



UN-GGIM
UNITED NATIONS
COMMITTEE OF EXPERTS ON
GLOBAL GEOSPATIAL
INFORMATION MANAGEMENT



Effective Land Administration Underpinned by Reliable Geospatial Information: A Singapore Case

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Singapore Land Authority

Land: Critical and Strategic Resource for Singapore

Land Planning



Land Administration



“One must reserve land for future development. The government is not looking five years or ten years ahead. Being a responsible government, we must look 30 years or 40 years ahead, and when the time comes, we must have land available for the requirements for that age.”

- E.W. Barker, Minister for Law (1964-1988)

Effective Land Administration is Core Business for SLA

Singapore Land Authority (SLA) is a statutory board under the Ministry of Law. It is formed in 1 June 2001. SLA acts as the main custodian's of Singapore's Land Assets to support the economic and social development of Singapore.

Limited Land • Unlimited Space

Optimise
land and
space
utilisation

Be a trusted
source of
land-related
information

Drive a Geo-
enabled
Singapore

Survey & Geomatics Division

I. Uphold accurate national geospatial and positioning reference system

1. Geodesy

We establish national coordinate reference system and maintain the underlying control points infrastructure that underpin the data capture, map production and applications related to Geoinformation.

2. GNSS

We establish and maintain the national GNSS Continuously Operating Reference System (CORS) infrastructure and provide positioning services that enhance the GNSS positioning reliability and accuracy in Singapore.

II. Deliver reliable and trusted digital Geoinformation

3. Cadastre

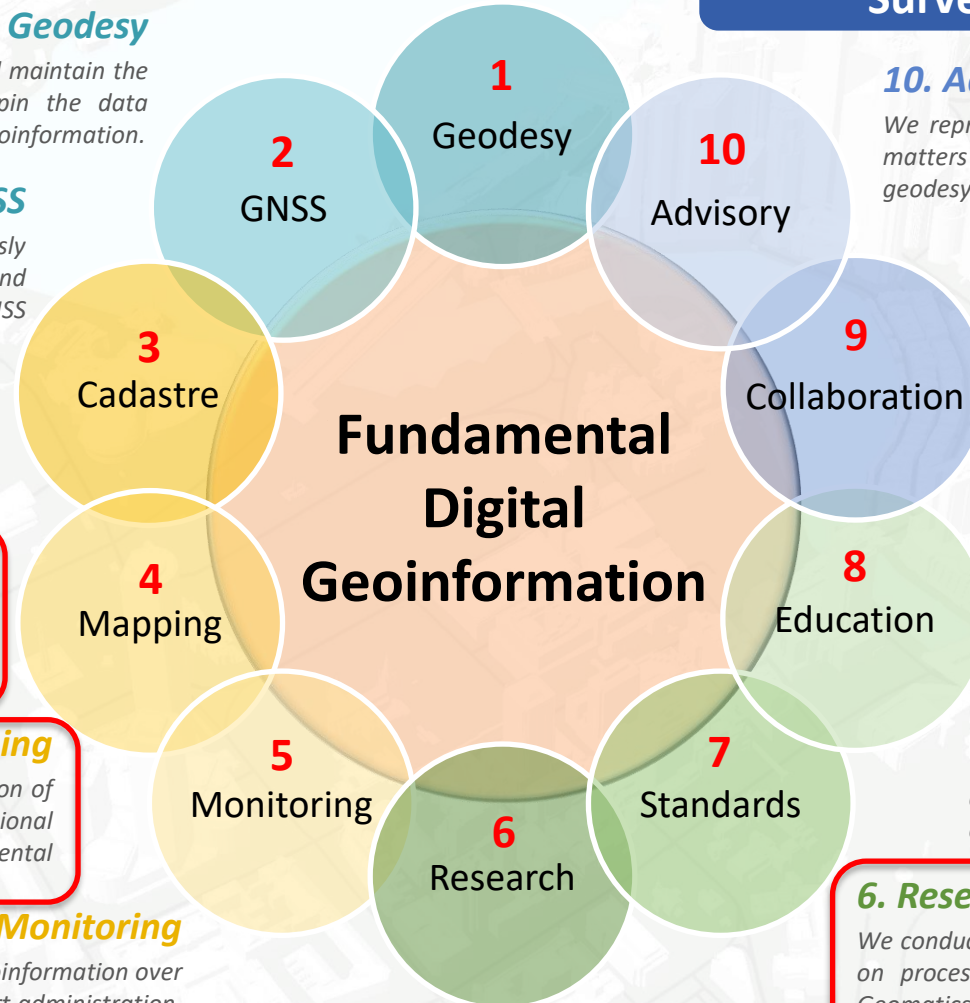
We administer the cadastral survey legislation and approve cadastral survey plans to support registration of titles and maintain map database as the fundamental dataset for sustainable development of Singapore.

4. Mapping

We capture, create and maintain digital geoinformation of underground and above ground; and produce national map(s) to support sustainable development, environmental protection, digital economy and smart applications.

5. Monitoring

We collect, analyse and manage digital geoinformation over time to detect changes on land that support administration, risk management and environmental monitoring.



IV. Lead WOG in the domain of Survey and Geomatics

10. Advisory

We represent the State and advise public agencies on matters related to policy and technical practices of geodesy, land surveying and mapping.

9. Collaboration

We collaborate with partners on technical and policy matters related to geodesy, land surveying, mapping and boundaries.

III. Drive industry innovation, standards and capacity

8. Education

We raise awareness and build capacity of Geomatics Engineering.

7. Standards

We develop and maintain technical standards and guidelines for the capturing, creation and exchange of digital geoinformation.

6. Research

We conduct innovative research and development on processes and technologies in the field of Geomatics Engineering to ensure we can continue to meet national needs and to lead the industry.

Digital Transformation in Cadastre since 2018

Cadastral Survey Management System (CSMS)

Registered Surveyors' Portal

Pre-validation

Plan Generation

Surveyor
Workspace

SG LandXML

SLA Intranet for Inspection and Approval

Cadastral
Workflow

Provenance GIS

Inspection Officer
Workspace

Fully Digital

Cadastral Validations

Innovations in Cadastre

Before 2004



2004



2018

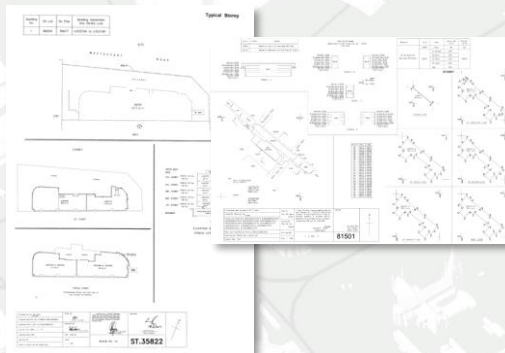


2024

Paper Plan



- Coordinated Cadastre with SVY21 (2004)
- Image Plan (2005)



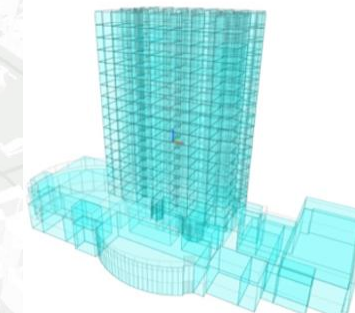
Digital Cadastre with SG LandXML

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  <Personnel name="Mokshin"/>
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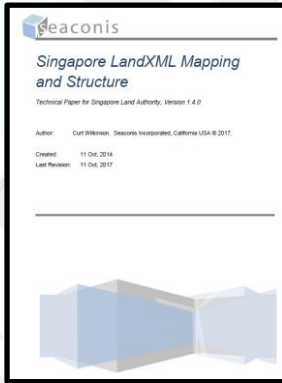
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3D Cadastre in BIM (IFC)

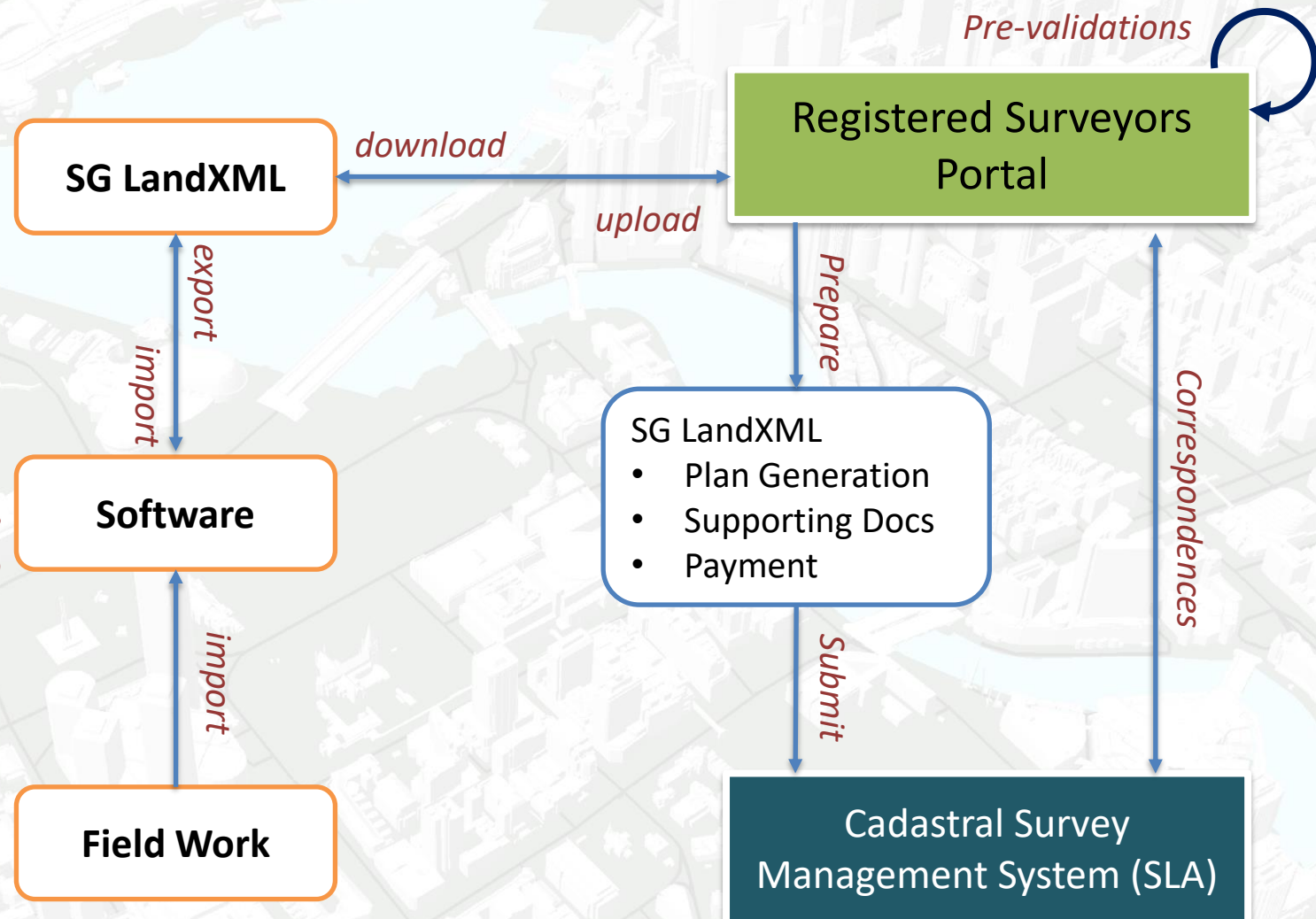


Cadastral Survey Submission Workflow

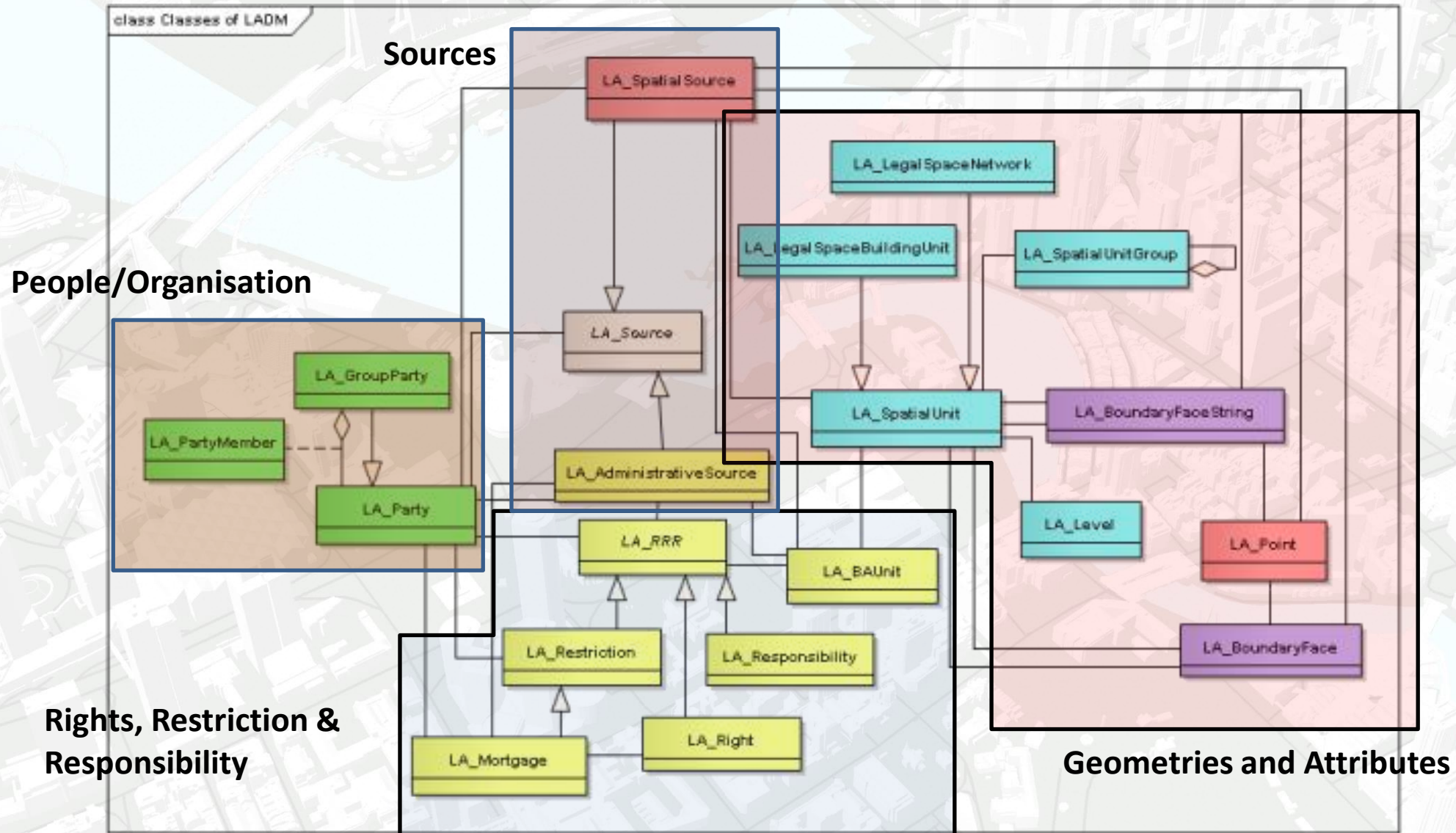
SG LandXML Specification



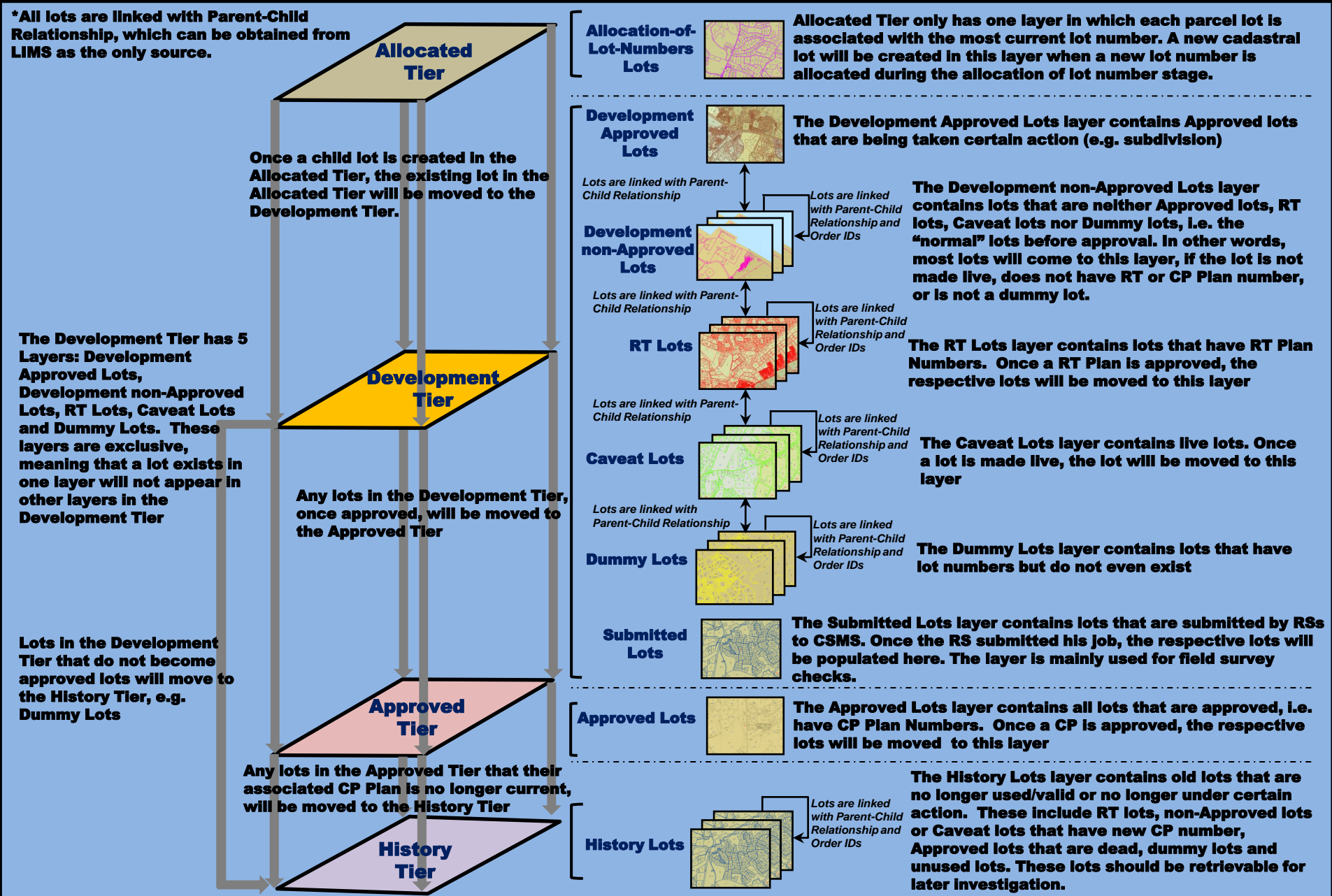
- *Listech Neo,*
- *Geocadastre*
- *Data Stream*



Cadastral Data Model based on ISO 19152 Land Administration Domain Model (LADM)

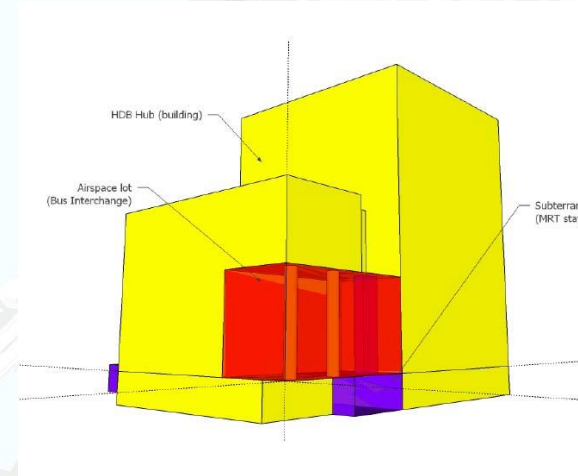


Managing Provenance of Cadastral Lots



3D Cadastre

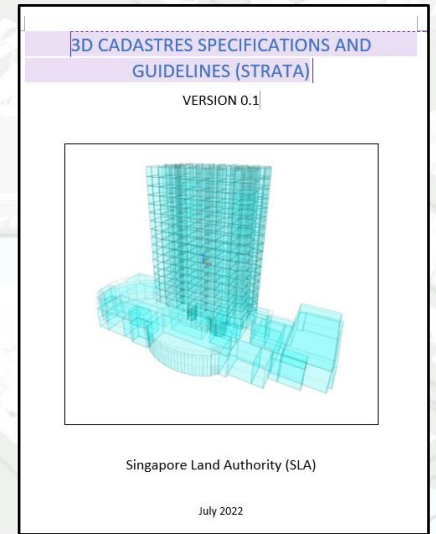
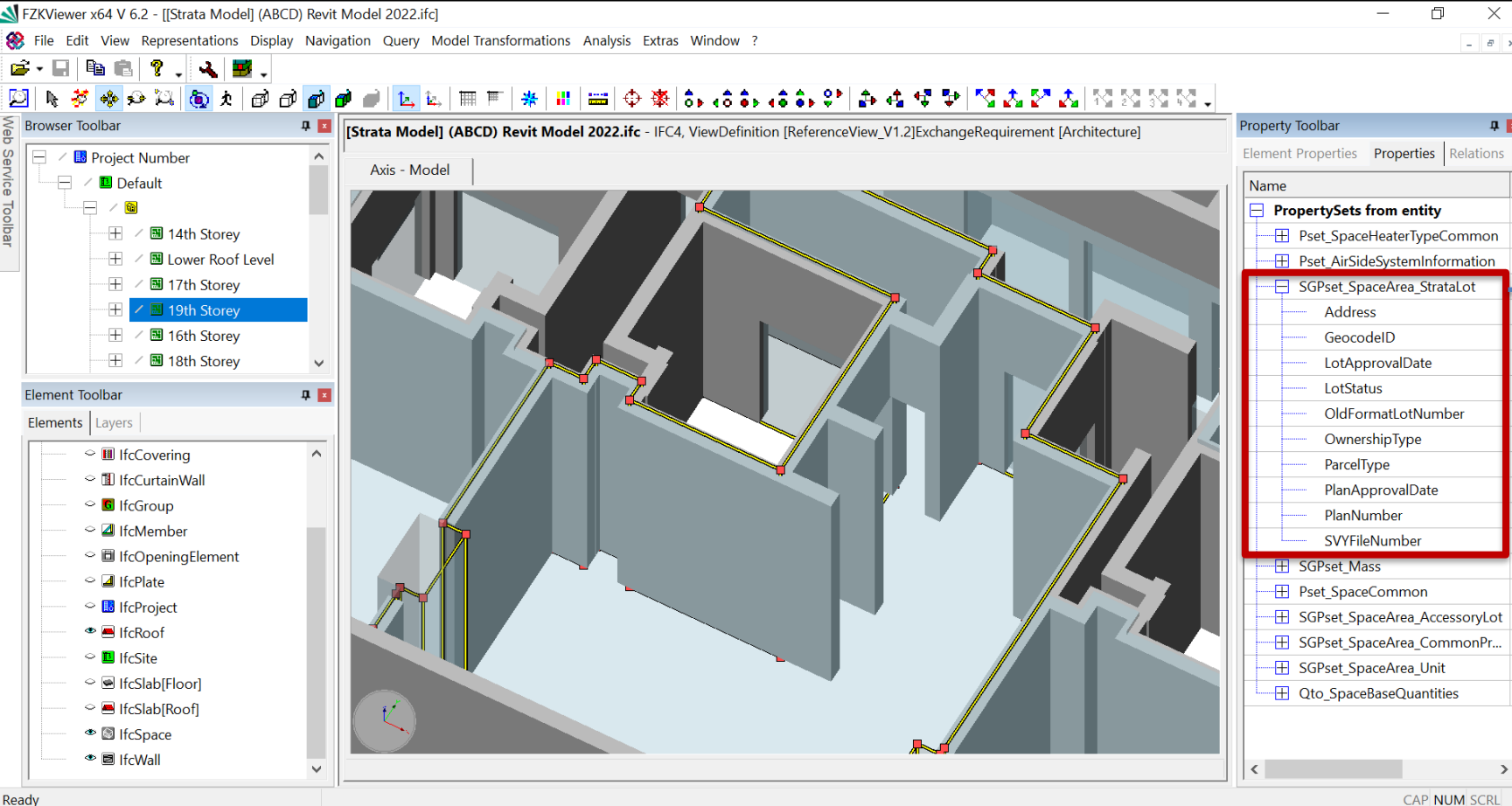
- Complexities of structures and related rights – 2D representation is not sufficient
 - Above and on ground
 - Underground
- Urbanisation – need planning in third dimension
- Trends in cadastre - AEC industry has moved to BIM



3D Strata Model in IFC – SG (Under Development)

IFC - SG

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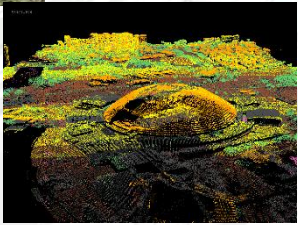
Visualisation of 3D Strata Boundaries in Building Information Model (BIM)

National 3D Mapping Programme

2014 **2015** **2016** **2017** **2018** **2019** **2020** **2021**

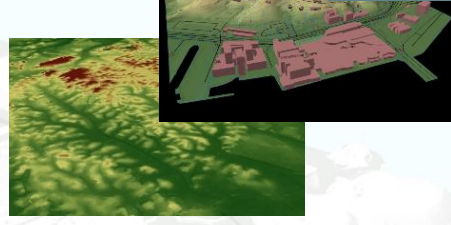


Commence 1st National Mapping Data Capturing



Data Processing

Apr Jun



Completion of 1st Aerial Mapping

Mar



Aug

Completion of Mobile Mapping (Covering 5,500km public streets)

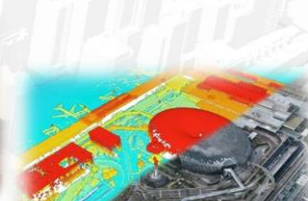
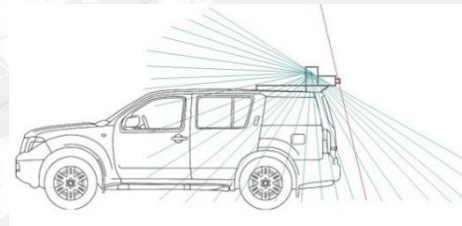


Commence 2nd National Mapping Data Capturing

Feb

Aug

Year 2 Mobile Mapping Maintenance

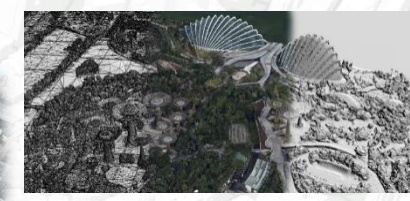


Data Processing

Jun

Aug

Completion of Mobile Mapping Maintenance



Completion of 2nd Aerial Mapping

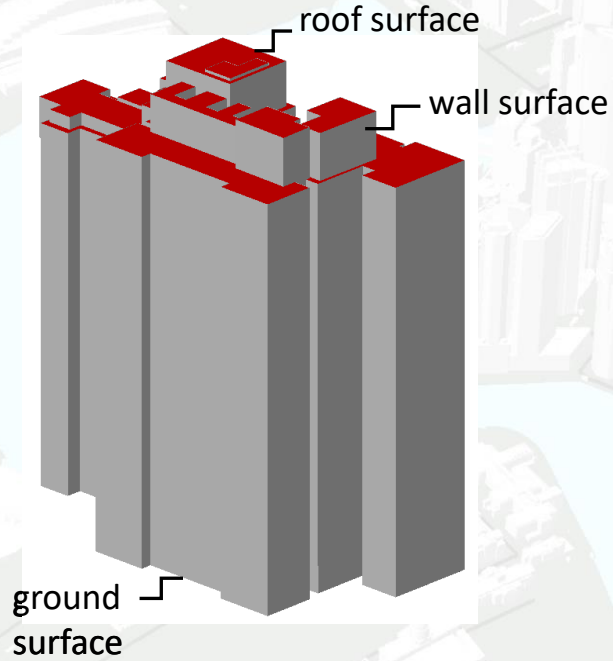
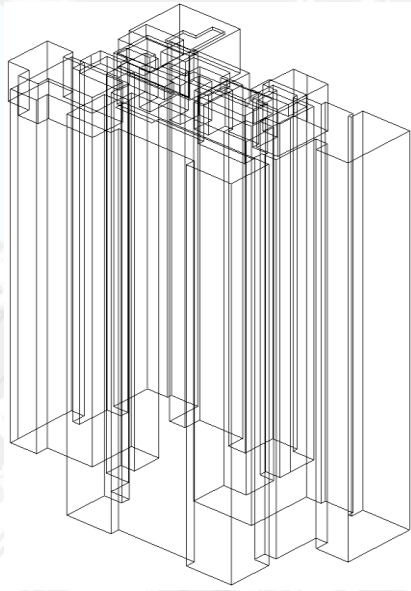
Oct

Mobile Mapping Refresh Tender in 2022

Covid-19 Circuit Breaker
7 Apr to 1 Jun



3D Building Models (LOD2) in CityGML



3D Geometry + Topology

+ **Semantics** +

Appearance

3D CITY STANDARDS DEVELOPMENT
REPORT

- CityGML is an XML base data format
- CityGML captures
 - 3D geometry, 3D topology, semantics, and appearance
 - 5 discrete scales (Levels of Detail, LoD)



LoD0
Terrain Model



LoD1
Block models with
no roof structures



LoD2
Explicit roof
structures



LoD3
Detailed
architectural
models

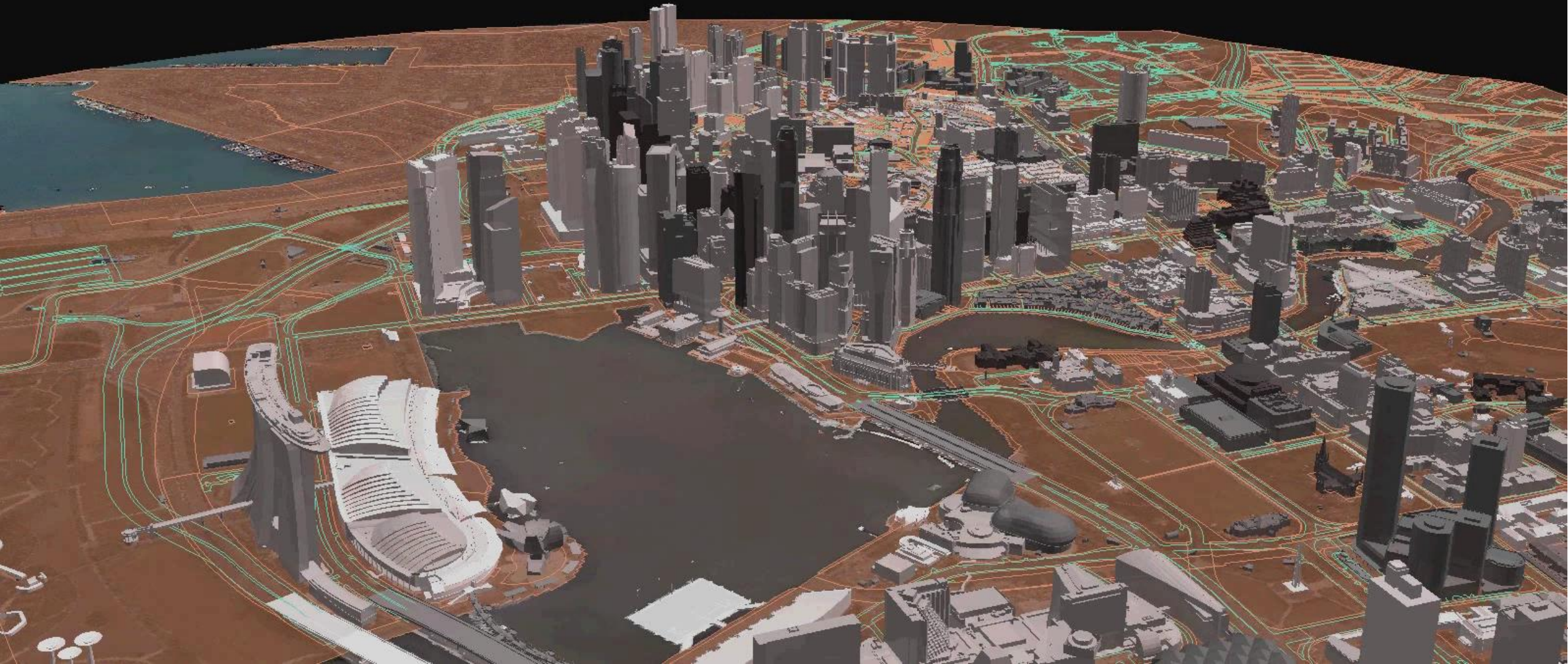


LoD4
Interior
modelled

Source: Thomas Kolbe

3D Building Models

3D Map
Downtown Singapore

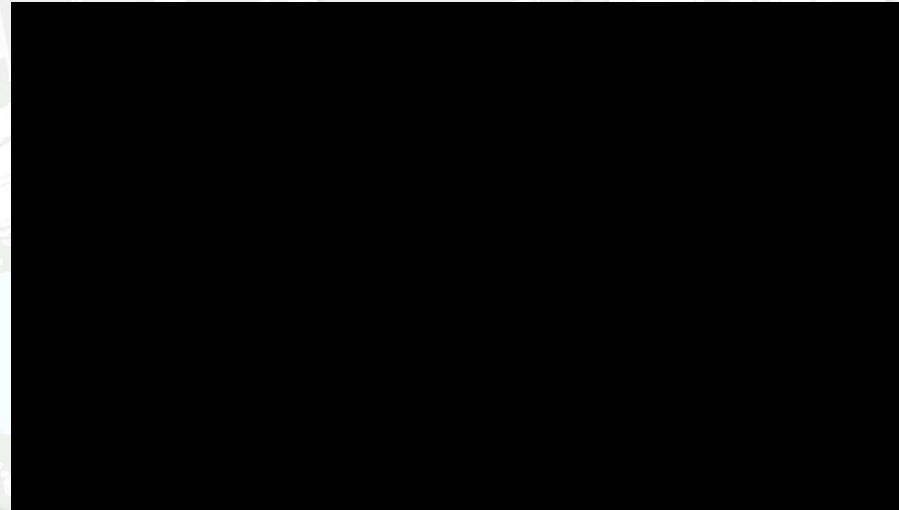


Supporting Public and Private Needs

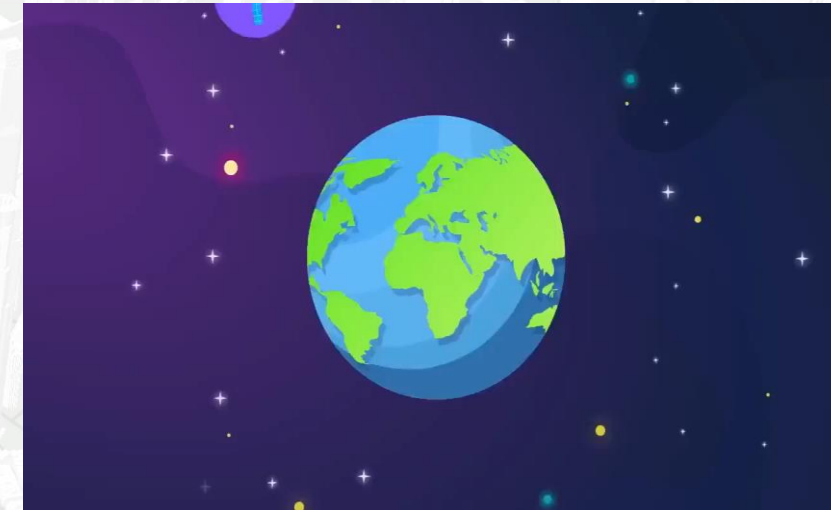


Proposed New Development

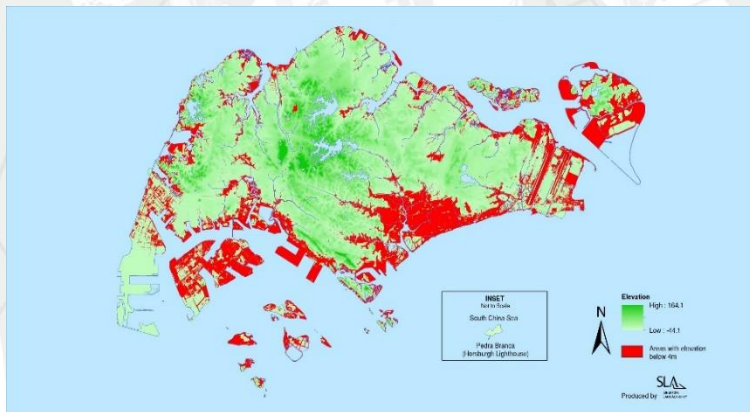
Urban Planning



Support adoption of solar energy using
Solar Potential Map



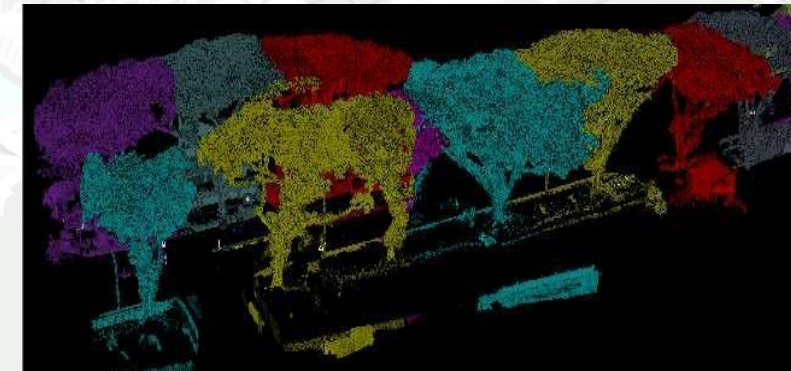
Support Whole Of Government (WOG)
Regulatory Approval for Building Works



Develop Flood Risk Map to mitigate
impact of sea level rise

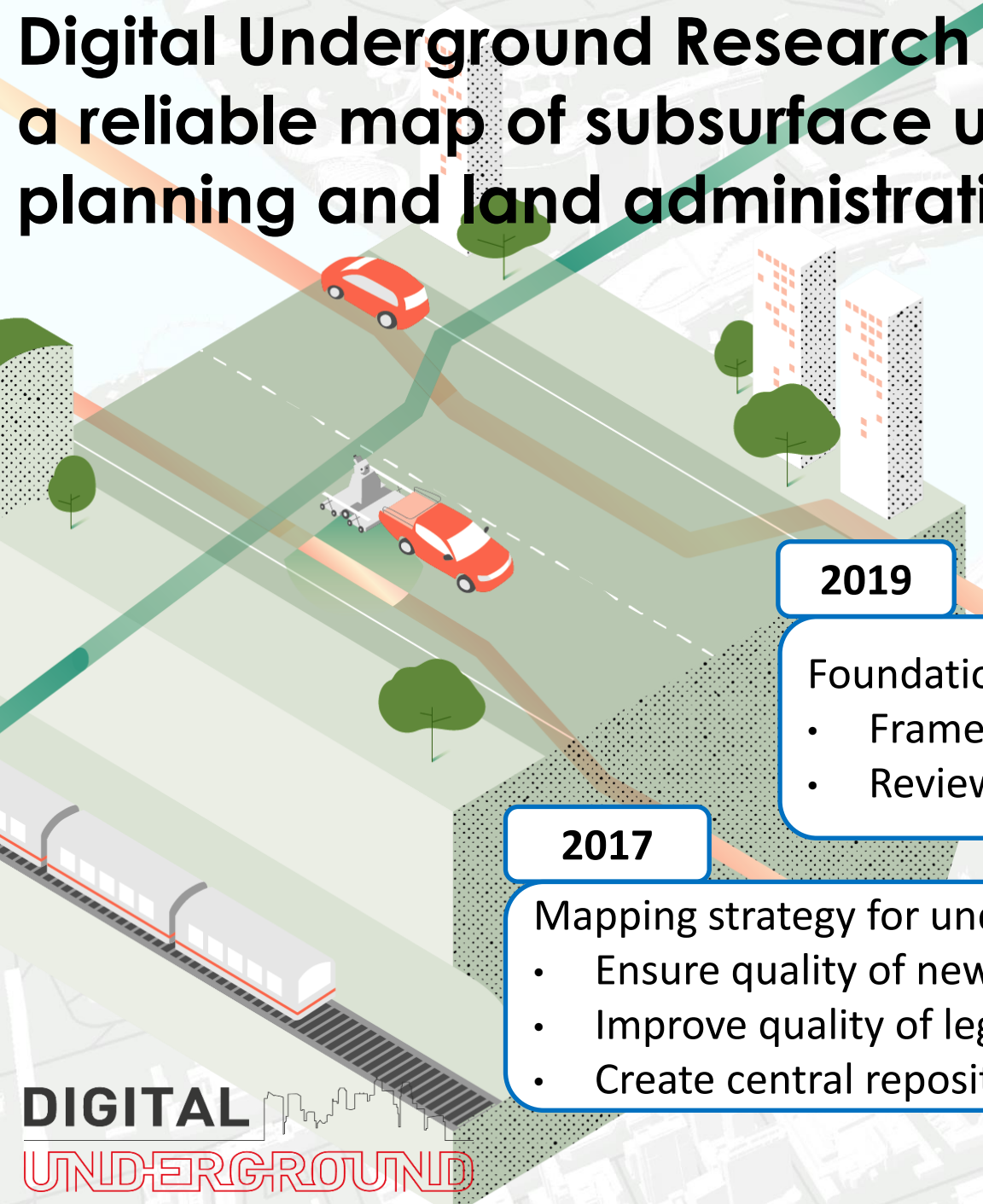


Develop 3D Aerodrome Terrain and
Obstacle map



Support National Parks Board in
tree mapping

Digital Underground Research Project: Towards developing a reliable map of subsurface utilities in Singapore for planning and land administration



2021

Workflows for reliable subsurface utility data quality

- Consolidated data platform
- Data quality management

2019

Foundations of utility mapping

- Framework for data quality governance
- Reviewed Utility Survey Standards

2017

Mapping strategy for underground utilities:

- Ensure quality of new data
- Improve quality of legacy data
- Create central repository of data

Collaborators:

(SEC) SINGAPORE-ETH
CENTRE

4 Key Data Management Strategies to Ensure Reliable GeoInformation

- 1. Single Source Of Truth** - a single reference to ensure consistency throughout entire lifecycle.
- 2. National Data standards** – a common vocabulary/ontology to achieve interoperability
- 3. Open and interchangeable formats** – to allow the use of multiple technologies (vendor-neutral)
- 4. Automated validations** using machine processable formats (e.g. XML) – to reduce human errors and achieve higher data integrity



Thank You

[\(soon_kean_huat@sla.gov.sg\)](mailto:soon_kean_huat@sla.gov.sg)