



Presented at the FIG Congress 2018,
May 6-11, 2018 in Istanbul, Turkey

6-11 May 2018
ISTANBUL

FIG Congress 2018



UTM
UNIVERSITI TEKNOLOGI MALAYSIA

3D Strata Modelling Based on Indoor LiDAR

Mohd Nor Isa, Keat Lim Chan, Muhammad Imzan Hassan,
Nur Amalina Zulkifli and Alias Abdul Rahman (MALAYSIA)

EMBRACING OUR SMART WORLD WHERE THE CONTINENTS CONNECT:
ENHANCING THE GEOSPATIAL MATURITY OF SOCIETIES

ORGANISED BY



MAIN SUPPORTERS



PLATINUM SPONSORS



FIG
2018
ISTANBUL

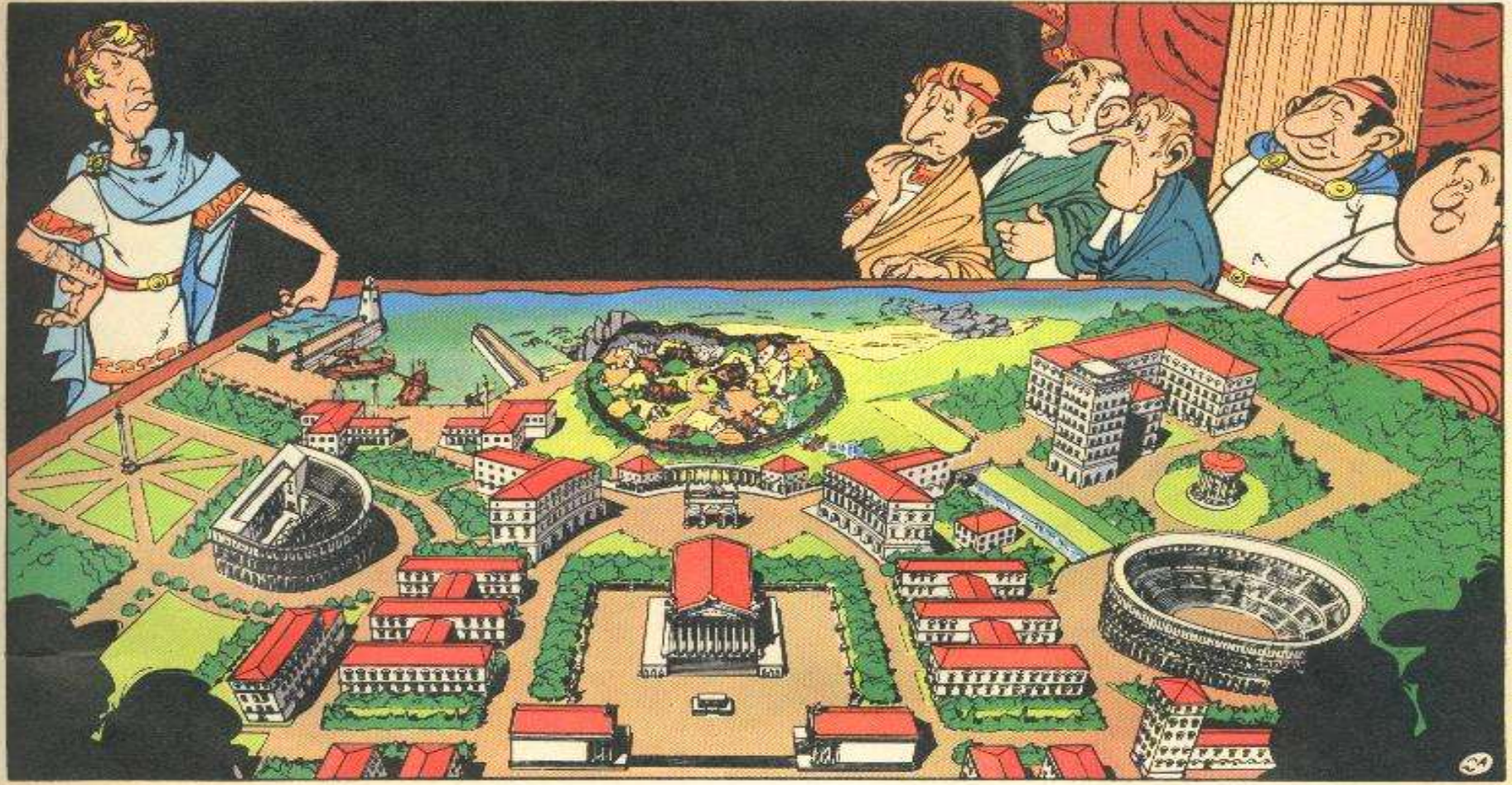
XXVI FIG Congress 2018



6-11 May 2018 ISTANBUL

EMBRACING OUR SMART WORLD WHERE THE CONTINENTS CONNECT:

ENHANCING THE GEOSPATIAL MATURITY OF SOCIETIES



Courtesy: 3D Cadastre Workshop 2012, TU Delft, The Netherlands

ORGANISED BY



MAIN SUPPORTERS



PLATINUM SPONSORS



Problems in 2D environment:

- The **high rise buildings** have been built in order to optimize the limited space. Hence, more **complex buildings** being built to cater the needs of the people who do business or stay in the big city.
- Obviously, such **2D system needs to be upgraded** to cater for the next generation of information community including cadastre community in Malaysia
- As far as Malaysia is concerned the needs is clearly **sought after by** the National Mapping Agency (**NMA**), i.e. JUPEM and the Land Office (LO), i.e. The Land and Mines Office (**PTG**).

Example cases in Malaysia:



1 Utama Shopping Mall with the building above the road



Plaza Putra located underneath Selangor Club House and Dataran Merdeka.

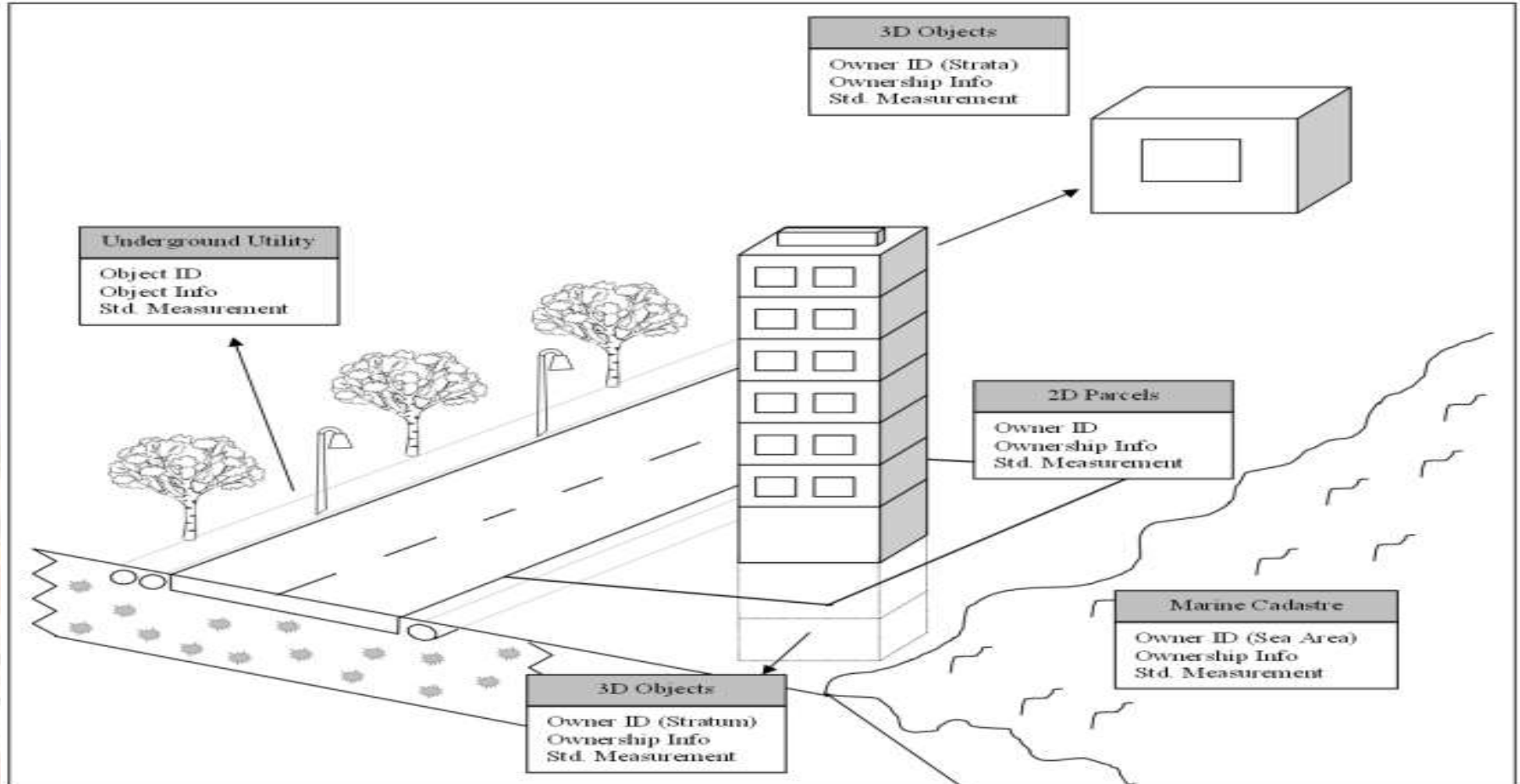


PETRONAS Twin Tower in Kuala Lumpur City Centre

6-11 May 2018 ISTANBUL

EMBRACING OUR SMART WORLD WHERE THE CONTINENTS CONNECT:

ENHANCING THE GEOSPATIAL MATURITY OF SOCIETIES



Multilevel of spatial information in the real world

ORGANISED BY



MAIN SUPPORTERS

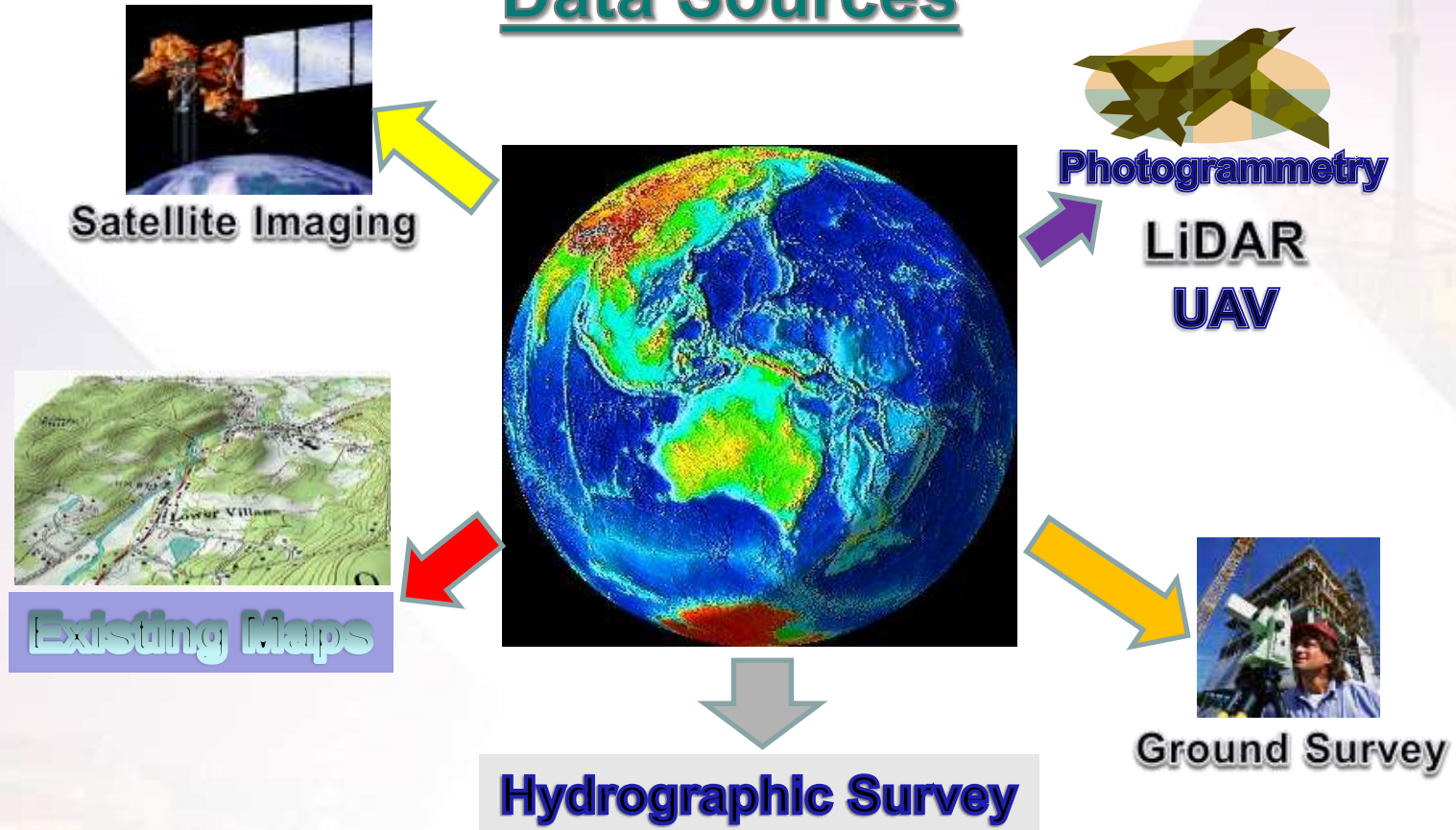


PLATINUM SPONSORS



- **2D information may not be able to serve complex situations.**
- **Need to extend into 3D cadastre.**
- **Several researches were presented concerning the LADM for 2D and 3D cadastre. (FIG2014, Kuala Lumpur)**
- **The conceptual idea is to use international standard of Land Administration Domain Model (LADM – ISO 19152) on heading to have a complete 3D cadastre.**

Data Sources



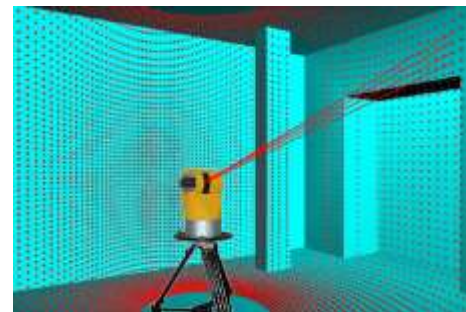
- LiDAR data being collected by national and private data providers for various mapping tasks including **for 3D city modelling, 3D cadastre and strata.**
- The data offers several advantages especially its high accuracy despite the **high cost and huge data volume.**
- Malaysian mapping agency attempts to make use of **LiDAR datasets for 3D geospatial objects representation within 3D cadastre**
- Indoor laser scanned data could be utilised for **strata modelling.**

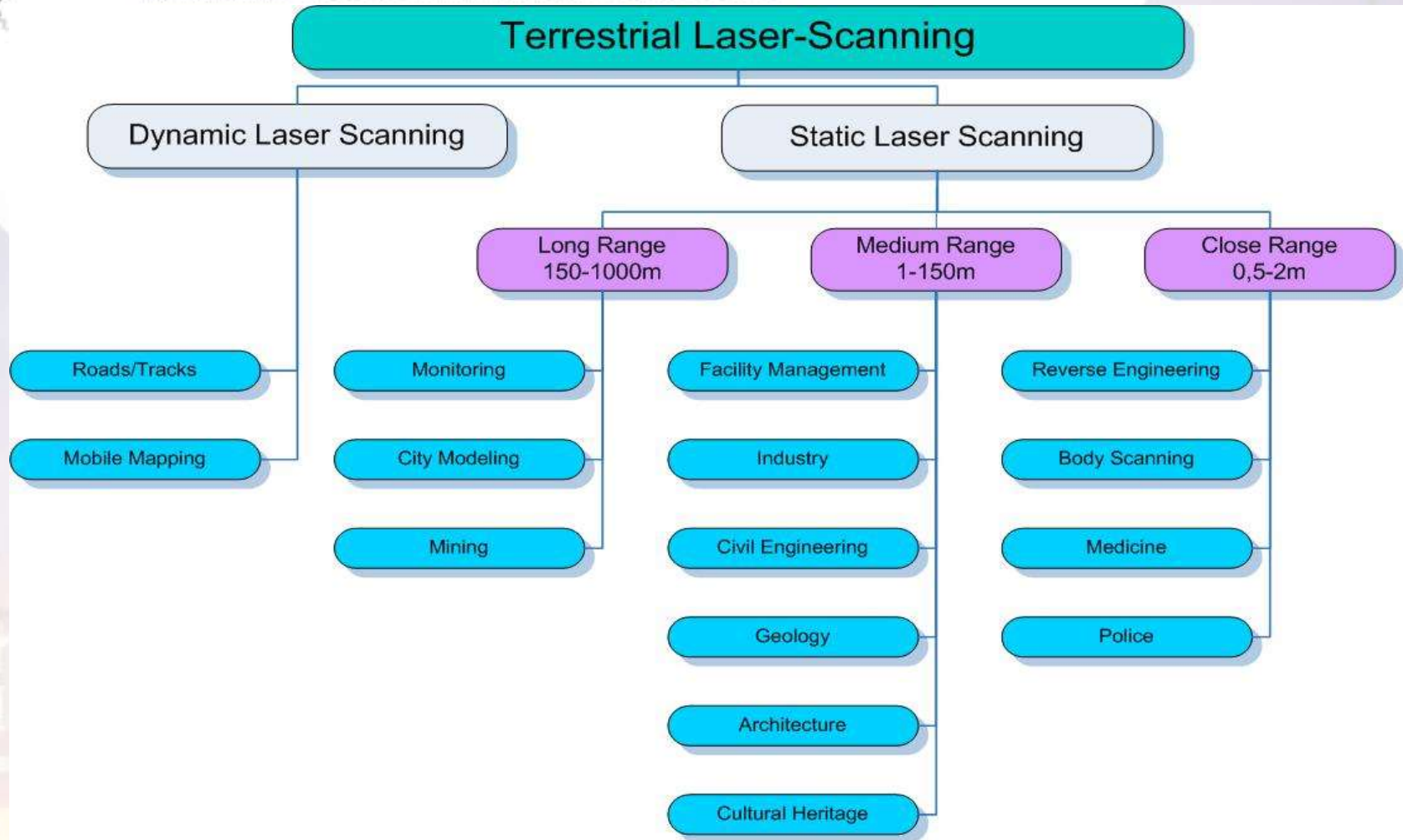
Various LiDAR data acquisition techniques

Airborne LiDAR



Terrestrial LiDAR





INDOOR LiDAR DATA – Data Collection

- There are two techniques been used for capturing methods:
 - Static Terrestrial Laser Scanning (TLS)
 - Indoor Mobile Laser Scanning (MLS)
- Recently, indoor Mobile Laser Scanning (MLS) has been utilized for building modelling purposes. It speeds up the acquisition and post processing.
- It has been proven to be a popular survey tool as it provides accurate and semantically rich 3D data

Static TLS

- Provides good quality of point cloud
- Use of GPS for translating, rotating, and possibly transforming a point cloud into georeferenced data.
- Requires several numbers of targets to register point cloud.

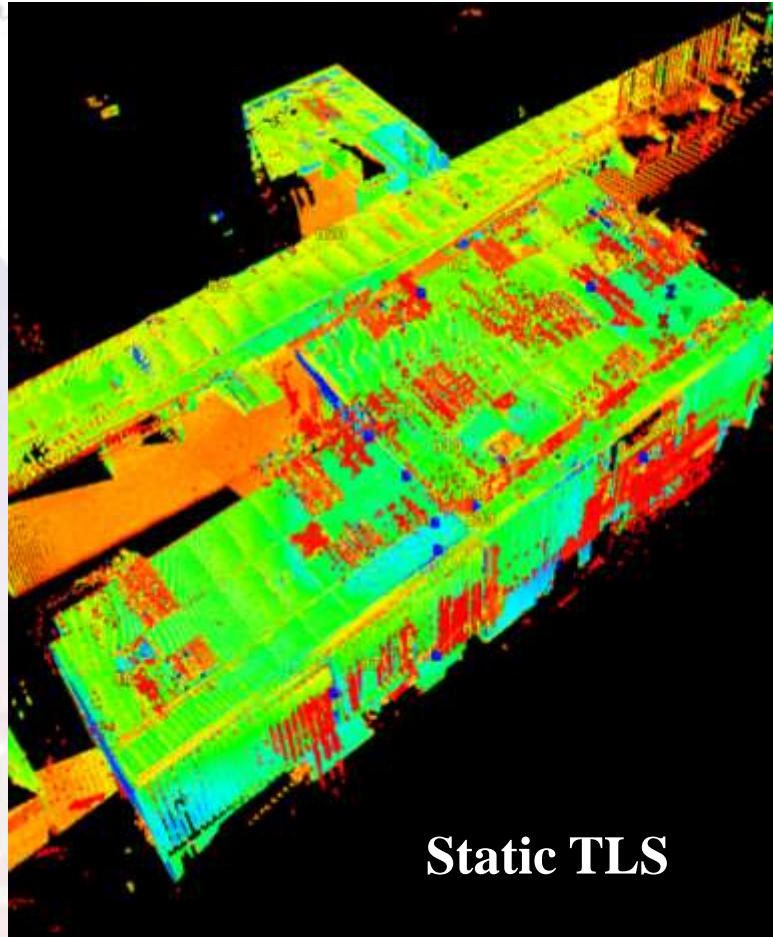
Indoor MLS

- Offers faster data acquisition
- The MLS utilizes Inertial Motion Unit (IMU) for processing workflow.
- Can be processed with or without targets

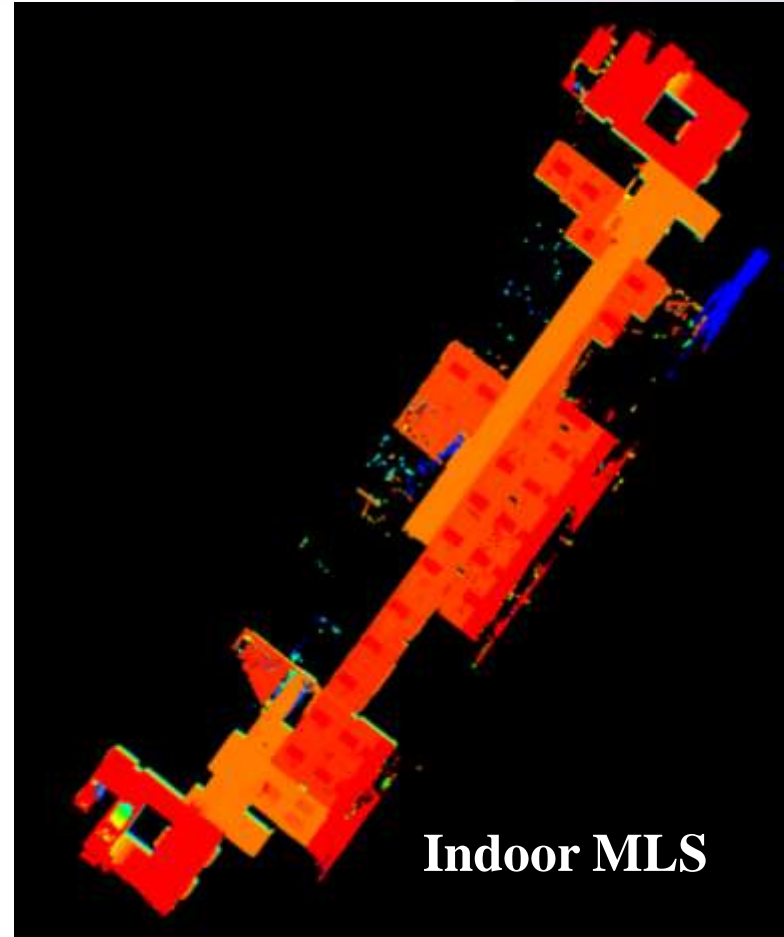
6-11 May 2018 ISTANBUL

EMBRACING OUR SMART WORLD WHERE THE CONTINENTS CONNECT:

ENHANCING THE GEOSPATIAL MATURITY OF SOCIETIES



Static TLS



Indoor MLS

ORGANISED BY



MAIN SUPPORTERS



PLATINUM SPONSORS



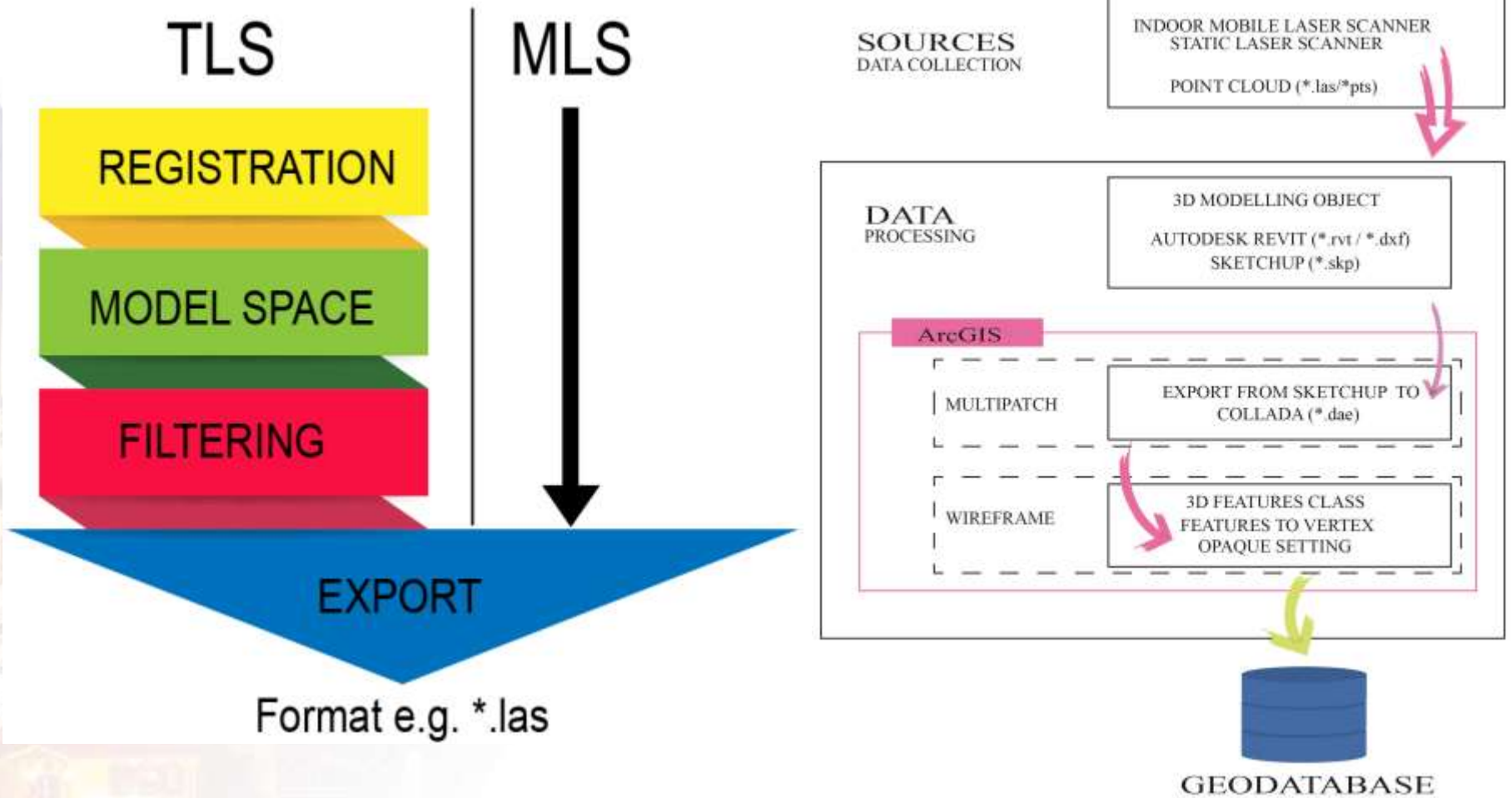
INDOOR LiDAR DATA – Data Processing

- LiDAR data processing **requires high-end computing** specifications due to huge number of data volume (point cloud).
- One of the tools for TLS data processing such as **Cyclone**, *on the other hand*, **RiSCAN PRO** been used for MLS datasets.
- Then, the data in *.las format been transferred **for 3D modelling** task
- Tool within ArcGIS could be utilized for 3D primitive (**multipatch feature and wireframe**).

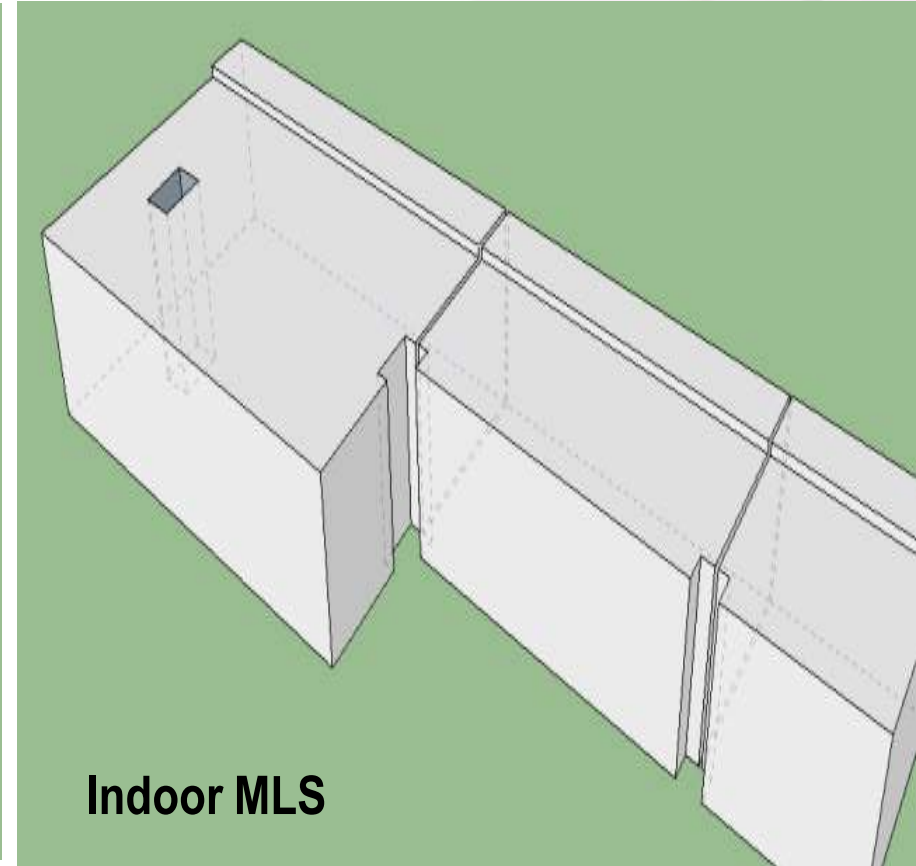
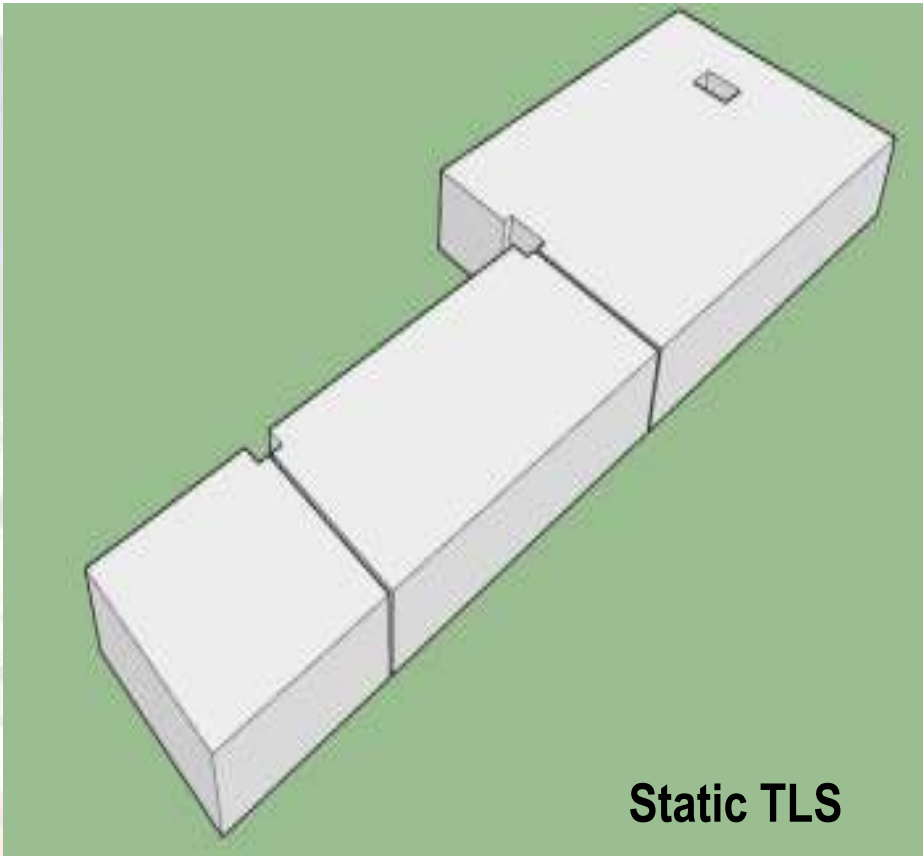
6-11 May 2018 ISTANBUL

EMBRACING OUR SMART WORLD WHERE THE CONTINENTS CONNECT:

ENHANCING THE GEOSPATIAL MATURITY OF SOCIETIES



3D Model



The difference measurements between TLS and MLS

Technique / Source	Measurement		Difference	
	Length	Width	Length	Width
Floor Plan	7.512 m	5.591 m	-	-
TLS	7.497 m	5.590 m	0.015 m	0.001m
MLS	7.480 m	5.557 m	0.032 m	0.034 m

3D STRATA MODELLING

- The needs of 3D strata is to register record and manage the information of spatial information (**geometry of building**) and non-spatial information (**ownerships – RRR**)
- The 3D model of the strata objects has been captured using **laser scanning** technique for the purpose of **modelling in a 3D environment**.
- The Unique Parcel Identifier (UPI) meant for 2D dataset. Meanwhile the identification for 3D objects needs more **reliable method of identifier (UFI)**.
- Each record in the property registration database has a **unique identifier** that eventually can be linked between **spatial records (NDCDB)** and **ownerships record (CLRS)**

Unique Features Identifier (UFI)

- The UFI code structured **based on UPI with additional 10 other characters** as the additional codes for the 3D strata objects.
- The UPI code represents the State, District, Town/City, Section, and Lot Number been extended to **Building (3 characters), Floor (3 characters), and Plot (4 characters)**.
- The UFI consists 26 characters code and it makes the particular 3D strata objects have **a unique identification** throughout the country.

State	District	Town/City	Section	Lot No.	Building	Floor	Plot
06	08	40	000	0001234	M01	001	0007
UFI	0608400000001234M010010007						

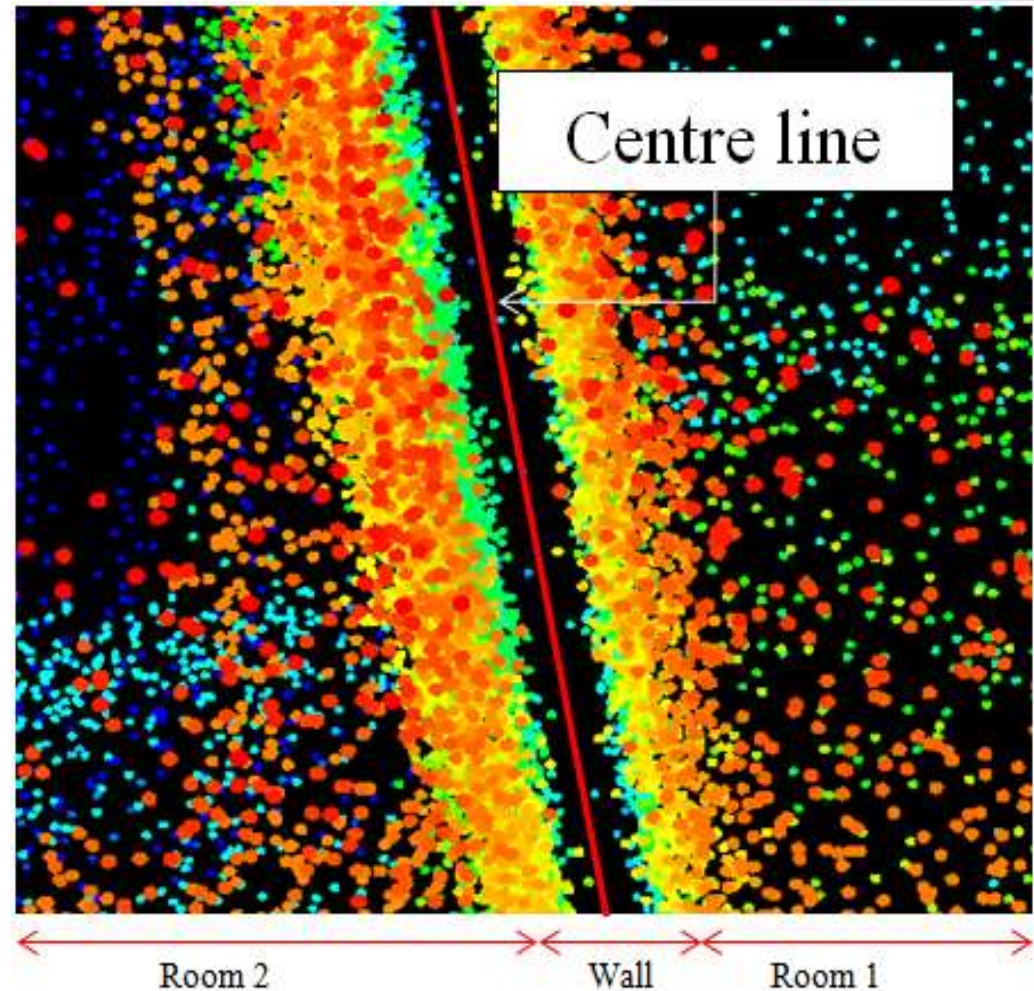
3D CADASTRAL INITIATIVE

- 3D Strata Modelling will be integrated to Land Administration Domain Model (**LADM**), Strata Title and Building Information Modelling (**BIM**) for efficient control and management.
- BIM in the aspect of **geomatics or geospatial** will be investigated in the near-future. It is one of the research areas at Malaysian National Mapping Agency (NMA), i.e. JUPEM. The outcome of this 3D modelling from indoor laser scanned (static and mobile) could be utilized for the **potential BIM initiative**.

Highlighted Issue

- Party-wall issues.

The centre line of the wall can be derived from two edges of the point cloud surface. The different point cloud density between TLS and MLS create vague edges, thus influent the accuracy on the edges detection.



Conclusion

- In this paper, we have described some aspects of **indoor TLS and MLS** data collection for **3D strata model within the geodatabase**.
- It shows that the indoor TLS/MLS has a potential in providing 3D data for building strata modelling purposes. Issue of **“party-wall”** – middle line for adjacent properties should be addressed.
- We anticipate extending this work as integration of **strata 3D model with BIM**.

Acknowledgment

- Department of Survey and Mapping Malaysia
 - Datasets
- Board of Land Surveyors Malaysia
 - Financial supports





XXVI FIG Congress 2018



6-11 May 2018 ISTANBUL

EMBRACING OUR SMART WORLD WHERE THE CONTINENTS CONNECT:

ENHANCING THE GEOSPATIAL MATURITY OF SOCIETIES

Thank You

Teşekkürler

ORGANISED BY



MAIN SUPPORTERS



PLATINUM SPONSORS

