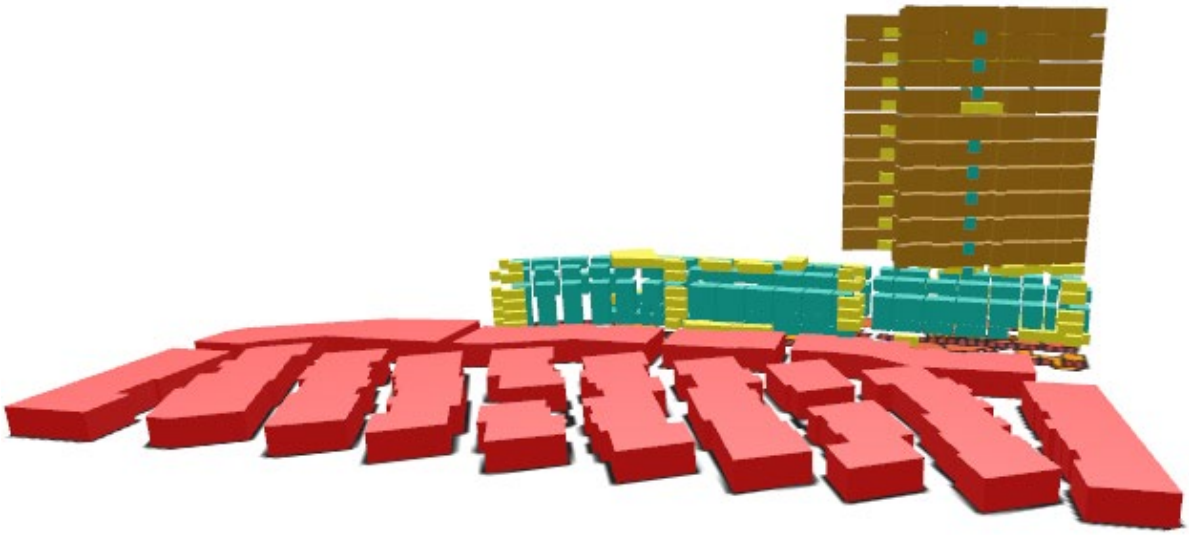


GUI of the conversion

Converting Strata XML to LADM (cont..)

- As the Strata XML stored height information at parent level, and applies to entire parcel unit of the floor, the converter used such information to aggregate the levels and store as Z value for each corner of the parcel unit.
- The result in 3D is then viewed in QGIS.

Converting Strata XML to LADM (cont..)

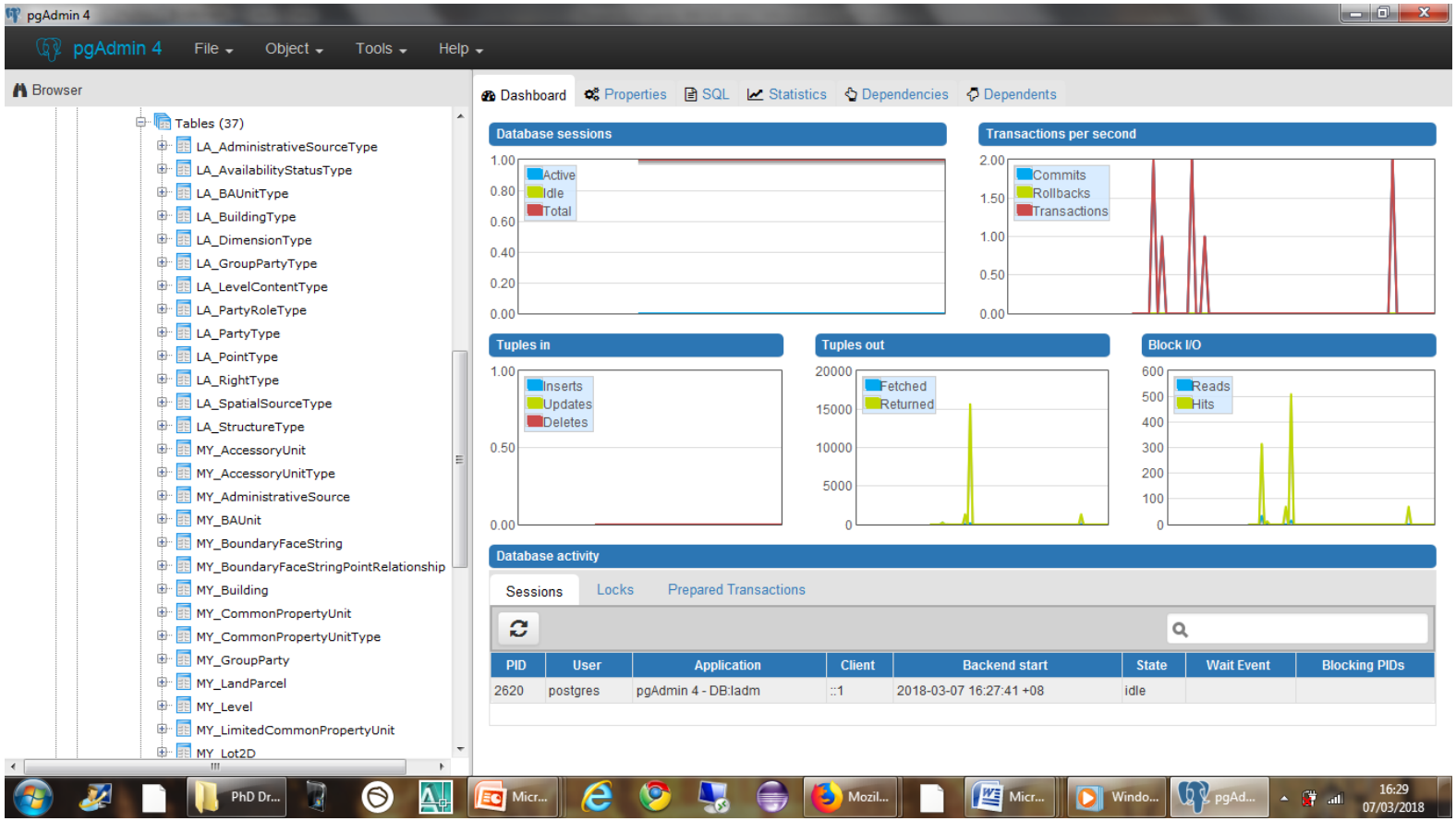


The entire scheme in QGIS

Prototype Development

- Development of the prototype begins with conceptual of strata objects model.
- 37 classes from the strata model are selected to translate it into tables in the database schema.
- Internally the local ID is enough for the various identifier values.
- ID's have to be unique for objects.
- Note that for a single object there may be multiple versions, which have the same ID, but can be differentiated via their beginDateTime attribute.

Prototype Development (cont..)

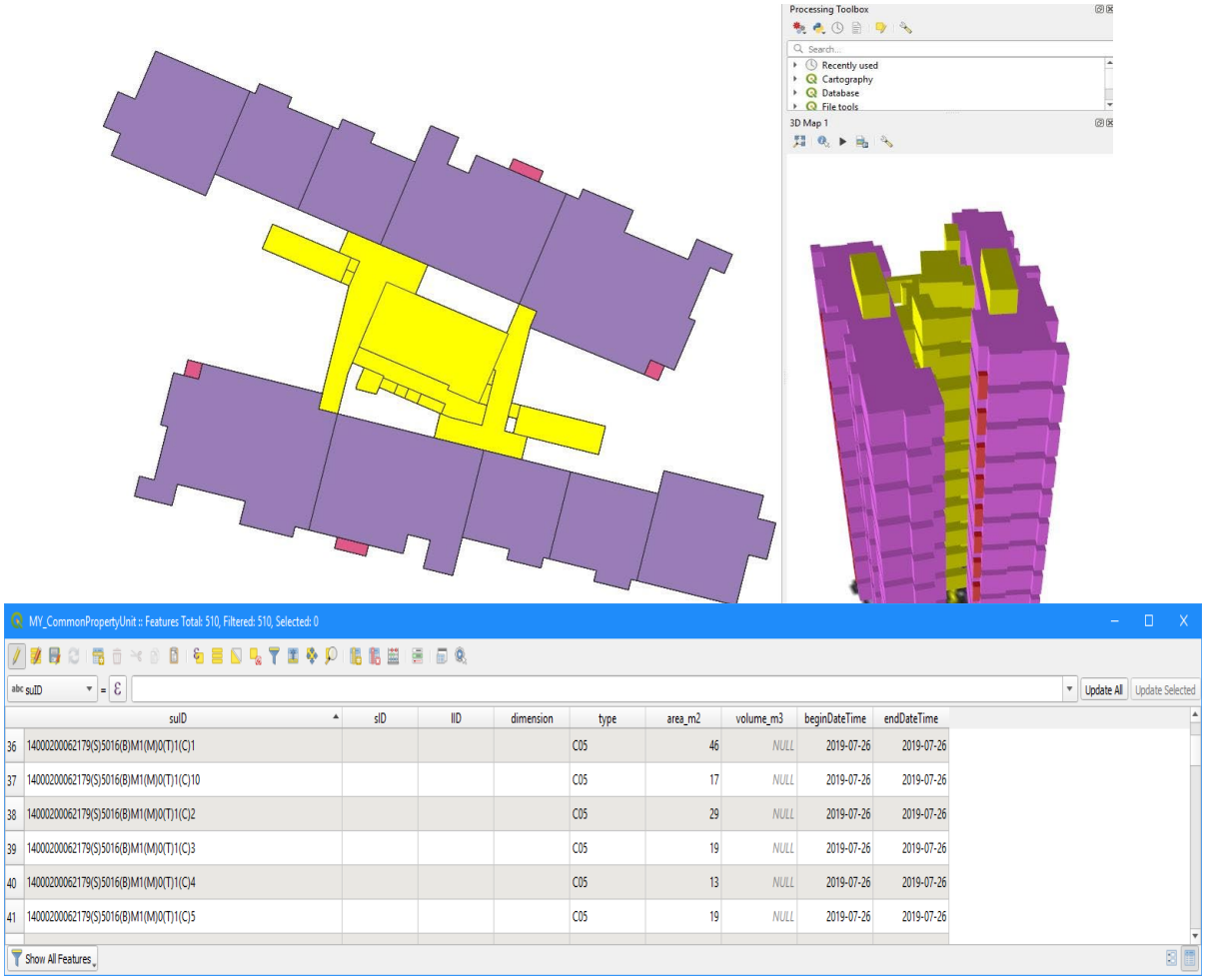


Postgres database

Prototype Development (cont..)

- Each code lists class is implemented by their own table.
- The table name has the extension ‘Type’ added after the code list name of the conceptual model.
- Existing sample data from JUPEM are converted into the technical model and loaded in the database.
- The data from the Postgres database can be accessed using QGIS software for 3D visualisation and editing.
- The Structured Query Language (SQL) will be used to query and extract the data from the database with the prototype.

Prototype Development (cont..)



	suID	sID	lID	dimension	type	area_m2	volume_m3	beginDateTime	endDateTime
36	1400020006217 9(S)5016(B)M1(M)0(T)1(C)1				C05	46	NULL	2019-07-26	2019-07-26
37	1400020006217 9(S)5016(B)M1(M)0(T)1(C)10				C05	17	NULL	2019-07-26	2019-07-26
38	1400020006217 9(S)5016(B)M1(M)0(T)1(C)2				C05	29	NULL	2019-07-26	2019-07-26
39	1400020006217 9(S)5016(B)M1(M)0(T)1(C)3				C05	19	NULL	2019-07-26	2019-07-26
40	1400020006217 9(S)5016(B)M1(M)0(T)1(C)4				C05	13	NULL	2019-07-26	2019-07-26
41	1400020006217 9(S)5016(B)M1(M)0(T)1(C)5				C05	19	NULL	2019-07-26	2019-07-26

Data query and visualization of strata objects using QGIS

Conclusions

- The contribution of this research is the formulation of this mapfile for the purpose of converting local industry strata scheme to LADM compliant datasets.
- This is important and essential to achieve both industrial demands in utilizing common scheme in daily business practices, while allowing standardization of data towards full implementation of LADM for the country as a whole.

Conclusions (cont..)

- The mapfile is a transition and intermediate solution towards the potential full implementation of LADM in Malaysia.
- Enriching the mapfile for supporting the latest version of Strata XML allow seamless integration between systems and standards.
- The outlook of this research is to develop a near-future prototype that covers all functionalities with large area and creating prototype with appropriate web-interface for JUPEM data accessibility.

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Thank You