Underground Geospatial Information Management in Singapore

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Singapore Land Authority

Key Missions

1. To optimise Land Use in Singapore
2. The Trusted Authority for Land and Property Ownership
3. The Geospatial Agency in Singapore

Key Objectives

a. Protect property ownership rights in Singapore
b. Promote use of State land and properties for economic and social objectives
c. Preserve State land and assets for future generations, and to meet Singapore’s needs
d. Advance geospatial information, science and technology to benefit Singapore
SLA co-drives NSDI programme

Singapore Geospatial Collaborative Environment (SG-SPACE)

Government-wide mechanism to make available the interoperable, organised and authoritative geospatial information, science and technology for:

- National-level Decision Making
- Public Security
- Cost-effective Businesses
- Location Awareness among Citizens
Singapore a land-scarce city-state

New York City
Land Size: 784 km\(^2\)
(302.5 sq mi)
Pop. Size: 8.55 million
Pop. Density: 10,831.1/km\(^2\)

1. Land scarcity and high urban density necessitate use of underground space
2. Increasing need to place underground developments in close proximity
Extensive use of underground space locally

**Surface/Basement Levels:**

- 1-3m: Utility lines (water pipes, telecom cables, power lines)
- 5-10m: Common Services Tunnel at Marina Bay
- 12-20m: Basement level space extensively used for retail, car parks and underground pedestrian Links, MRT, Roads/Expressways
- 20-50m: Deep Tunnel Sewerage System
- 60m: Power Transmission Cable Tunnels

**Deep Rock Cavern Level:**

- 130-150m: Hydrocarbon Storage Facility
- Underground Defence Facility
Existing Underground Geospatial Information (UGI) efforts

1. In-house conversion from 2D plans to 3D GIS data
2. 170+ subterranean lots converted island-wide
3. Data to facilitate underground planning

3D Subterranean Boundary Data

Utility Survey Standard

a. To provide guidelines on data capturing to improve data reliability
b. Stipulates data and attributes to be collected
c. Guides surveyors to achieve ±100mm accuracy horizontally and vertically
Amendments to underground space acquisition and ownership

To support long term planning for use and underground space development

State Lands Act

1. Landowners possess 30m of subterranean land below the Singapore Height Datum (SHD)*
2. Land deeper than 30m SHD belong to the State

Land Acquisition Act

3. Government can acquire a specific stratum of underground or air space instead of the entire column of land, when developing public projects

* Fixed datum surface set at 0.000 metres of Singapore’s historical mean sea level
Underground Master Plan in the works

To ensure systematic planning and space optimisation for underground space

1. Focuses on specific areas suitable for underground developments

2. Complements Singapore Master Plan and integration with surrounding uses

Quality 3D UGI required
### UGI challenges encountered

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<tr>
<td>UGI ownership not clearly defined</td>
<td>Existing UGI:</td>
<td>No systematic sharing and some legal and confidentiality</td>
<td>No common UGI standards</td>
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<td></td>
<td>1. Incomplete/hard to retrieve</td>
<td>concerns</td>
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<td>2. Unreliable or inaccurate</td>
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<td>3. Not georeferenced</td>
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<td>4. Not digitised</td>
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<td>Yet to identify government-wide platform to support UGI use and sharing</td>
<td>Cost-effective and sustainable methods for UGI collection and management</td>
<td>Funding required by UGI owners in collection and management</td>
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Government-wide work group to holistically address UGI challenges

Underground Geospatial Information Management Work Group (UGIM WG)

Role

To coordinate government-wide effort to plan, formulate and implement a holistic strategy and approach for UGI

Composition

Public agencies from 5 domains:

1. Urban Planning
2. Utility (Energy/Water/Telcom)
3. Transport & Mobility
4. Buildings & Structures
5. Technology
UGIM WG approach & current efforts

1. Establish Data Governance
2. Establish UGI Standards
3. Unlock UGI Sharing
4. Consolidate UGI & Identify Common Data Platform
5. Integrate Above & Underground Geospatial Information Management
6. Address Funding Concerns for UGI Collection & Management

Current efforts:
- Established commitment and timeframe for UGI sharing in support of underground master plan
- Government-wide workshop to identify planned/potential underground developments and UGI needs
Key challenges remain to be addressed

1. Need to identify fundamental UGI datasets
   - Provides spatial reference for other UGI

2. UGI data models, standards & attributes to be aligned
   - Ensure UGI usefulness and interoperability

3. Cost implication in implementing new UGI-related requirements
   - Especially for utility agencies

(Illustrations courtesy of Dynamic Graphics, Mike Annear, Murphy Surveys and ScanLAB Projects respectively)
Collaboration will be fundamental to address UGI issues

1. OGC UI Study a useful platform to tackle UGI challenges

2. Holistic framework and collaborative approach crucial to achieve common utility standard and ensure data interoperability
Thank You