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Volunteering for the future – Geospatial excellence for a better living

LESSONS LEARNT IN REVIEWING TECHNOLOGIES UTILISED TO IMPROVE CAPACITY AND THE SPATIAL INTEGRITY OF THE "ONE MAP PROJECT" IN INDONESIA OR OTHER FIT-FOR-PURPOSE LAND ADMINISTRATION SYSTEMS.

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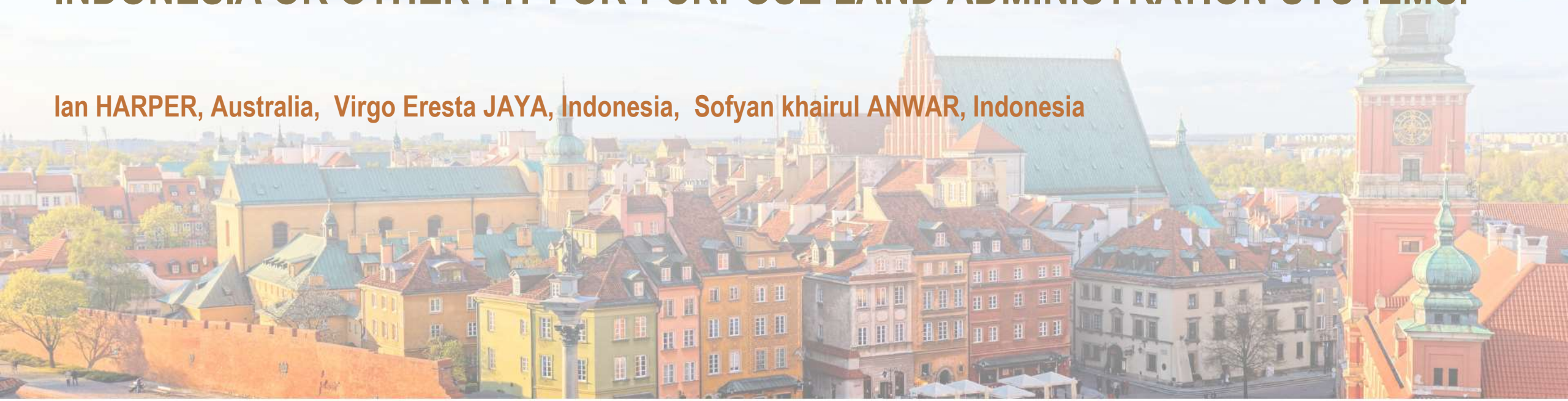

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Contents

A Business and Technical Based Project Review – from considerable experience across survey and legal processes and applications from field data collection to Land Administration database management

Status of One Map Project

The Indonesian Project to Accelerate Agrarian Reform (One Map Project) is a five year project that began in **November 2018** and ends on **31 October 2023**.

Building Digital Infrastructure across Indonesia - the project components include Participatory Mapping, Agrarian Reform, Geospatial Data Infrastructure for Environmental and Natural Resources, Project Management, Institutional Development and Monitoring. It is an implementation of the philosophy outlined in the Fit-For-Purpose Land Administration publication by FIG and World Bank.

It is managed by the Badan Pertanahan Nasional (BPN) – the Indonesian National Land Agency. For further details contact Co-Author **Virgo Eresta JAYA.**

Project activities related to this component of the One Map Project have produced a parcels map approaching **4 million parcels.**

Data with obvious spatial issues

Reviewing Survey and Spatial Issues

In the One Map Project, surveyors and field data recorders across the country provide parcel data to BPN to include in the national cadastral database. In the initial stages of the project data was lacking in spatial integrity that affected:

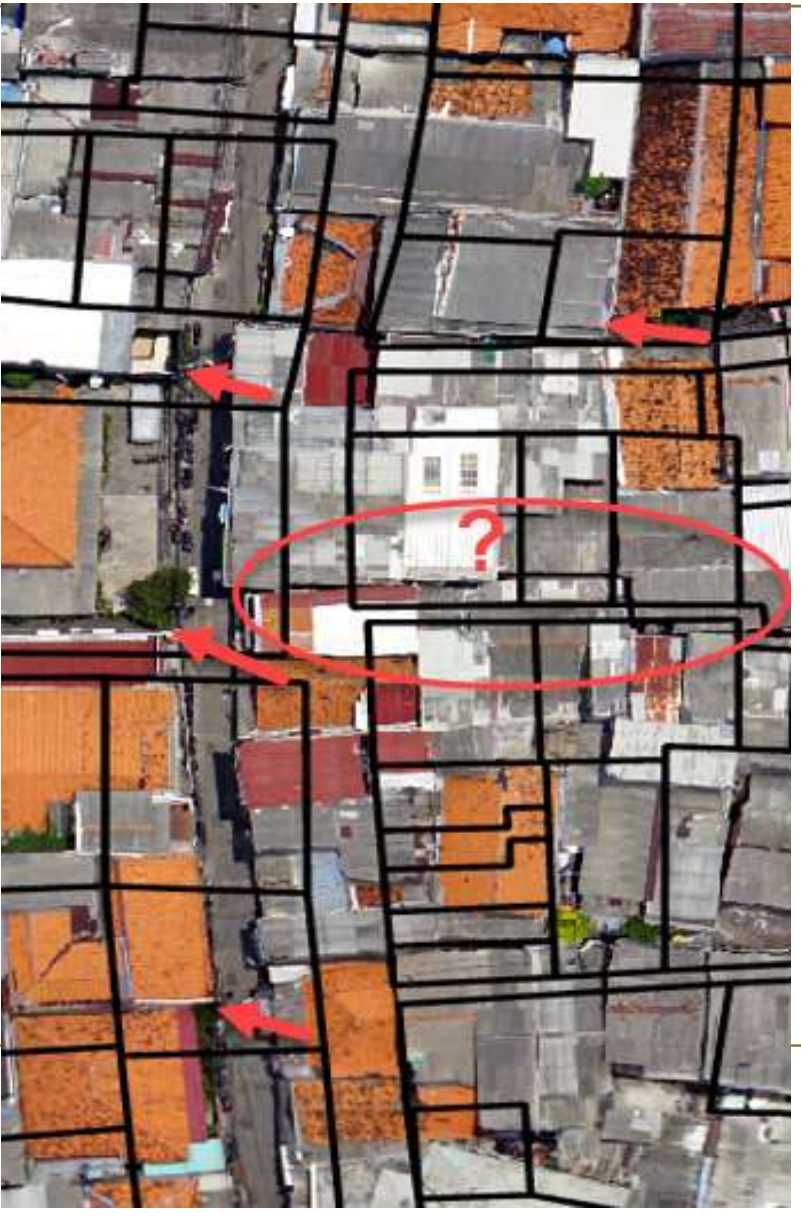
1. **Parcel Location** – It was difficult to determine even approximate locations
2. **Parcel Topology**
   - Surveyors need to expand their cadastral mindset of suveying one parcel to consider the relationship of that parcel with other parcels
   - Critical to ongoing spatial improvement through various adjustment options and identifies the true spatial relationship between neighbours

Greater governance and instruction has now been implemented to provide better and smarter data but historical problems remain.

One of the goals of this project was to investigate if and how spatially poor parcel data can be improved.

Data with obvious location and topology issues shown below but there was little metadata to assist in resolution. Information from the original data collectors would assist but this is generally unavailable so rectification is difficult.

This data has location issues but it is possible for database managers to determine the extent of the location issues and greatly improve the spatial integrity of the database in relation to the imagery, particularly as topology appears reasonable.



Database Spatial Upgrading.

Location Options:

Field Survey (GNSS or traverse) – Control Point data high accuracy but limited output

Use of Imagery – Lesser accuracy (based on imagery integrity) but high production of control points – Fit For Purpose (FFP)

Adjustment Options

GIS/Mapping Adjustment

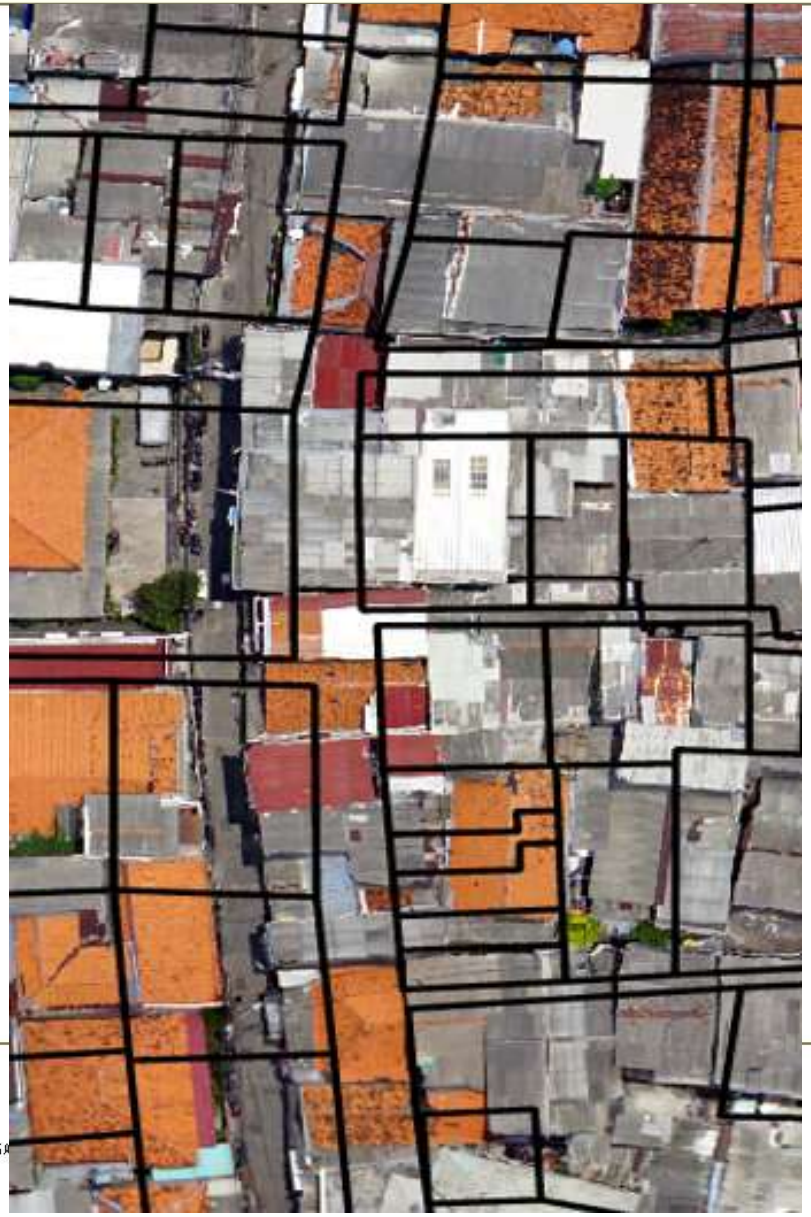
- Bulk Shift, Rubber sheeting, etc – Suitable for most FFP databases.

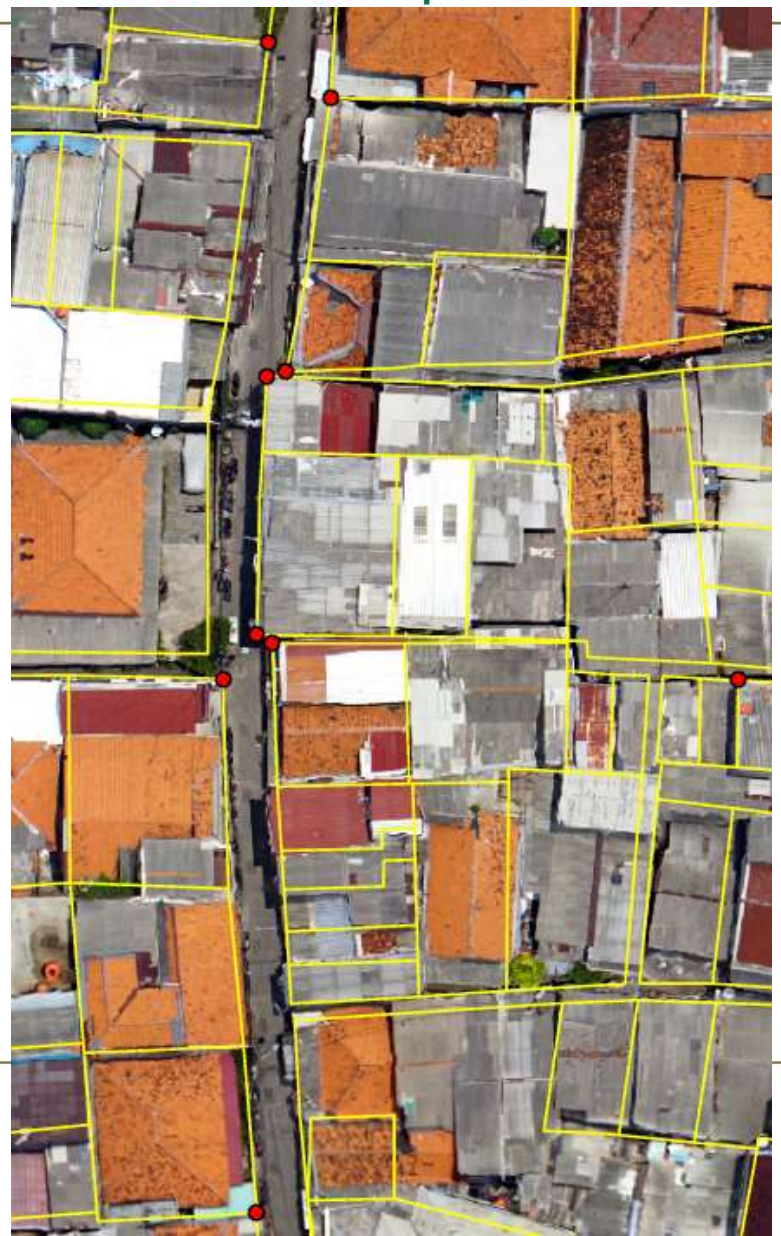
Survey

The desired survey adjustment outcome is that when new accurate, smart parcel data is added to the database, the adjustment ensures that the correct location and shape of the good parcel data is not corrupted by the surrounding historical parcel data of less integrity data.

- Cadastral survey based Least Squares Adjustment – Parcel Fabric
  - ESRI Parcel Editor – Capacity for National database management
  - GeoCadastre (Geodata Australia) - Local survey database solution

Adjusted Database using LSA with control points sourced from Imagery.





Comparison of before and after LSA using control from imagery

This is a considerable improvement but there are still many parcels that could be improved.

This becomes a management decision as to how much time is spent in adding control and running adjustments.

This type of desktop improvement can be done in hours once the Parcel Fabric format and clean topology is in place.

Possible improvements From the Review

1. Flexibility in technologies and processes used with consideration of how 'smart' the data is.

Creation and management/upgrading of cadastral databases should vary between:

- Inner city – higher rigour
- Rural Areas – less rigour

Fit For Purpose solutions

Possible improvements From the Review

2 - Decentralisation of spatial management of cadastral databases

Managing the spatial component of Indonesian land administration at a centralised office is a considerable challenge. There must be strong governance and processes in place to ensure data does not contain minor problems that should have been resolved at the source.

There would be a strong case for regional offices to maintain their own survey/cadastral database where they resolve topology issues and adjustments for spatial upgrading prior to sending data to the main BPN office for general land administration.

The benefits of higher regional responsibilities include:

- Local surveyors / parcel data collectors are best placed to resolve problems
- Local employment and upskilling
- Local pride in their work

Incorporating 3D Cadastre

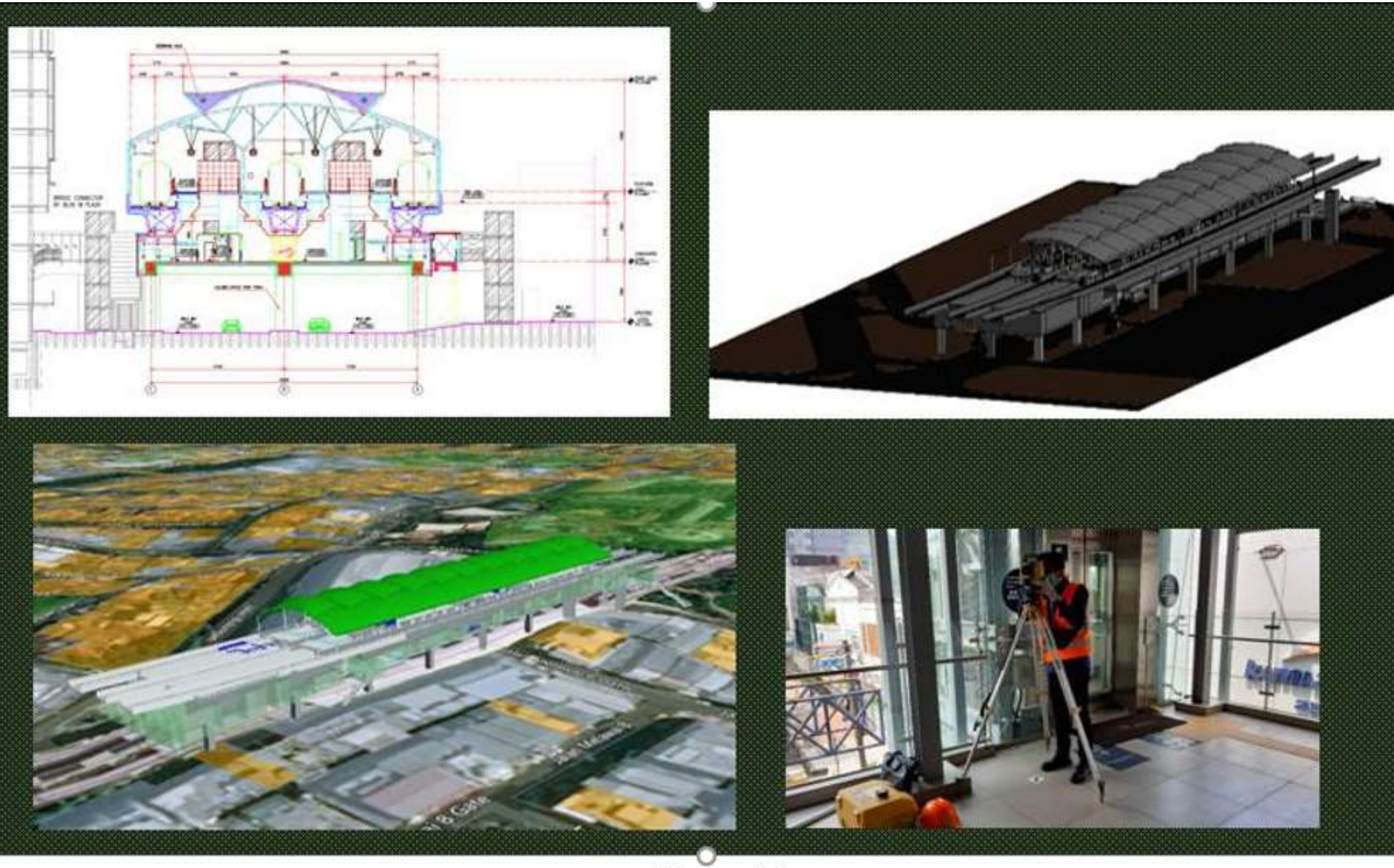
Another goal of this review was to investigate the move to a 3D cadastre and a Digital Twin.

Three types of projects with varying technical processes were considered as part of the review with a focus on the business outcomes.

3D Project 1

A Pilot Project defined 3D spaces in a recently constructed Mass Rapid Transport (MRT) rail station.

Whilst successfully creating an accurate Digital Twin, it involved a high level of technology and resources.



Disusun oleh:

3D Project 2 - A Pilot Project involving survey of a multi-storey building defining separate titles on each floor – instructions provided to surveyor.

3D Project 2 - Even though minimal building data was collected in the field it involved a high level of technology and would have an application to higher value property titles and inner city buildings

(a)

(b)

(c)

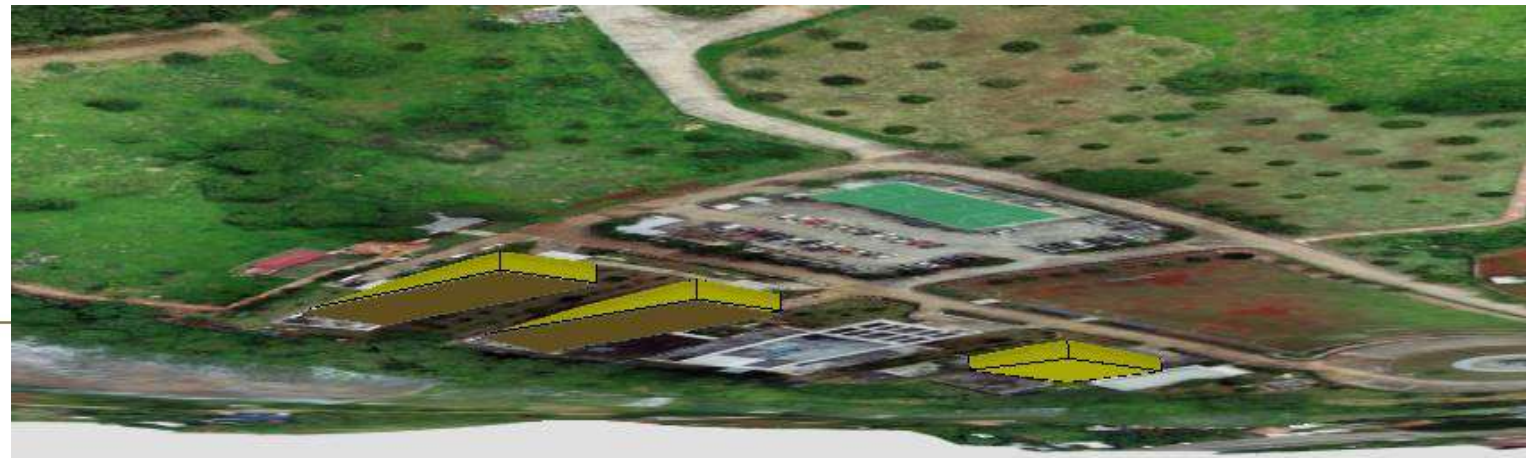
Field Work Image : (a) GNSS CORS, (b) Total Station Reflectorless, (c) UAV Lidar

3D Project 2

Lidar data of the ground provided a mathematical model of the local geoid surface.

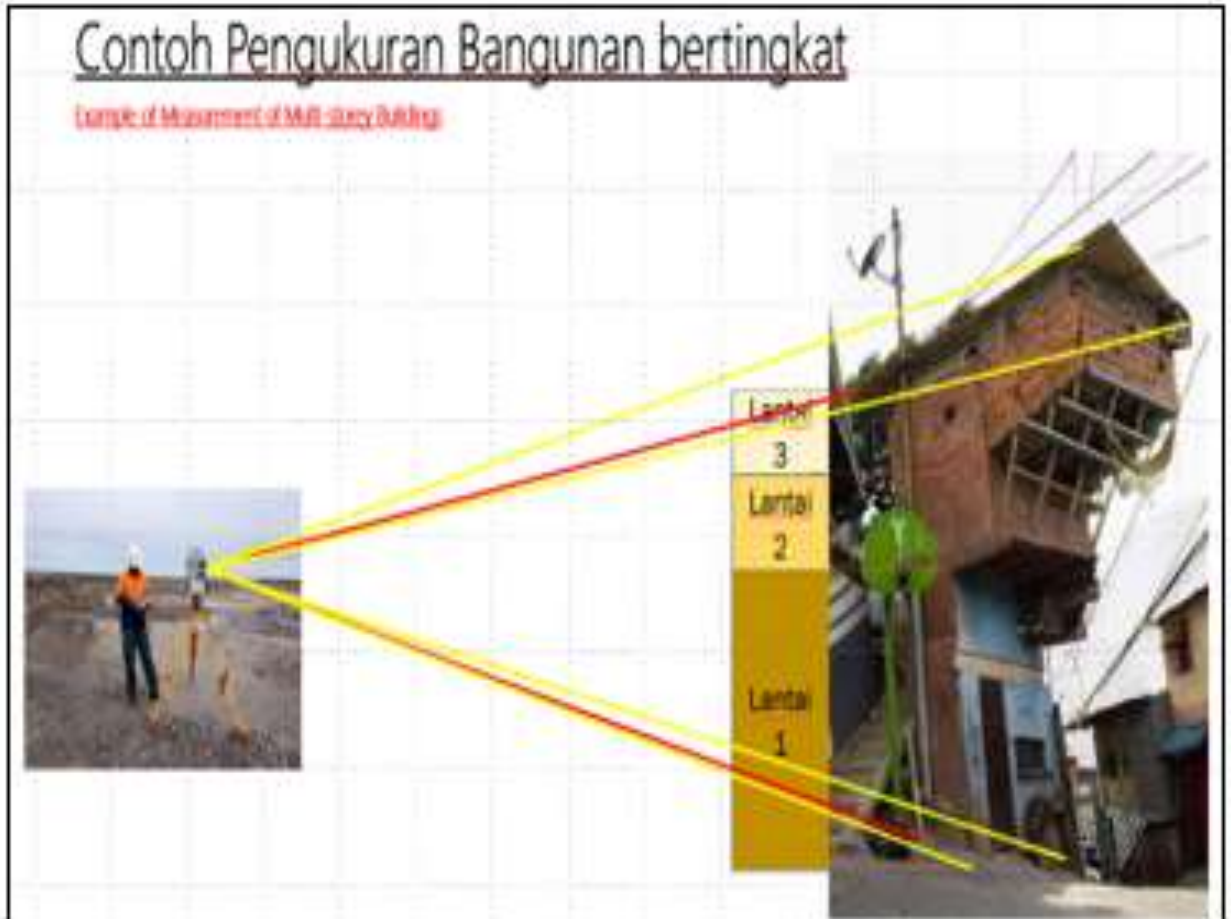
Whilst this geoid data was accurate it only covered a limited area adjacent to the buildings.

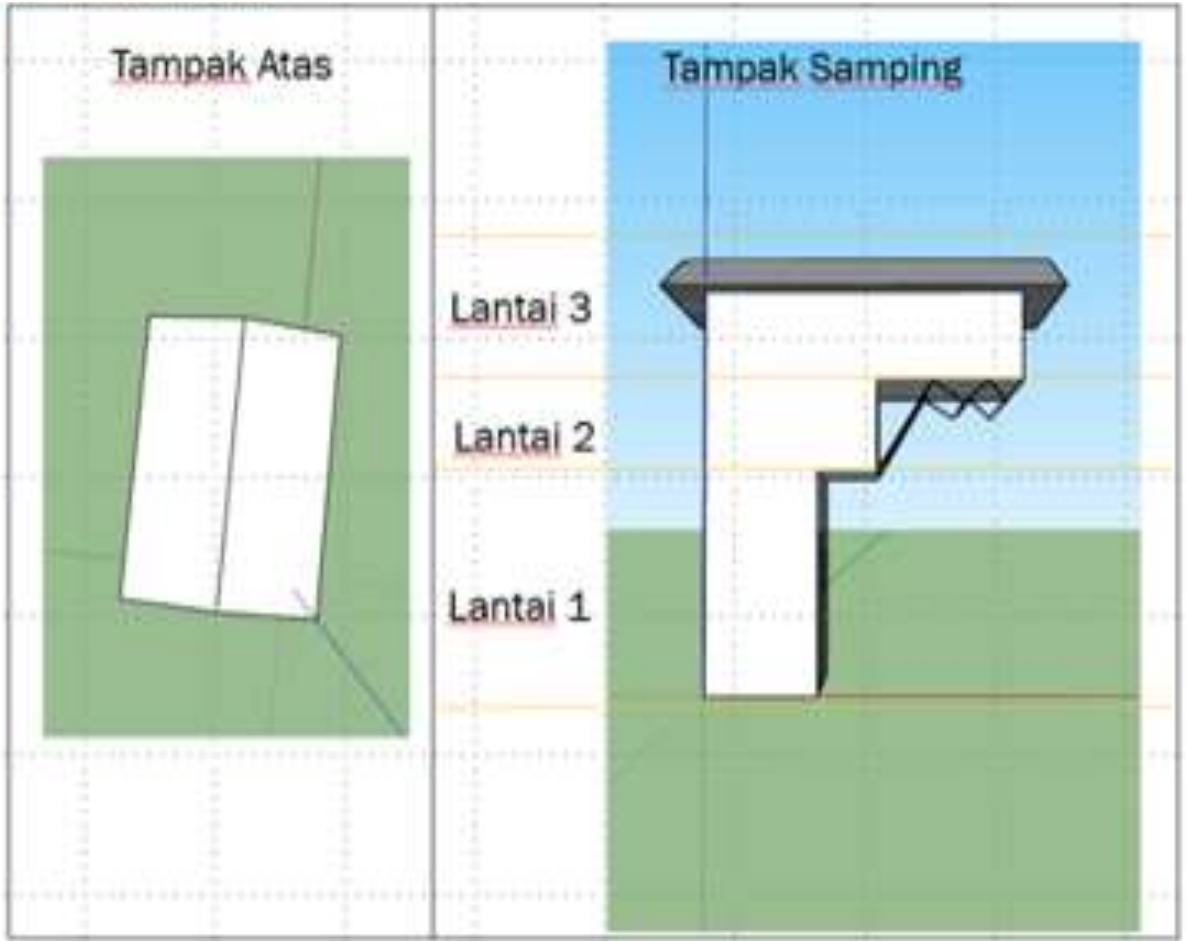
In the future LIDAR will provide larger areas to model accurately



3D Project 3 – To represent the extents of ownership/occupation of a unique, lower socio-economic building.

Method 1 - Survey - Some field survey was undertaken to generate an accurate model of the building extents. No vertical datum was connected to so there was not possible to correctly position the building relevant to the geoid.





3D Project 3

Method 2 - Desktop – Imagery was used to generate a shape that approximately enclosed the extents of the building.

This was a simple desktop exercise that can be positioned from imagery but the only heights available would be relative to the ground.

3D Projects – In the diagram all titles shown have been generated in 2D from imagery and all floor and other levels are approximate and related to a local ground level datum.

Imagery placed at zero datum allows modelling of 3D objects across a wide area without the need to connect heights to a geoid or other mathematical surfaces.

Parcel building heights can be adjusted as more data is available.

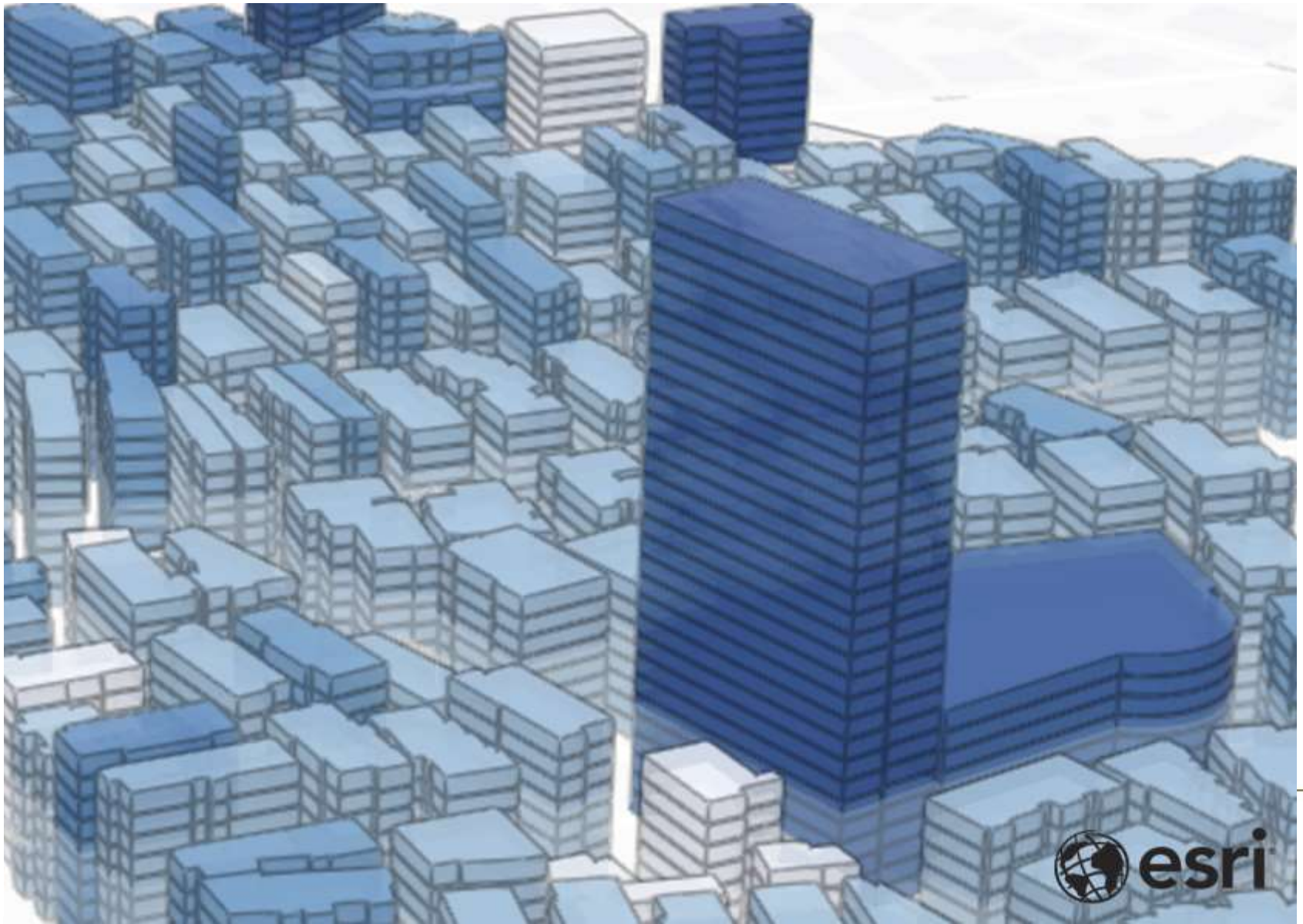
- **Non-Identical DIGITAL TWINS**
- **BABY BIMS**

As better data becomes available they will support stronger and smarter land administration

Fit For Most Purposes Database

Technology is now building capacity to automatically generate 3D building blocks from LIDAR.

It becomes a cost/benefit business decision based on a knowledge of the available resources and data.



Towards 3D

BPN have proven they have the capacity to manage 3D cadastre and are looking to require future multi-story developments to provide a BIM model with cadastral attributes.

The challenge is collecting the cadastral data and heights relating to existing 3D titles across Indonesia.

The technology is there but the business case comes down to what the outcomes are required:

- technical correctness for planning purposes - Quality
- land administration for revenue purposes - Quantity

Quality or Quantity ?

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