Preparation of Database for Urban Development

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Definition

- Municipal Geographical Information System is data base including topography, infrastructures, socio economic situation, metric house addressing system, cadastral situation and link these data to tax system of the municipality
- Infrastructures are data like transport, electricity, water supply, waste management.
- Metric house addressing system is naming of street and assigning house number in metre.
- Cadastre data superimposition is superimposition of cadastral data on data base.

Status of Urbanization in Nepal

- Urban Population of Nepal

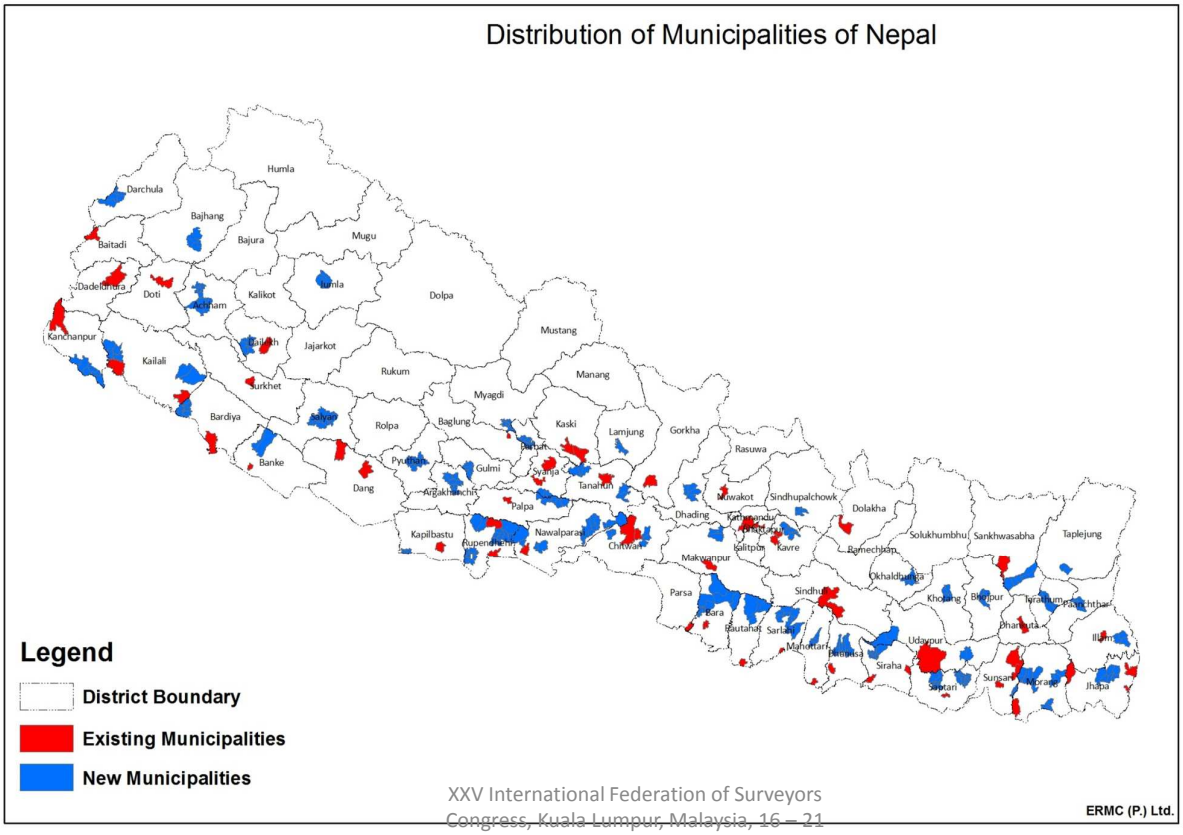
  The urban population is 17.07%

  Annual increment rate of 3.38% and

  Population with own houses 85.25%

  (Population Census 2011)
- Recently planned 72 municipalities
- Present Urban Population 25.16%
- Present Urban area 6.9%
- Whole Kathmandu Valley will be municipal area

Distribution of Municipal area in Nepal



Status of Urban Mapping

- Department of Urban Development and Building Construction (DUDBC) conducted the creation of required data base of selected 45 municipalities and available to public of 20 municipalities,
- Data base is at the scale of 1:2,500- 1:5,000 and at the scale of 1:10,000 for the remote forested area.
- Cadastral Maps available of all private land parcels of Nepal at the scale of 1:500- 1:4,800 and general scale is 1:2,500

Historical Development

- Large scale topographical mapping of urban area in 1972 at the scale of 1:2000
- Ortho photo mapping of municipalities in 2001
- Data base of 45 municipalities and 10 new towns are available.
- Some kinds of geo database is available of all municipalities.

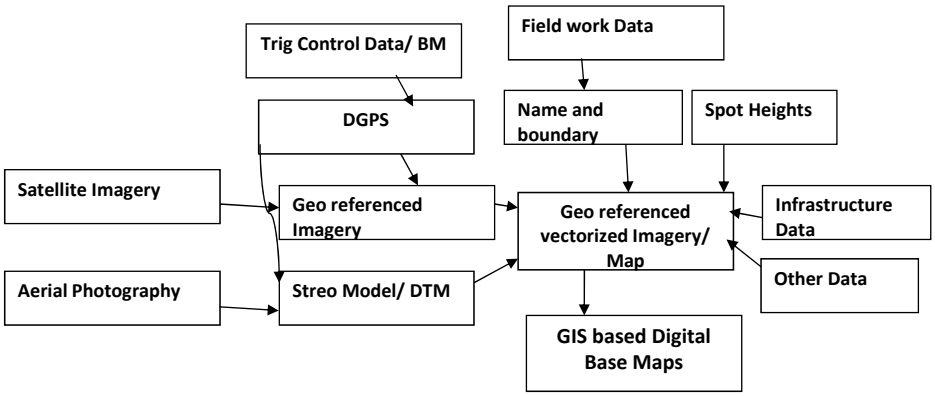
Legislations

- The Urban Development Act, 2045 (1988)
- Specification for Urban Geographic Information Service in Nepal in 1999 by Survey Department
- Colour Codes for Digital Base Maps and Planning Norms and Standards 2013 by DUDBC.

Objectives of preparation of urban map

- Preperation of digital maps of the urban area at scale of 1:2500 based on high regulation (0.5m) sattelite imageries, aerial photographs, available topographical maps and field survey data.
- Collection and development of municipal geographical information system incorporating the cadastral information, existing infrastructures, demography and socio-economy of each household, environment, administrative units etc.
- Development and establishment of effective house numbering and street addressing system
- Development of the GIS system to link tax system software being used by the municipality.

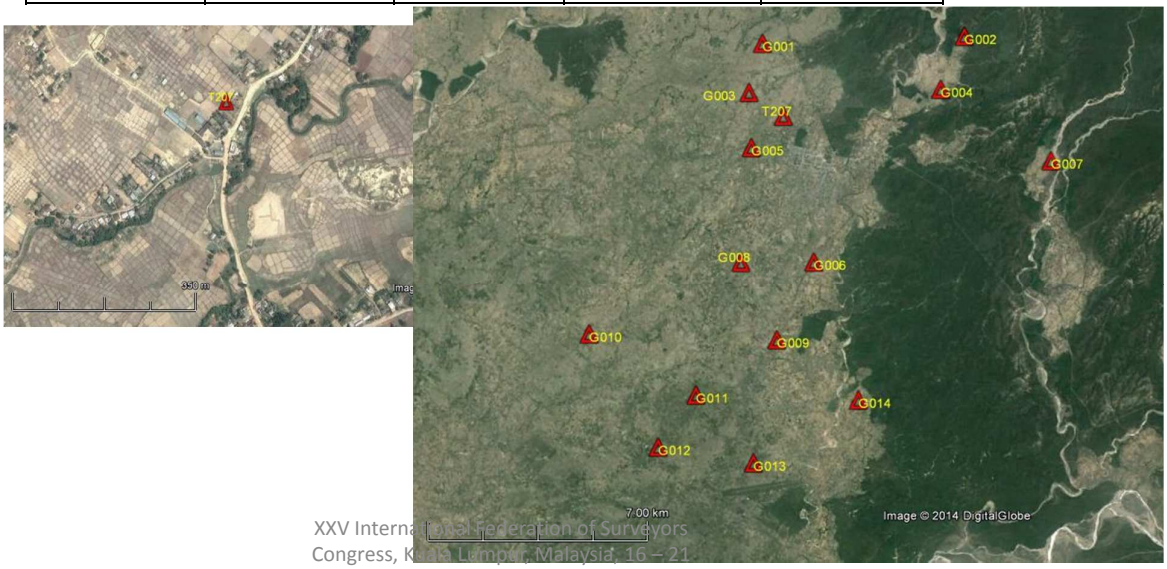
General Methodology



Location of DGPS

Base Station

S. No	Description	WGS84/GRS80		
		Easting	Northing	Ortho-Height (EGM 2008)
1	TRIG 207	566405.234	3121293.540	-



DIGITAL BASE MAP
OF
KHURKOT NEW TOWN

100 50 0 100 200 m

Scale 1: 2500
Contour Intervals 1m/5m

Projection

Spheroid:..... Everest 1830 (1937 Adjustment)
Projection:.....Modified Universal Transverse Mercator
Origin:.....Longitude 87° East, Latitude 0° North
Vertical Datum.....Indian Mean Sea Level (MSL)

False co-ordinates of origin:.....500 000 m Easting
0 m Northing
Scale factor at Central Meridian:.....0.9999

Legend

Administrative
- VDC Boundary
- TDC Boundary
- Ward Boundary
- W-4 Ward Number
- Location Name

Land Cover
- Cultivation
- Builtup Area
- Forest
- Barren Land
- Bushes/Shrubs
- Grass
- Tree Cluster
- Sand
- Swamp Area
- Trees / Tree
- Orchard
- Plantation
- River / Stream
- Pond
- Canal
- Land Slide
- Charateristic Land

Topographic Feature
- .1605 Spot Height
- 1500 Contour

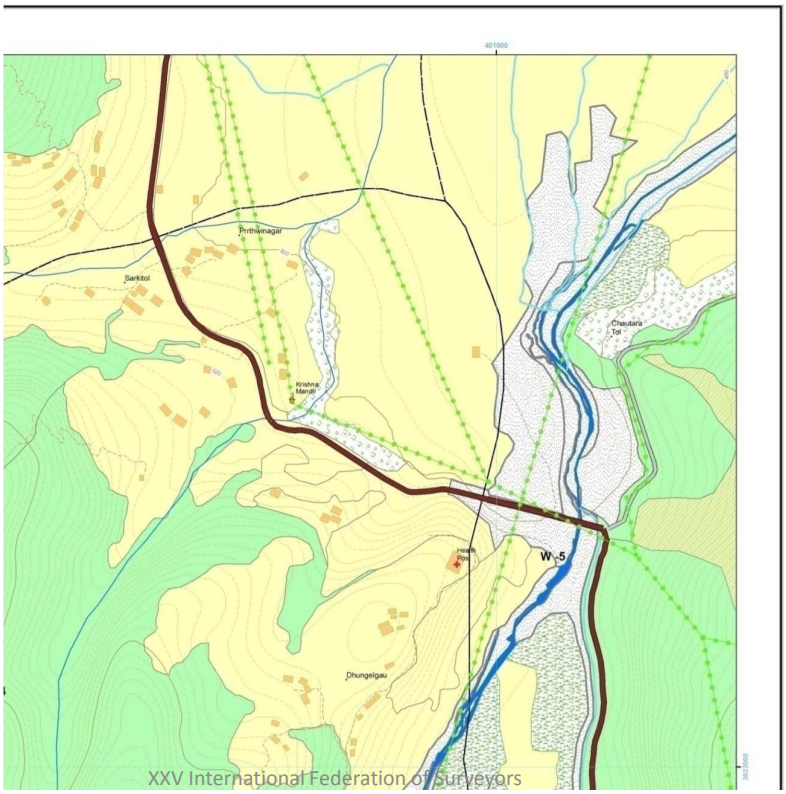
Landmarks
- Statue
- City Gate

Control Point
- National Geodetic Control Point
- National Bench Mark
- GPS Points/Control Points

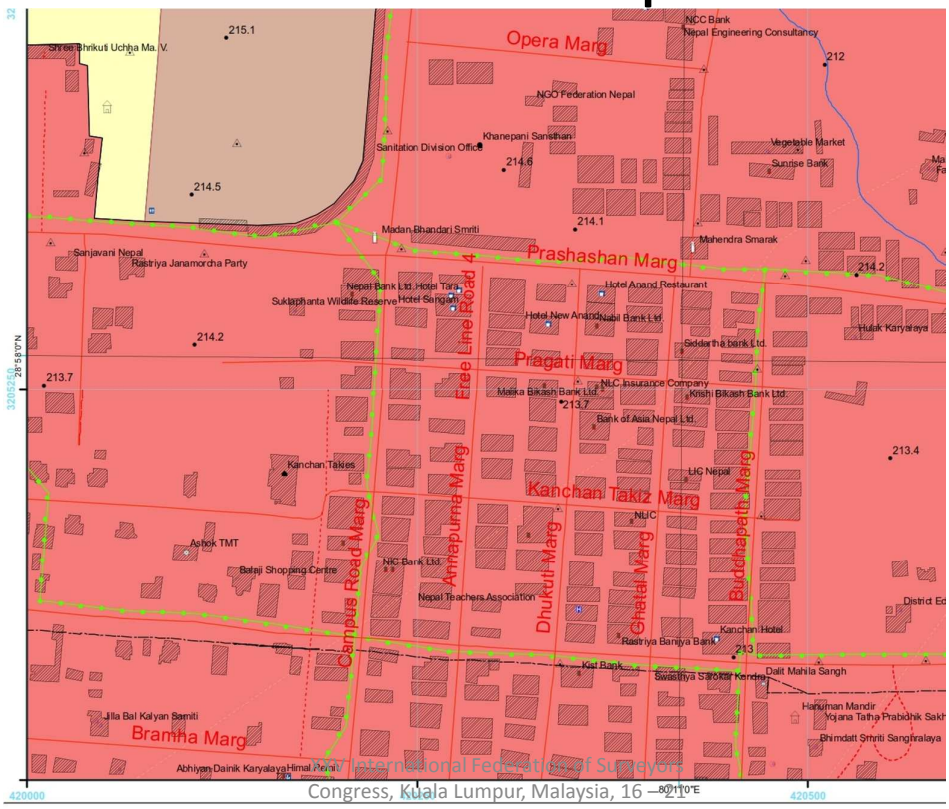
Transportation Infrastructure
- Black Topped Road with Bridge
- PCC Road
- Gravel Road
- Stone Pavement Road
- Brick Pavement Road
- Earthen Road
- Tracks
- Airport Runway

Physical Infrastructure
- Building
- Temple
- Stupa
- Monastary
- Church
- Mosque
- Crematorium(Ghat)
- School/College
- Bank/Cooperative
- Health Service
- Police Station
- Check Post
- Post Office
- Telephone Office
- Water Supply Office
- Electricity Office
- Hotel
- Factory/Industry
- Poultry Farm
- Airport
- Bus Stop
- Picnic Spot
- Petrol Pump
- Water Tank
- Spring
- Public Tap
- Well
- Drinking water Source
- Water Supply Pipe
- Electricity Pylon
- High Tension Line
- Electric Transformer
- Telecom Tower

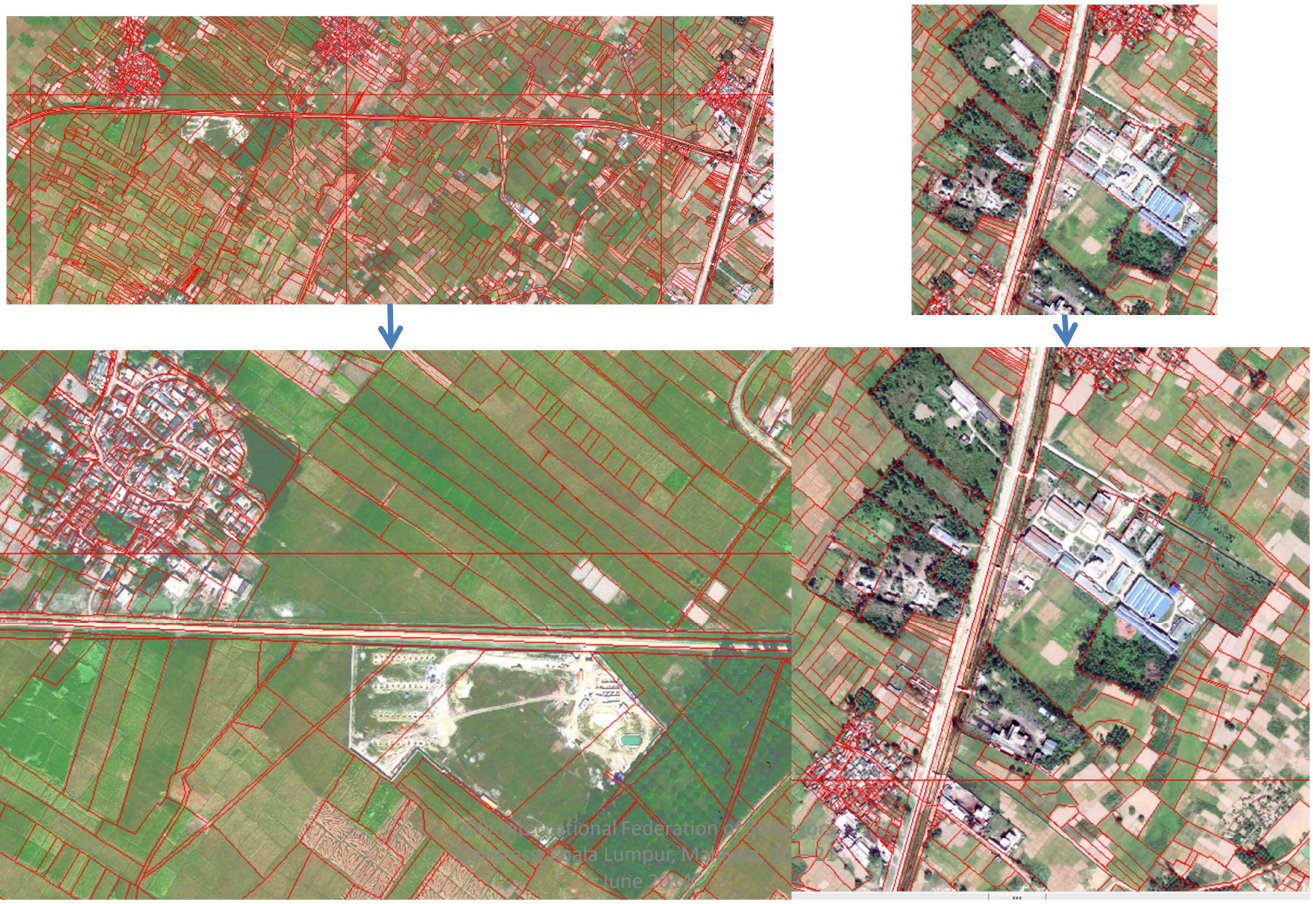
Topographical Map



Street Map



Validating the geometrical accuracy against the cadastral data



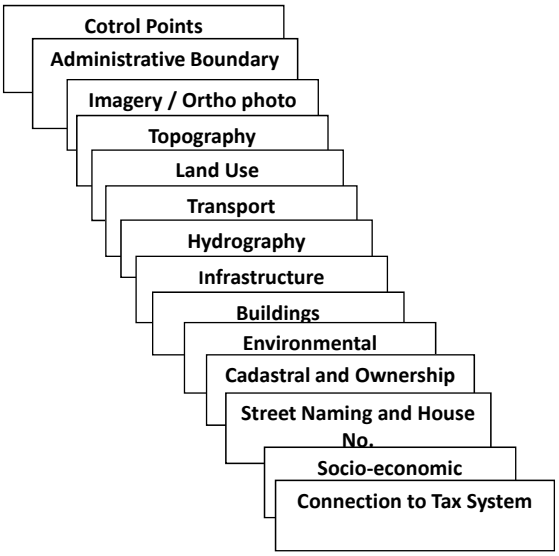
Confusion Matrix

	Agriculture	Forest	Resisdentia	Commercial	Industrial	Public Service	Other	Total	user Accuracy
Agriculture	85	1	0	1	0	1	2	90	94.44444444
Forest	1	30	0	0	0	0	0	31	96.77419355
Resisdential	0	0	50	3	0	0	0	53	94.33962264
Commercial	0	0	1	19	0	0	0	20	95
Industrial	0	0	1	0	4	0	0	5	80
Public Services	0	1	0	0	0	19	1	21	90.47619048
Other	1	0	0	0	0	0	9	10	90
Total	87	32	52	23	4	20	12	230	
producer Accuracy	97.7011494	93.75	96.15385	82.60869565	100	95	75	216	
omission error	2.29885057	6.25	3.846154	17.39130435	0	5	25		**93.91304348**

Kappa Statistics: (KIA): 0.92

$$K = \frac{N\sum_{i=1}^{r} X_{ii} - \sum_{i=1}^{r}(X_{i+} * X_{+i})}{N^2 - \sum_{i=1}^{r}(X_{i+} * X_{+i})}$$

Overall accuracy : 93.9%



Data Model

DESCRIPTION OF DATABASE

Data base is designed for thematic layers,

entities (types, categories, components) and

topological relationships between feature classes.

Thematic layers of base Map

- Control points-
- Administrative boundary-
- Topographical and hypsographic features-
- Transport- Road-; airport-; bridge- ; railway
- Hydrography-
- Land Use
- Infrastructures- Water Supply; Sewerage-; Electricity-; Communication
- Buildings-
- Environment- watershed, hazards, flora and fauna,
- Cadastre-
- Street names and house number-
- Socio-economic data-
- Linkage of data with Tax System-

Data description

Feature Class Category	Description	Feature Geometry	Feature Attributes
Municipal/VDC Boundary Line	Municipal/VDC area boundary line	Line	Feature Code: <integer> VDC Name:<string> VDC Code:<integer> Length:<double>
Municipal/VDC Area	Municipal/VDCcoverage area	Polygon	Feature Code: <integer> District Name:<string> District Code:<string> VDC Name: <string> VDC Code:<integer> Area:<double> Perimeter:<double>
Ward Boundary Line	Ward boundary line	Line	Feature Code: <integer> Length:<double>
Ward Area	Ward coverage area	Polygon	Feature Code: <integer> VDC Name: <string> VDC Code:<integer> Ward Number:<integer> Area:<double> Perimeter:<double>
Service Area Boundary Line	Service area boundary line	Line	Feature Code: <integer> Length:<double>
Service Area	Service area coverage	Polygon	Feature Code: <integer> Service Area Code:<string> Service Area Type: <string> Service Area Authority:<string> Area:<double> Perimeter:<double>
Locations	Location of designated places	Point	Feature Code: <integer> Location ID:<integer> X Coordinate: <double> Y Coordinate:<double> Designated Name:<string>

LAND SUITABILITY DECISION FOR URBAN DEVELOPMENT

- Land suitability analysis by
  - SLEUTH Model - SLEUTH stands for Slope, Land cover, Exclusion, Urbanization, Transportation and Hill shade and
  - Multi Criteria Analysis (MCA) Model is used for development which is influenced by both natural and social-economic conditions.
  - It is difficult to find enough land in hill area as per these model.

CONTRIBUTION OF BASE MAPS FOR SUSTAINABLE URBAN DEVELOPMENT

- National planning commission collects from lower level to national planning commission and decides the programmes on the basis of resources available and the resources allocated on the basis of database.
- Lack of detail geo-database, will delay the development programmes 2-3 years and accordingly cost of project will increase.
- The detail digital base maps/data will provide above data of the situation of the area.
- Database will be useful for future urban development and conservation of nature and culture.
- Data base will be sufficient to carry out technical, social and financial feasibilities.

PROBLEMS ENCOUNTER

The main problems are :

- **Technological**- updated with the technological changes like software, imagery, aerial camera, photogrammetric instrumentation and ortho photo or DTM generation facilities,
- **Land form** is either too steep or too flat. The steep land form is prone to land slide and expensive to develop infrastructure and flat land are flooded in rainy season every year
- **Climatic**- Rainy season, fog- cold wave, extreme altitude/slope and temperature situation are main physical problems in the field and
- **Maintenance** (updating and upgrading) of existing GIS database is essential.

Recommendation

- The urban population will increase with greater rate annually and urban development will necessitate take place at greater speed to provide housing and infrastructure to the urban people whether the city is planned or not. Hence, database required to prepare of all municipalities.
- It is also required to update existing topographical maps and creation of new ortho photo, and start preparation of large scale maps of the whole country at the resolution of 0.5m - 1m .
- It is also required to maintain existing geodetic control net work

Thanks

- 25th FIG congress
- Session Chairperson, Rapporteur, and participants
- Host & PEJUTA (Association of Authorised Land Surveyors Malaysia)