

# Developing 2D and 3D Cadastral Registration System based on LADM: Illustrated with Malaysian Cases

**Nur Amalina Zulkifli, Alias Abdul Rahman, Malaysia**  
**Peter van Oosterom, The Netherlands**

# Outline

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2. Spatial data modelling
3. Non-spatial data modelling
4. Unique Parcel Identifier (UPI)
5. Case study
6. Implementation
7. Results
8. Conclusions
9. Future work

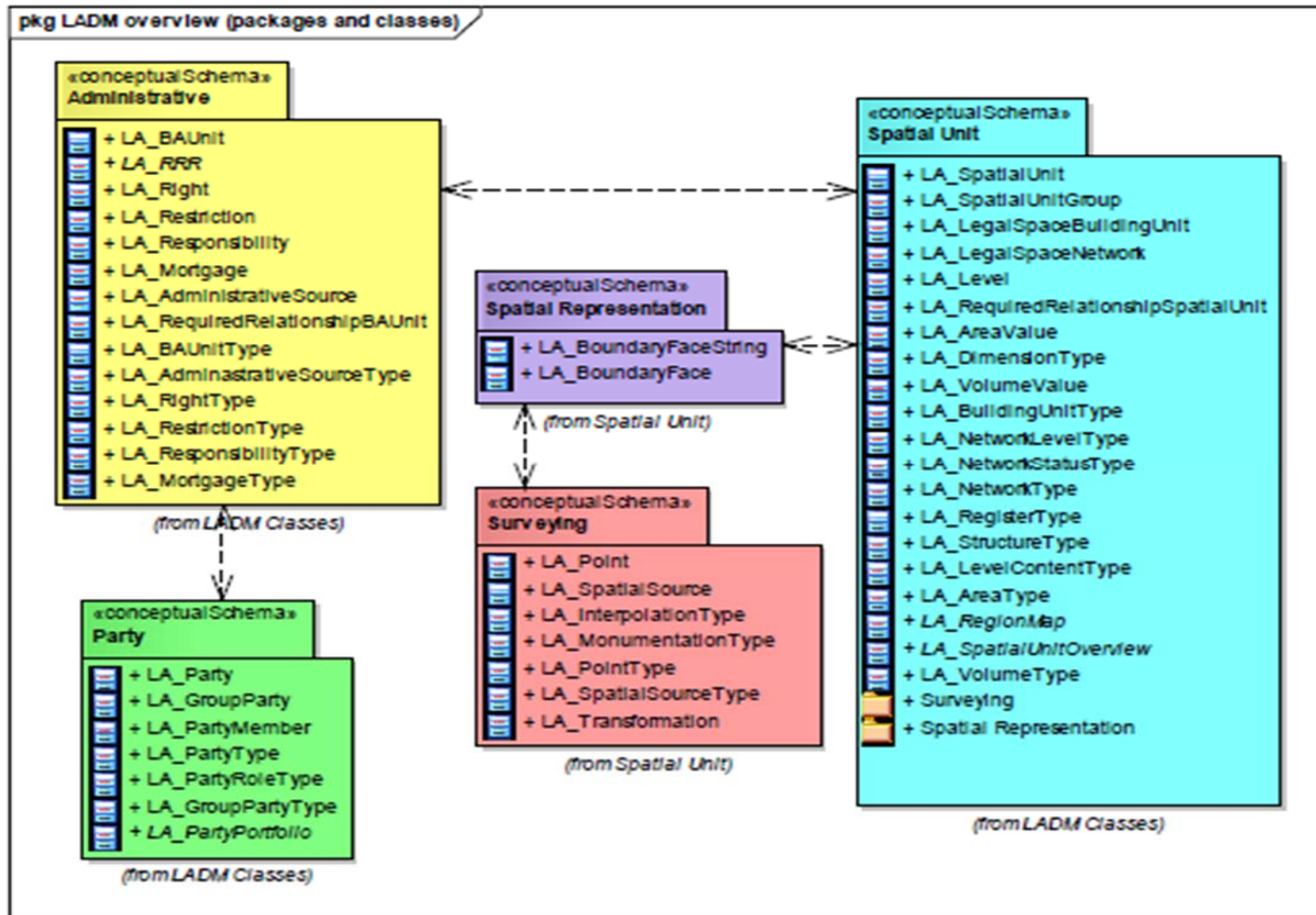
# 1. Introduction

- LADM has been introduced as a model for land registration purposes by various researchers (e.g. Lemmen (2012), Pouliot (2011), Van Oosterom et al (2011), Hespenha (2012), Ary Sucaya (2009) etc.)
- Two important goals of this model as listed by (Van Oosterom et. al 2006) are;
  - avoid reinventing and re-implementing the same functionality over and over again
  - enable involved parties, both within one country and between different countries, to communicate based on the shared ontology implied by the model

# 1. Introduction (cont...)

- Land Administration(LA) = Land registration + Cadastre
- The field of knowledge on land administration is called land administration domain.
- Land Administration Domain Model (LADM) also known as ISO 19152
- Output of LADM = conceptual model
- Note: content of presentation reflects **‘work in progress’** towards Malaysian country profile supporting 2D and 3D.

# 1. Introduction (cont..)



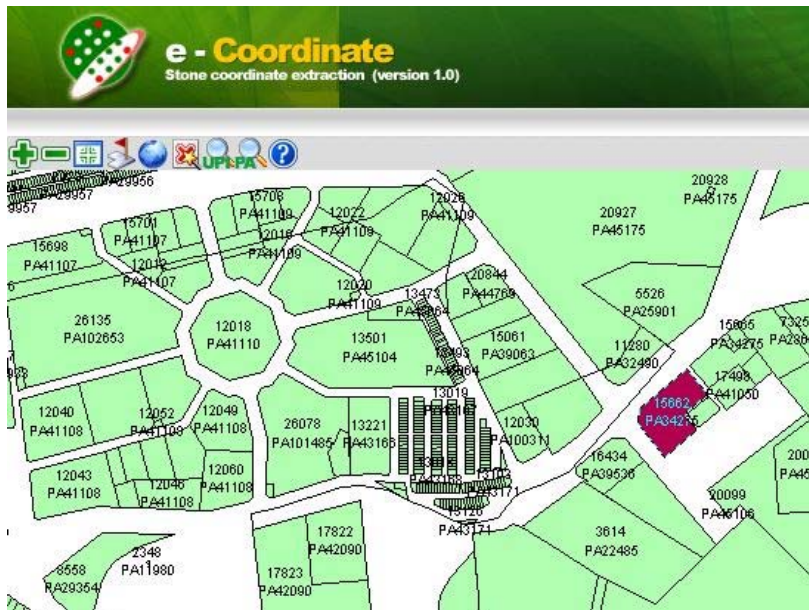
Packages & Classes of LADM

# 1. Introduction (cont..)

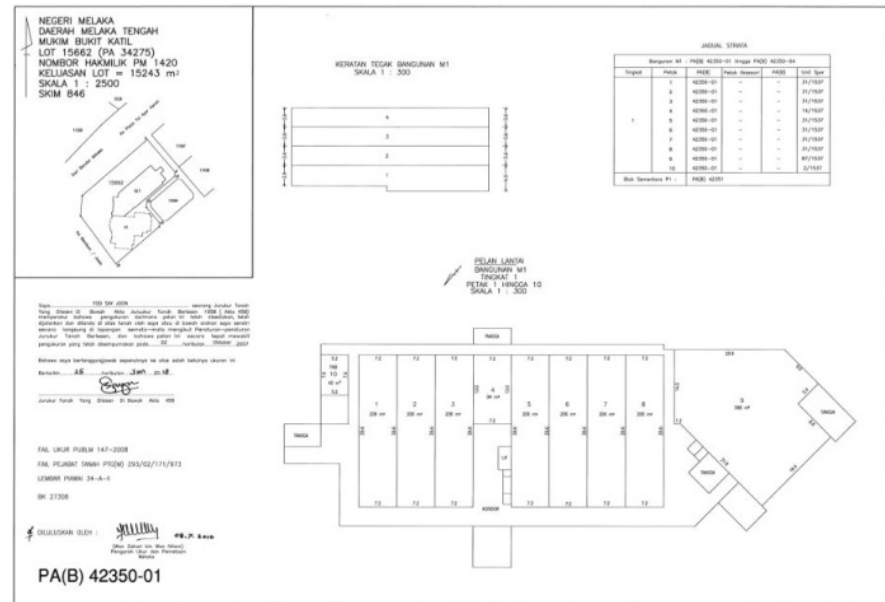
	Term	Definition
L A N D  O F F I C E	<b>Party</b>	A person or organization that plays a role in a rights transaction
	<b>Right</b>	Action, activity or class of actions that a system participant may perform on or using an associated resource
	<b>Responsibility</b>	Formal or informal obligation to do something
	<b>Restriction</b>	Formal or informal entitlement to refrain from doing something
	<b>BAUnit</b>	Administrative entity consisting of zero or more spatial units against which (one or more) unique and homogeneous rights (e.g. ownership right or land use right), responsibilities or restrictions are associated to the whole entity, as included in a Land Administration system
J U P E M	<b>Spatial Unit</b>	Single area (or multiple areas) of land and/or water, or a single volume (or multiple volumes) of space
	<b>Point</b>	0-dimensional geometric primitive, representing a position
	<b>Boundary Face String</b>	Boundary forming part of the outside of a spatial unit
	<b>Boundary Face</b>	Face that is used in the 3-dimensional representation of a boundary of a spatial unit

# 1. Introduction (cont..)

- Types of Malaysian object registration:
  - Land parcel
  - Legal space of building

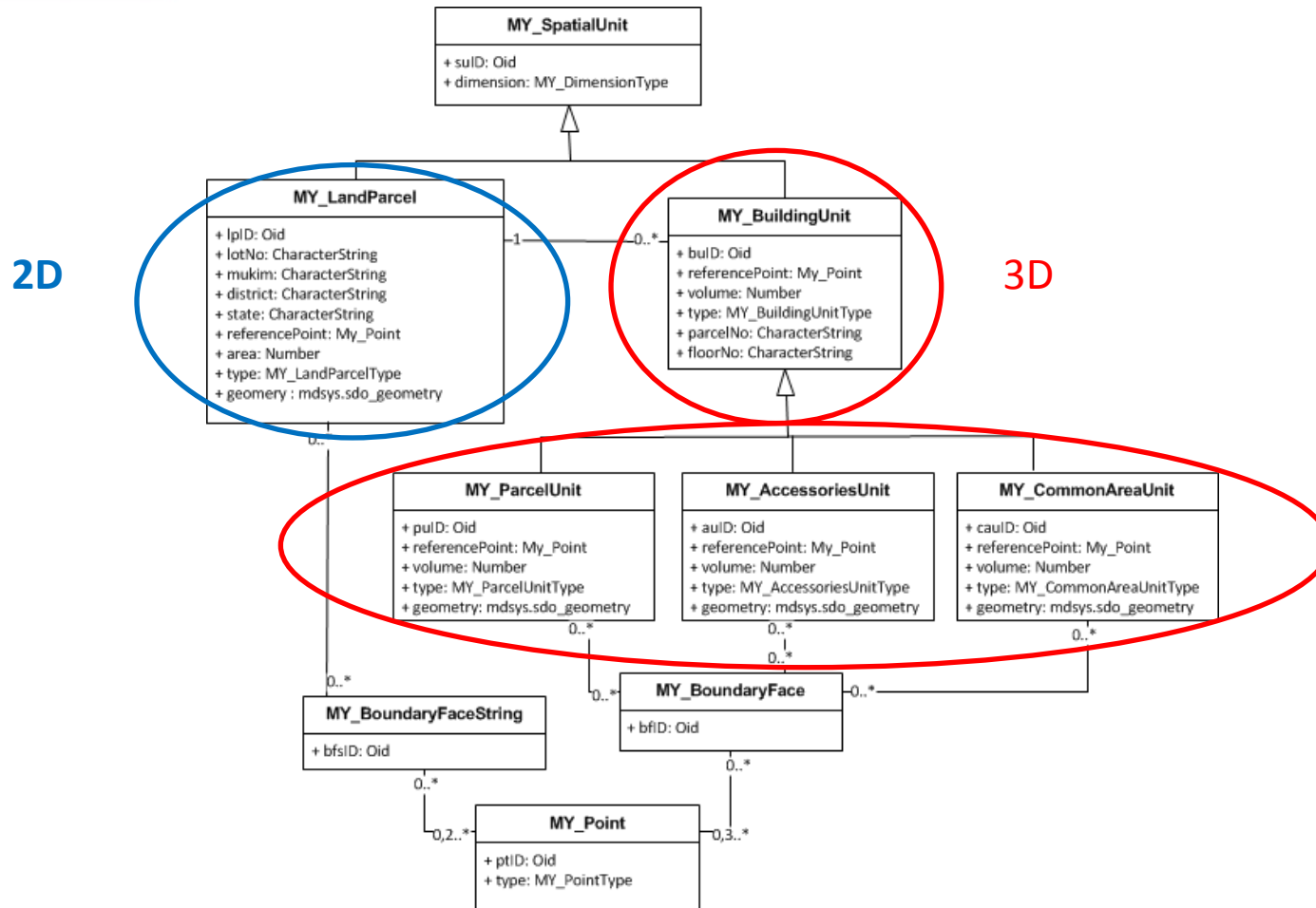


Land parcel



Floor plan of building

## 2. Spatial data modelling



Spatial data modelling based on LADM



## 2. Spatial data modelling (cont..)

<<CodeList>> <b>MY_ParcelUnitType</b>		<<CodeList>> <b>MY_CommonAreaType</b>		<<CodeList>> <b>MY_LandParcelType</b>	
+ Apartel	{CBU1}	+ Unknown	{C01}	+ Agriculture	{L01}
+ Office	{CBU7}	+ Stairs	{C02}	+ Residential	{L02}
+ Restaurant	{CBU8}	+ Passage	{C03}	+ Industrial	{L03}
+ Retail	{CBU9}	+ Air space	{C04}	+ Others	{L04}
+ Shop house	{CBU10}	+ Lift	{C05}		
+ Shop office	{CBU11}	+ TNB	{C06}		
+ Stall	{CBU12}	+ Parking	{C07}		
+ Supermarket	{CBU13}	+ Play ground	{C08}		
+ Shopping arcade	{CBU14}	+ Swimming pool	{C09}		
+ Parking	{CBU16}	+ Garbage room	{C10}		
+ Factory	{IDU3}	+ Others	{C11}		
+ Clinic	{INU40}				
+ Condominium	{REU1}				
+ Service apartment	{REU2}				
+ Apartment	{REU3}				
+ Low cost house	{REU14}				
+ Public housing	{REU6}				
+ Private housing	{REU7}				
+ Flat	{REU8}				
+ Transit housing	{REU11}				
+ Communal housing	{REU12}				

<<CodeList>> <b>MY_BuildingUnitType</b>	
+ Residential Building	{BA0010}
+ Commercial Building	{BB0010}
+ Industrial building	{BC0010}

<<CodeList>> <b>MY_AccessoriesUnitType</b>	
+ Parking	{A01}
+ Flower park	{A02}
+ Store	{A03}
+ Ramp	{A04}
+ Others	{A05}

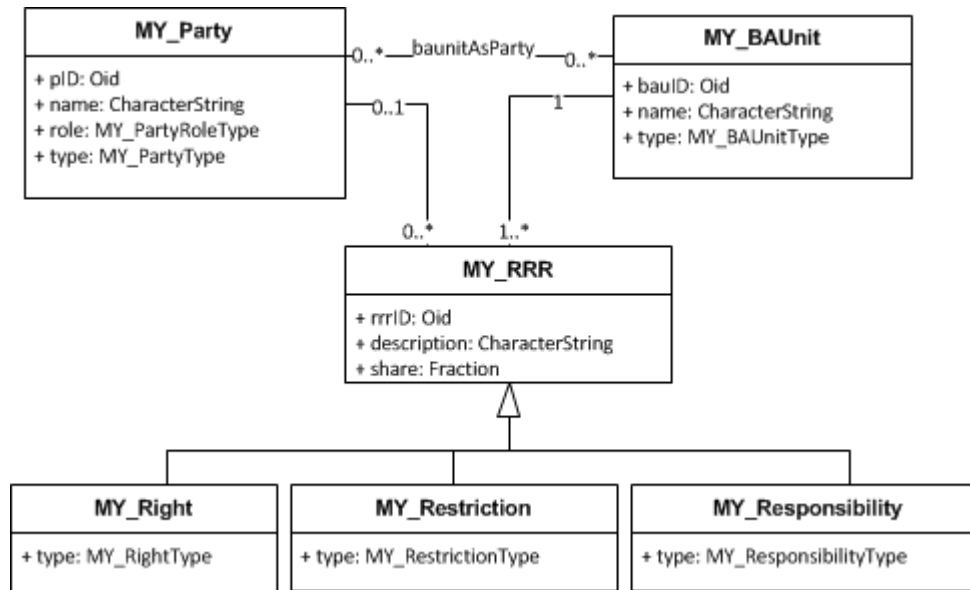
<<CodeList>> <b>MY_DimensionType</b>	
+ 0D	{DT01}
+ 1D	{DT02}
+ 2D	{DT03}
+ 3D	{DT04}

<<CodeList>> <b>MY_PointType</b>	
+ control	{PN01}
+ noSource	{PN02}
+ source	{PN03}

Code list for spatial package

# 3. Non-spatial data modelling



Non-spatial data modelling based on LADM

### 3. Non-spatial data modelling (cont..)

<<CodeList>> MY_PartyRoleType	
+ owner	{PR01}
+ bank	{PR02}
+ licenseSurveyor	{PR03}
+ citizen	{PR04}
+ employee	{PR05}
+ farmer	{PR06}
+ moneyProvider	{PR07}
+ stateAdministrator	{PR08}
+ surveyor	{PR09}

<<CodeList>> MY_PartyType	
+ group	{P01}
+ naturalPerson	{P02}
+ nonNaturalPerson	{P03}

<<CodeList>> MY_BAUnitType	
+ freeHold	{BU01}
+ leaseHold	{BU02}

<<CodeList>> MY_RightType	
+ ownership	{RG01}
+ vegetation	{RG02}
+ surface	{RG03}
+ airSurface	{RG04}
+ lease	{RG05}

<<CodeList>> MY_RestrictionType	
+ noTransfer	{RT01}
+ noBuilding	{RT02}

<<CodeList>> MY_ResponsibilityType	
+ monumentMaintenance	{RP01}
+ buildingMaintenance	{RP02}

Code list for non-spatial package (party and administrative package)

## 4. Unique Parcel Identifier (UPI)

OBJECT	UPI
Land Parcel	04010800015662
Building unit;	
- main block (M)	04010800015662(S)846(B)M1(M)1
- provisional block* (P)	04010800015662(S)846(B)P1
PAC unit;	
- parcel unit **	04010800015662(S)846(B)M1(M)1(T)1(P)1
- accessories unit	04010800015662(S)846(B)M1(M)1(T)1(A)1
- common area unit	04010800015662(S)846(B)M1(M)1(T)1(C)1

(\*) provisional block is future extension to main building

(\*\*) parcel unit is individual unit inside building (apartment)

## 5. Case study

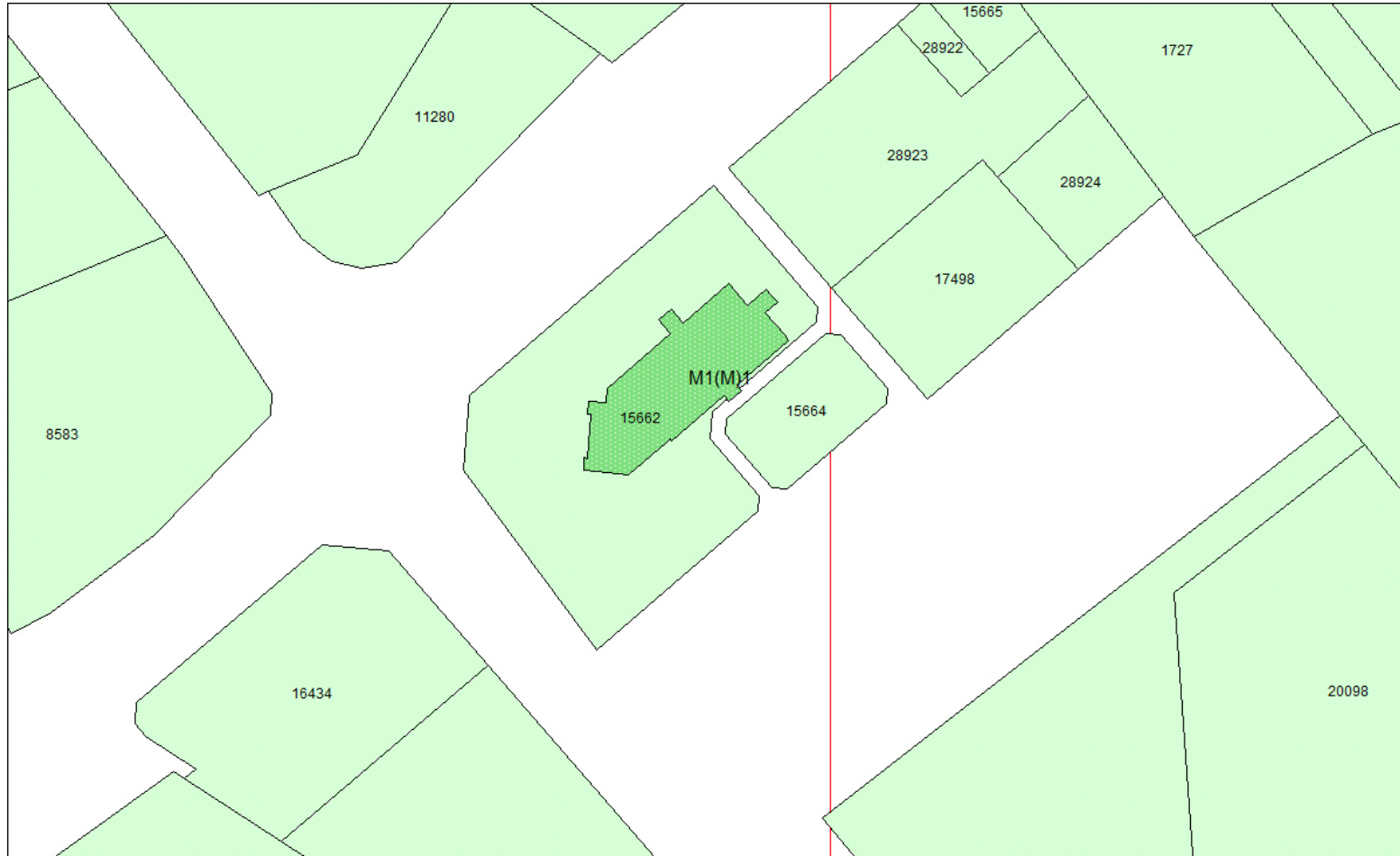
- The study area for this research is at World Youth Foundation (WYF) building in the state of Melaka and some land parcels around that building.
- WYF is a commercial building with four storeys.
- The building is meant for 3D cadastral registration system meanwhile the land parcel around that building is for 2D cadastral system based on LADM.
- In Malaysia, ownership for building subdivision is called strata title.

## 5. Case study (cont..)



Pictures of WYF building

## 5. Case study (cont..)



## 5. Case study (cont..)

- Strata title is different from the land title.
- Share units in strata title is determined by area of each parcel units.
- Meanwhile, for land title, the share units are based on agreement that was made between the owners of the land.
- For example, there are five owners on one land named with individual A, B, C, D and E with their share units: A (6/20), B (2/20), C (2/20), D (7/20) and E (3/20).
- The total number for share units in land title must equal to 1.



## 5. Case study (cont..)

- The total share units for building (strata title) also include the provisional block.
- For an example, strata schema for World Youth Foundation (WYF) building has one provisional block.
- Thus, the share units for that block also calculated in that strata schema.
- The total share units in strata schema for WYF building is 1537.

## 6. Implementation

- The conceptual model has been transformed into a physical model with seven tables in a relational database, which represent spatial and non-spatial data.
- MY\_Party, MY\_BAUnit, MY\_RRR represent non-spatial data.
- MY\_SpatialUnit, MY\_LandParcel, My\_BuildingUnit and MY\_PACunit represent spatial data.
- MY\_PACunit is a combination of MY\_ParcelUnit, MY\_AccessoriesUnit and MY\_CommonAreaUnit.

## 6. Implementation (cont..)

- Database construction is based on Oracle spatial. Oracle spatial uses the MDSYS.SDO\_GEOMETRY type.
- In the Malaysian country profile, no topology structure is used.
- In managing 2D and 3D spatial object, Oracle Spatial supports storage for 3D points, lines and polygons.
- MY\_LandParcel represent 2D cadastral object (polygon, GTYPE=2003).
- MY\_PACunit represent 3D cadastral object (building unit). In MY\_PACunit, the 3D cadastral objects are stored by multipolygon method (GTYPE=3007).

## 6. Implementation (cont..)

```
INSERT INTO MY_LANDPARCEL VALUES (  
'04010800015662', ← UPI land parcel  
'040108PM00001420',  
'04-42351',  
'04010800015662(S)846(B)M1(M)1',  
'LOT 15662',  
'BUKIT KATIL',  
'MELAKA TENGAH',  
'MELAKA',  
'15243 METER PERSEGI', ← Geometry type 2003 (2D polygon)  
'L03',  
MDSYS.SDO_GEOMETRY(  
2003,24571,NULL,  
MDSYS.SDO_ELEM_INFO_ARRAY(1,1003,1),  
MDSYS.SDO_ORDINATE_ARRAY (  
23760.739732,12526.967747,23764.120124,12529.857883,23764.146353,12530.177957,  
23763.122615,12531.371914,23763.166398,12531.942536,23765.33952,12533.79983,  
23765.36406,12534.120404,23763.19715,12536.655672,23758.092262,12532.293218,  
23757.968013,12530.714111,23760.739732,12526.967747)));
```

Insert 2D data using Oracle Spatial

## 6. Implementation (cont..)

```

INSERT INTO MY_PACUNIT VALUES (
'04010800015662(S)846(B)M1(M)1(T)1(P)1',
'040108PM00001420',
'04-42351',
'04010800015662(S)846(B)M1(M)1',
'803 METER PADU',
'P',
'CBU7',
'1',
',',
MDSYS.SDO_GEOMETRY(3007,24571,NULL,
MDSYS.SDO_ELEM_INFO_ARRAY(
1,1003,1,
16,1003,1,
31,1003,1,
46,1003,1,
61,1003,1,
76,1003,1),
MDSYS.SDO_ORDINATE_ARRAY(
23763.508701,12534.314343,0.193868,23763.508701,12534.314343,0,23763.238999,12534.084021,0,
23763.238999,12534.084021,0.193868,23763.508701,12534.314343,0.193868,23763.238999,12534.084021,0.193868,
23763.238999,12534.084021,0,23764.154808,12533.005249,0,23764.154808,12533.005249,0.193868,
23763.238999,12534.084021,0.193868,23764.42451,12533.235571,0.193868,23764.42451,12533.235571,0,
23764.154808,12533.005249,0,23764.154808,12533.005249,0.193868,23764.42451,12533.235571,0.193868,
23763.508701,12534.314343,0.193868,23763.508701,12534.314343,0,23764.42451,12533.235571,0,
23764.42451,12533.235571,0.193868,23763.508701,12534.314343,0.193868,23764.42451,12533.235571,0,
23763.508701,12534.314343,0,23763.238999,12534.084021,0,23764.154808,12533.005249,0,
23764.42451,12533.235571,0,23764.42451,12533.235571,0.193868,23763.508701,12534.314343,0.193868,
23763.238999,12534.084021,0.193868,23764.154808,12533.005249,0.193868,23764.42451,12533.235571,0.193868)));

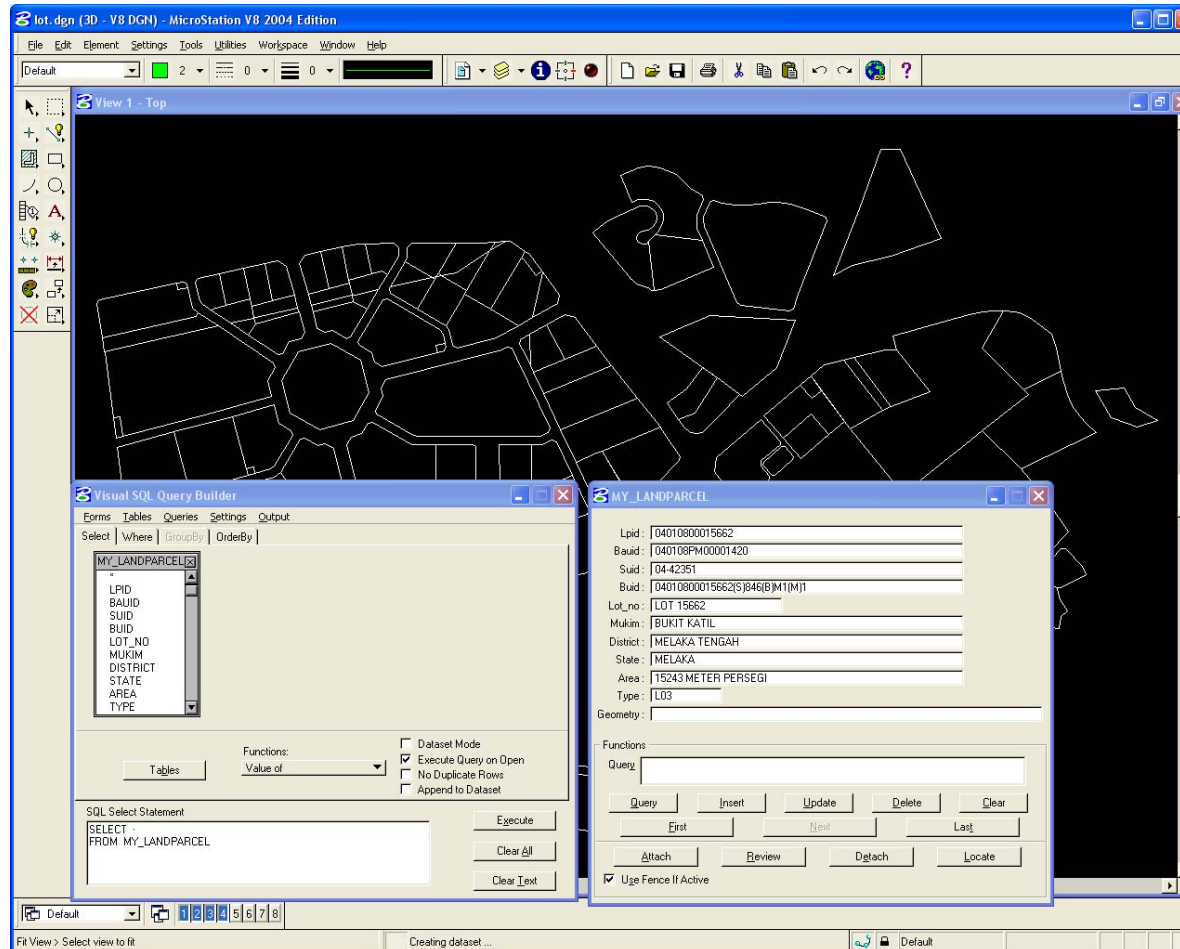
```

← UPI individual parcel unit (apartment)

← Geometry type 3D multi polygon ('closed volume')

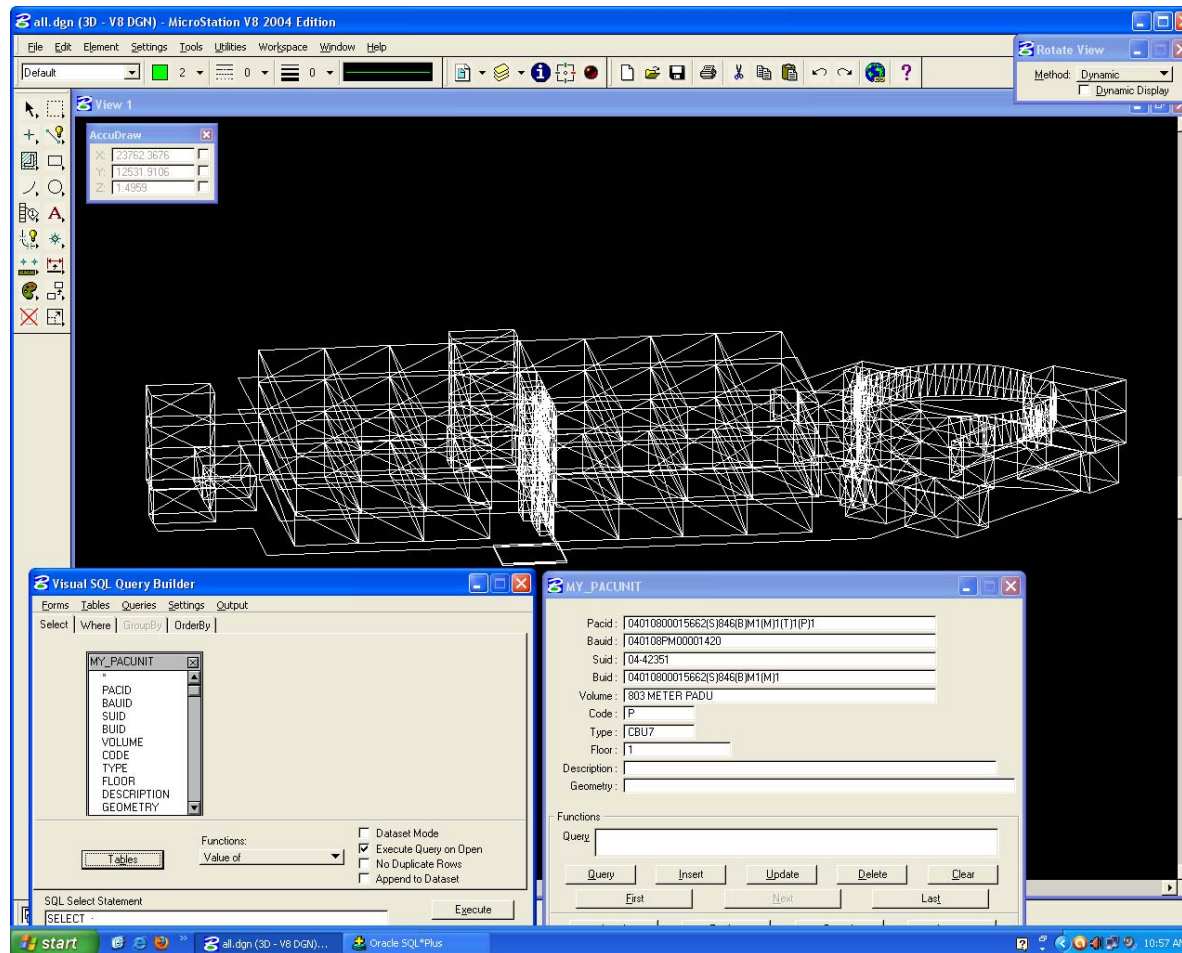
Insert 3D data using Oracle Spatial

# 7. Results



2D data query and visualisation using Bentley Microstation

# 7. Results (cont..)



3D data query and visualisation using Bentley Microstation

## 8. Conclusion

- Referring to conceptual model that is proposed in this paper, LADM provides standardized class names for spatial and non-spatial data.
- For spatial data class, they have their own standard name called SpatialUnit.
- In this project, SpatialUnit is divided into two parts, which are Land Parcel (2D) and Building Unit (3D). Building Unit is also divided into three components, which are Parcel Unit, Accessories Unit and Common Area Unit.
- The table PACunit is a combination of Parcel Unit, Accessories Unit and Common Area Unit classes.



## 8. Conclusion (cont..)

- Query 2D spatial object in this project is based on MY\_LandParcel table.
- Meanwhile, we use MY\_PACunit to query the 3D spatial object.
- MY\_Party and MY\_RRR is used to query non-spatial data.
- Besides, UPI also is important to link between spatial and non-spatial data. It is also used to query data from spatial and non-spatial data.
- A new code lists for spatial and non-spatial data to improve the Malaysian standard are also proposed.

## 9. Future Work

- Assessment of draft model, and where needed refine, extend, correct model.
- Quality checking 2D and 3D representations: closed, no overlap/gap between neighbours.
- Explore possibilities for cadastral registration of network utilities (legal spaces above, below and on surface).
- Investigate integration of non-spatial (Land Registry) and spatial data (JUPEM), purpose:
  - Consistency of data
  - Combined query
- How to develop and use Malaysian Information Infrastructure to realize this.

# Thank You