SINGAPORE LAND AUTHORITY

(SEC) SINGAPORE-ETH CENTRE

Digital Underground

Towards a reliable underground utility map in Singapore

地下數碼化：建立新加坡可靠地下管線地圖

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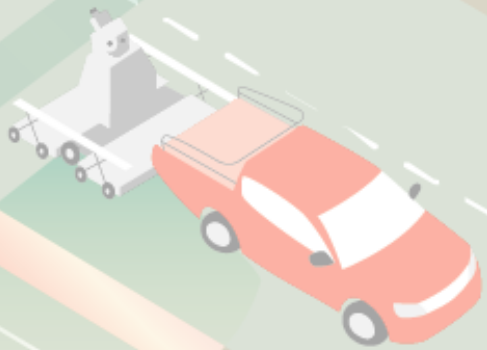
DIGITAL UNDERGROUND



ABOUT SLA

Singapore Land Authority (SLA) is a statutory board under the Ministry of Law. It is formed in 1 June 2001 from the merger of 4 different entities. We act as the main custodian's of Singapore's Land Assets to support the economic and social development of Singapore.

Survey Department

Singapore Land Registry

Land Office

Land Systems Support Unit

OUR VISION

Limited Land . Unlimited Space

Optimise land and space utilisation

Be a trusted source of land-related information

Drive a Geo-enabled Singapore

SG Digital Twin - Motivation

Cities of Tomorrow will be powered by Digital Twin

Sustainable
- Urban Planning
- Green Energy
- Urban Heat
- Natural Capital
- ….

Resilient
- Climate Change
- Sea Water Rise
- Change Detection
- Subsurface Infrastructure
- …..

Smart
- Digital Construction
- Autonomous Mobility
- Intelligent Transportation System (ITS)
- 5G Deployment
- ……

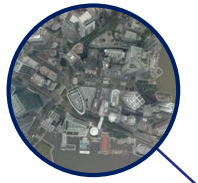
Source: Poland Today

SG Digital Twin – Geodata Framework

14 Core Datasets

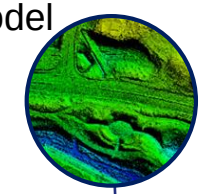
6 Key Add-on Datasets

Orthophoto



3D Coastline

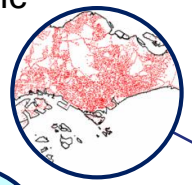
Digital Terrain Model



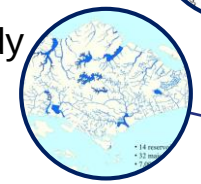
Point Cloud

3D Reality Mesh

Geodetic Control

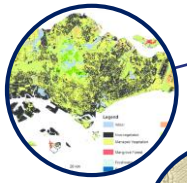


Waterbody

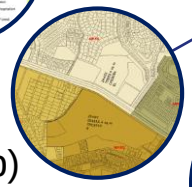


Administrative Boundaries

Land Cover/ Land Use



Cadastre (Ownership)

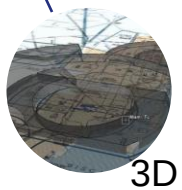


3D Building Models (LoD1 and LoD2)

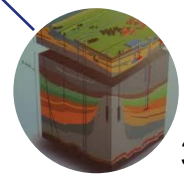
3D Road

Vegetation / Tree

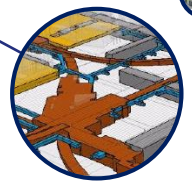
3D Airspace



3D Geology



3D Underground Asset



BIM (Design Model)

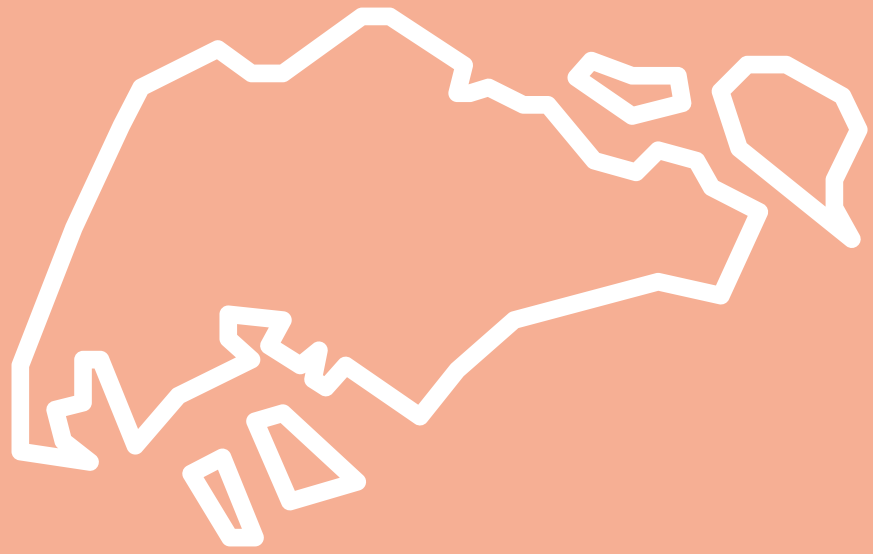
3D Address / 3D Unit

Positioning Infrastructure

Imagery (Satellites, Oblique etc)

Digital Twin Going Underground

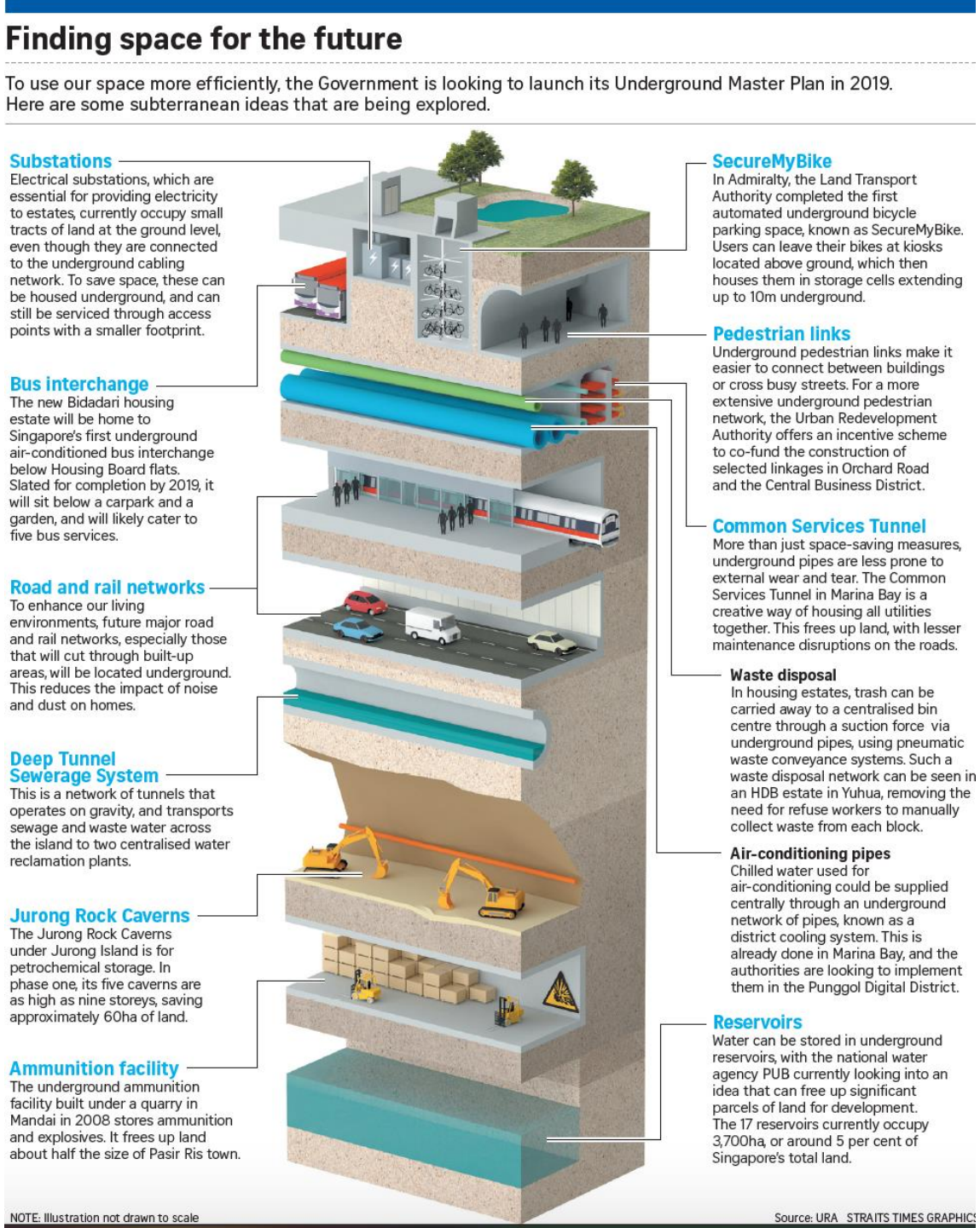
The need for a reliable map of subsurface utilities in Singapore



Going underground demands quality data

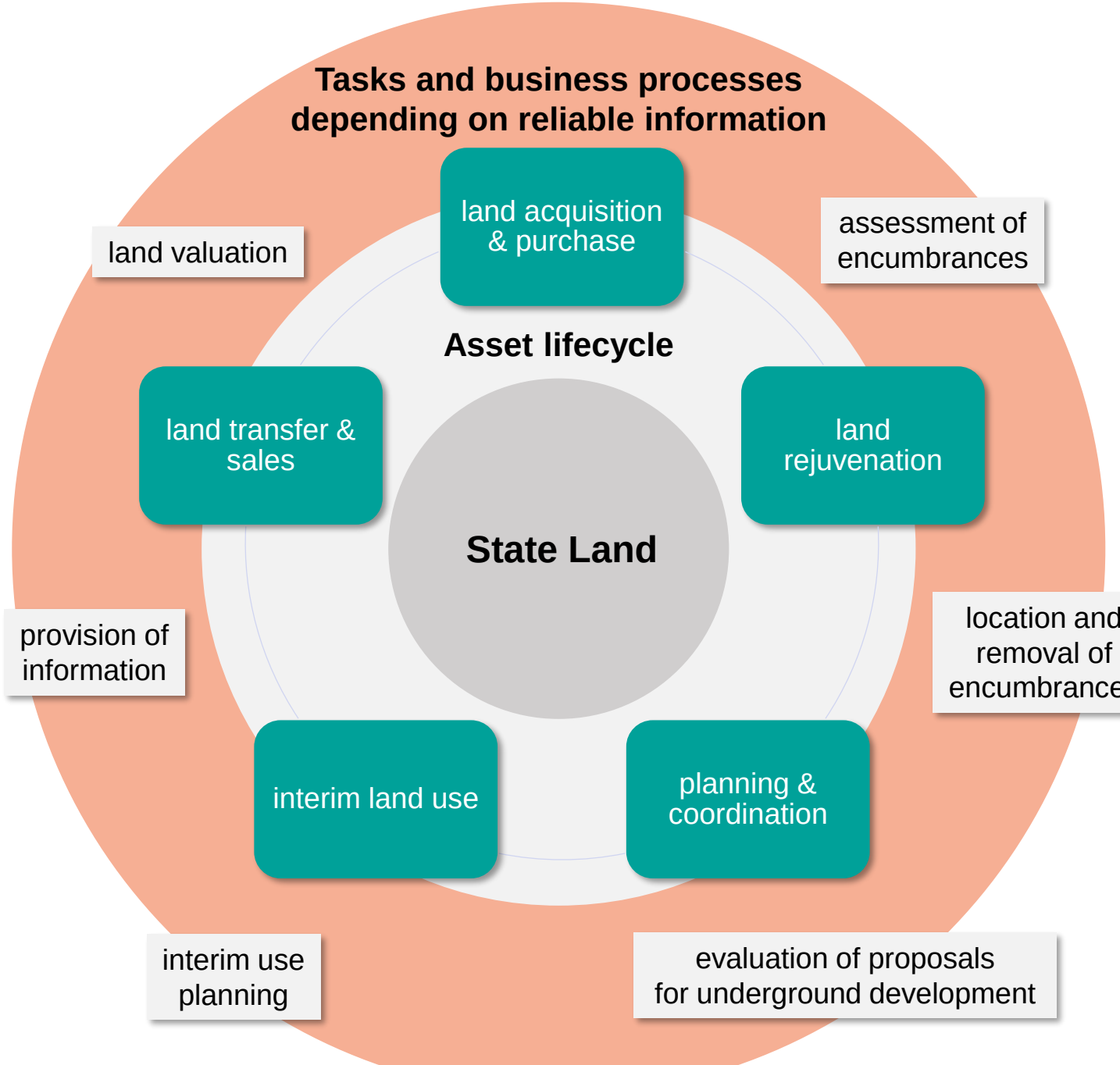
- Mindset shift: From land to space
- Systematic and continuous management of underground space as asset is required
- Planning and land administration need to integrate space above and below the surface

Reliable 3D data on what lies beneath is essential

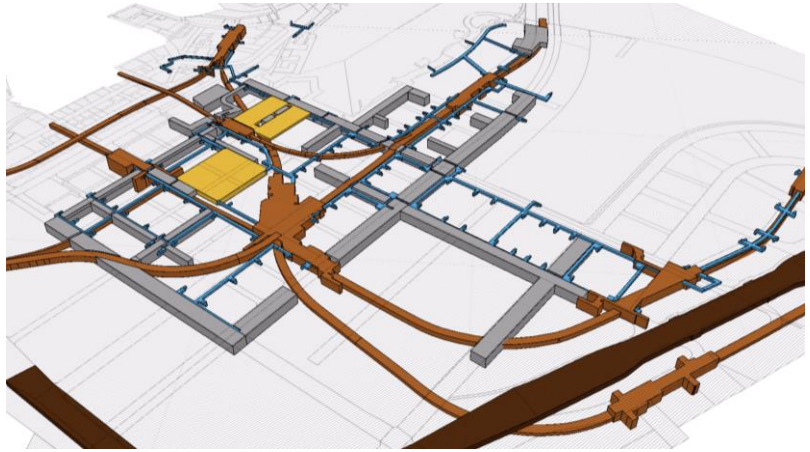


Underground space

- Underground space is a valuable asset
- Planning and use of underground space is often uncoordinated and chaotic
- Systematic, continuous management is required
- Good information is essential



Reliable information on underground utilities will lead to better decisions and save resources



Planning and land administration

Better planning outcomes; land use optimisation

Infrastructure development

Elimation of uncertainty and risks during planning and design

Construction and engineering works

Minimisation of disruptions to environment and services; increased safety

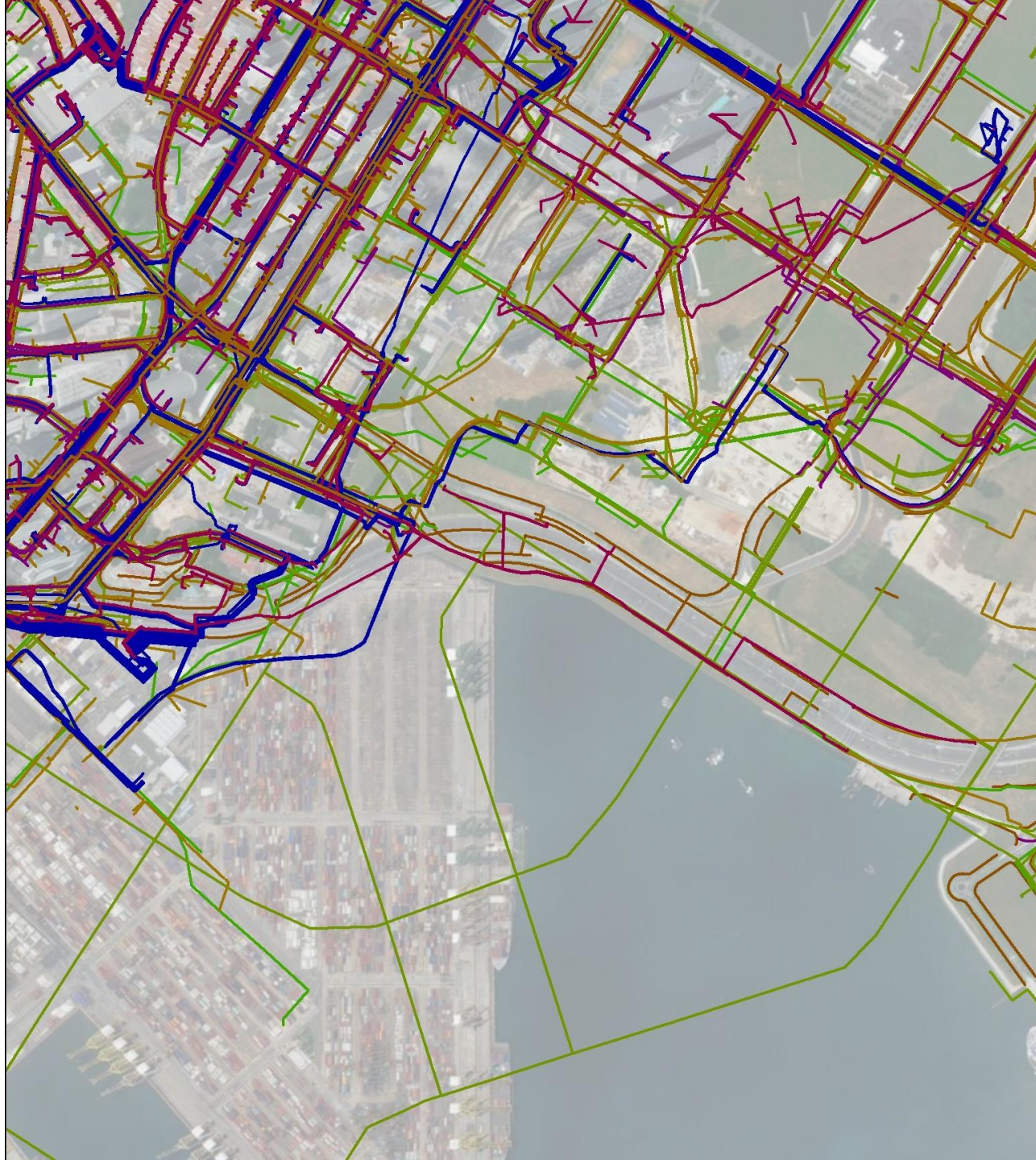
How reliable is the available data?

Data quality is insufficient

Data is often locationally inaccurate, not up to date, and incomplete.

Data quality is undefined

Data quality is a largely unknown and technique of measure is undefined



Repeated pains felt due to unreliable data

- Sub-optimal use of underground space; loss of opportunity
- Long and costly planning, design, and development of infrastructure
- Nuisances, incidents, and disruptions

THE STRAITS TIMES

Cut cables disrupt fibre broadband in eastern Singapore

Feng Ming Construction fined for damaging water main, which disrupted supply to nearly 40 homes in Bukit Timah area

Construction work ruptures gas pipe near Lau Pa Sat

By ROBIN CHOO

Digital Underground Initiative

DIGITAL UNDERGROUND

The Digital Underground project

Objective

Towards developing a reliable map of subsurface utilities in Singapore for planning and land administration

	Project period
Phase 1	Jan 2018 - Jun 2019
Phase 2	Jul 2019 - Jun 2021

**co-funded by SLA and Underground Studies Project Fund*

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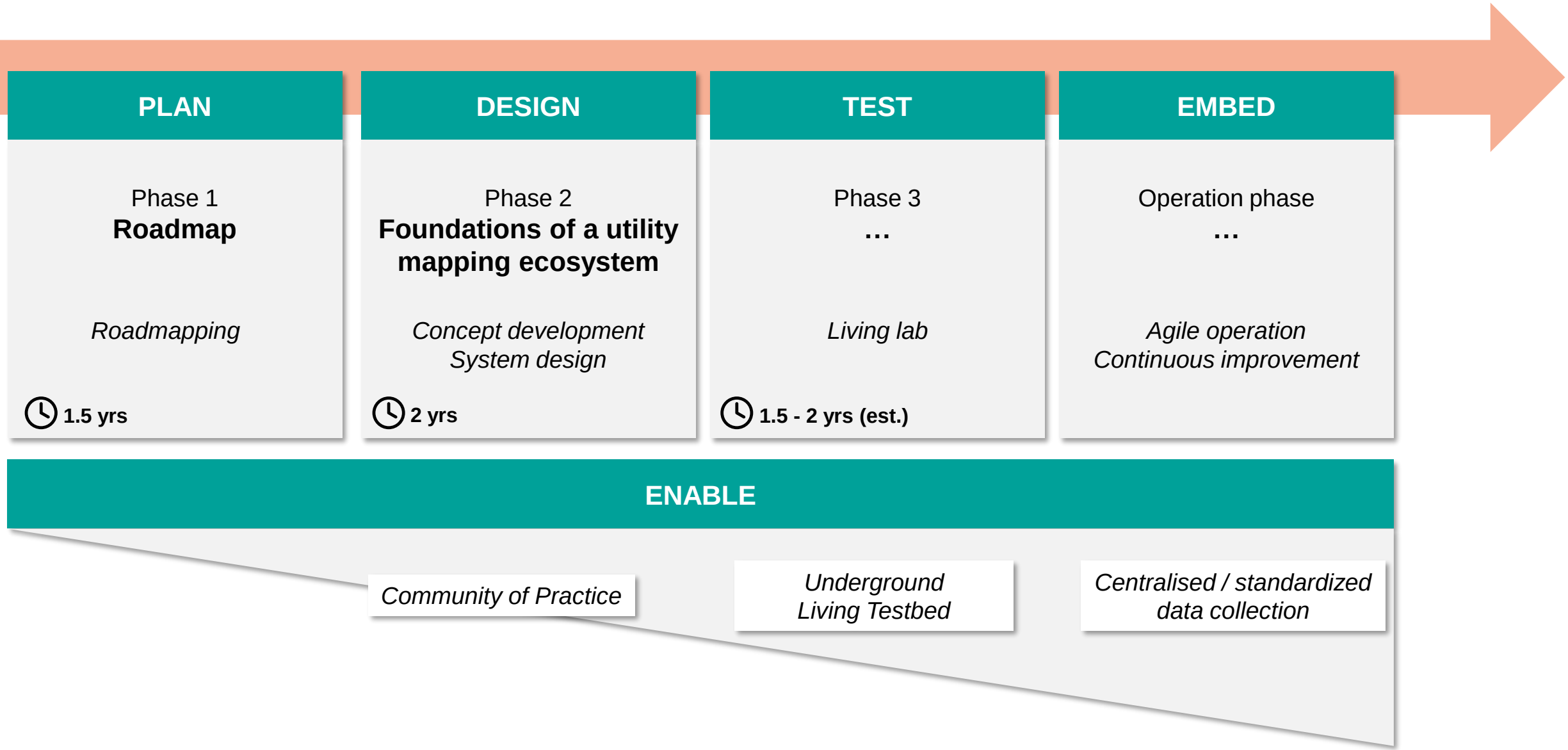
SLA SINGAPORE LAND AUTHORITY

Long-term vision



Phase 1: Roadmap
(2017-2019)

Stakeholder engagement and roadmapping

Looking overseas

Exploration of mapping techniques

CASE STUDY: LARGE AREA MAPPING

Objectives

Assess the practical feasibility of operating a 3D GPR mobile mapping platform on the streets of Singapore

Assess the feasibility and viability of large volume, large area data subsurface capture to improve the quality of data on existing utilities.

Data capture technology: Leica Pegasus:Stream

38 antennae, 6cm spacing

Two polarisations

200Mhz and 600Mhz

Integrated above and below surface data capture

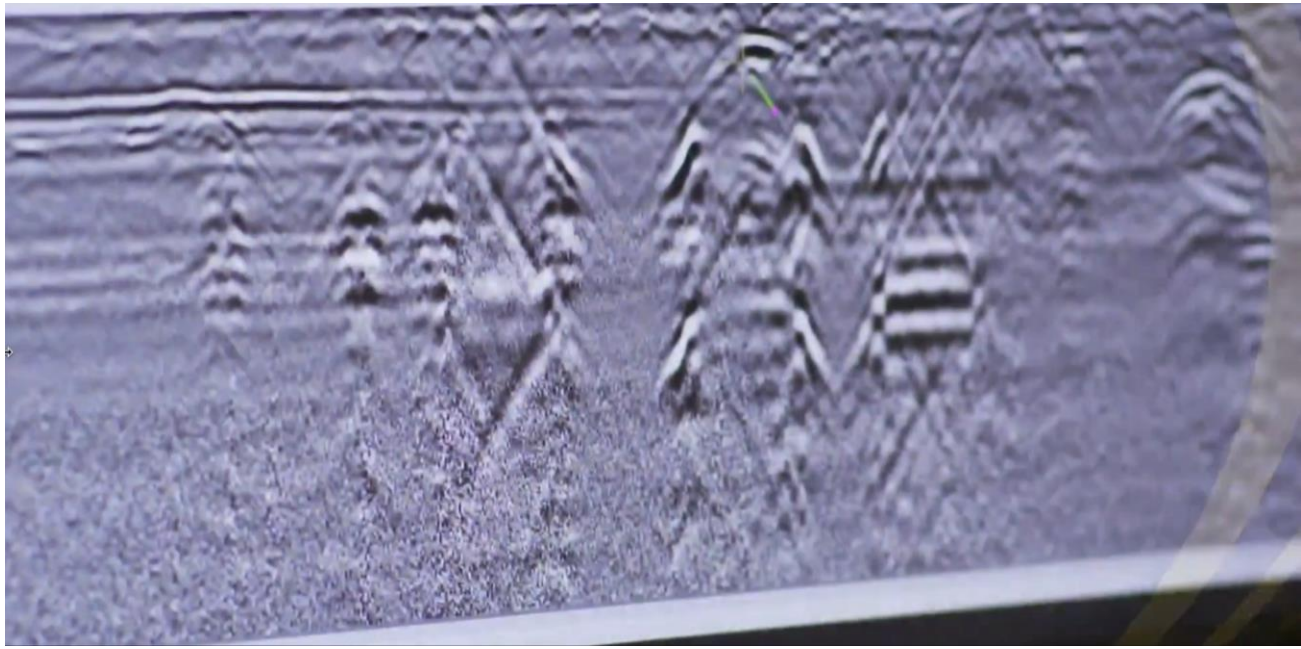
Approach

Data capture in nine distinct locations

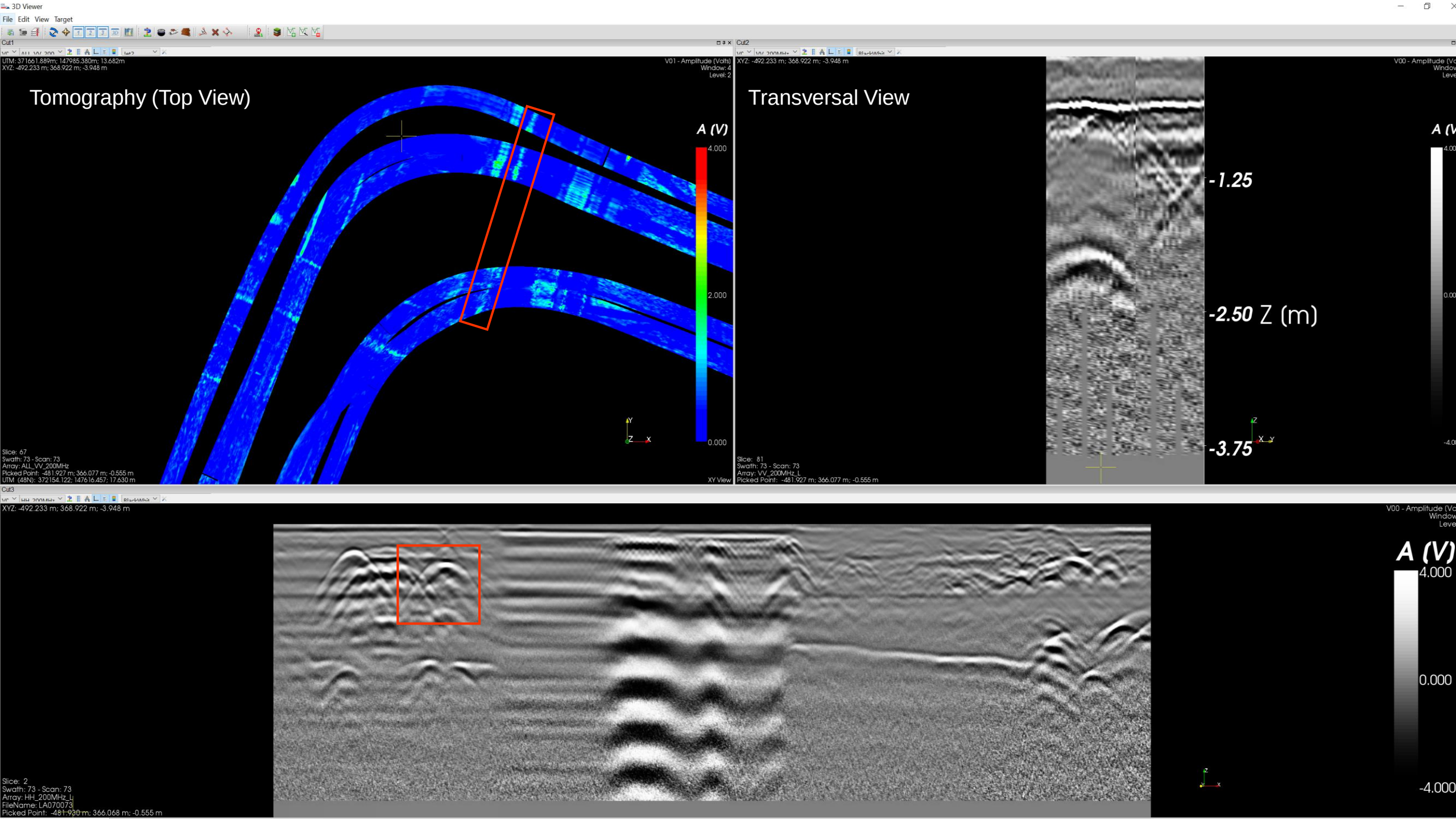
Post-processing and extraction of detected utilities

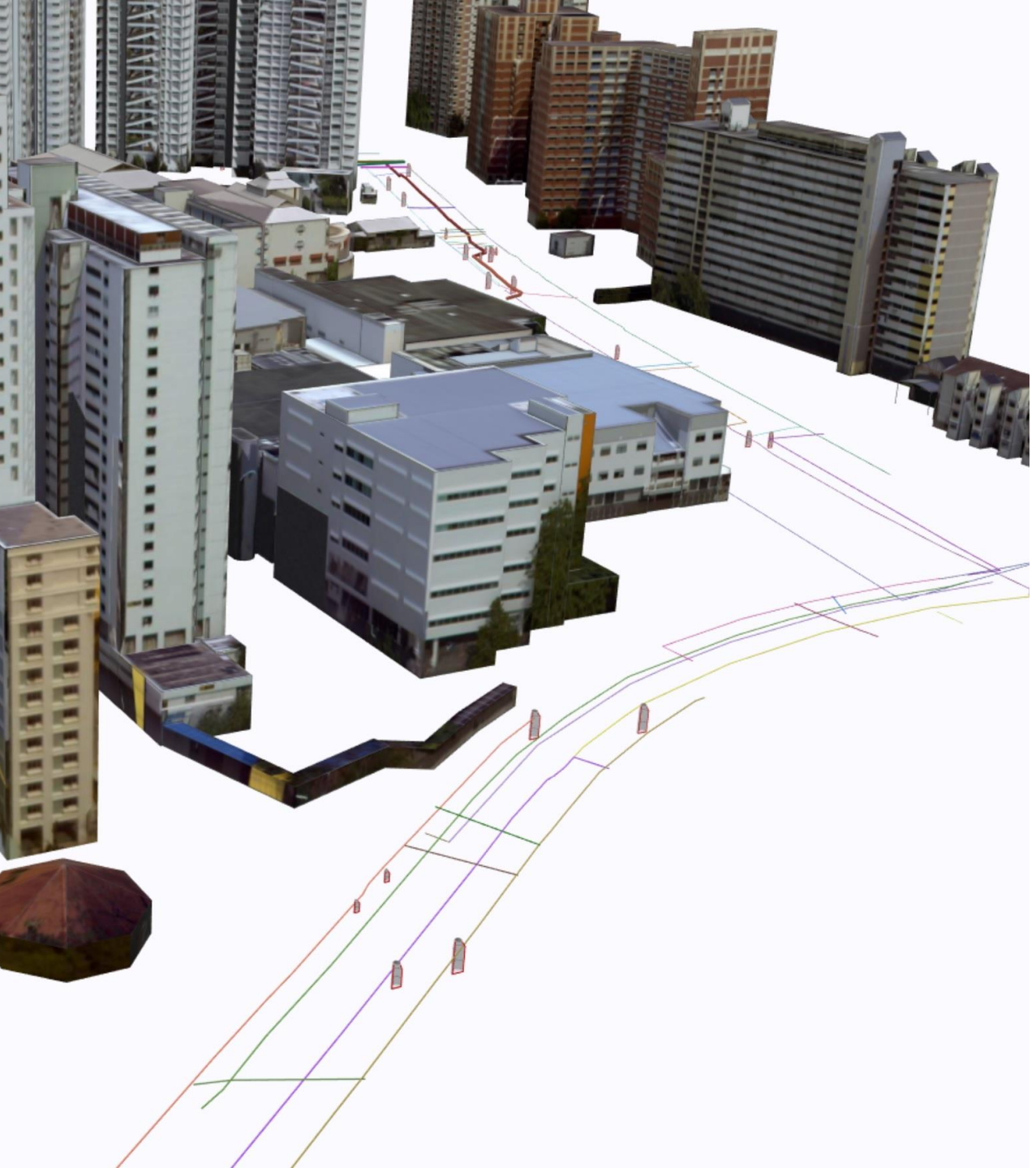
Evaluation of practical operation and effort spent

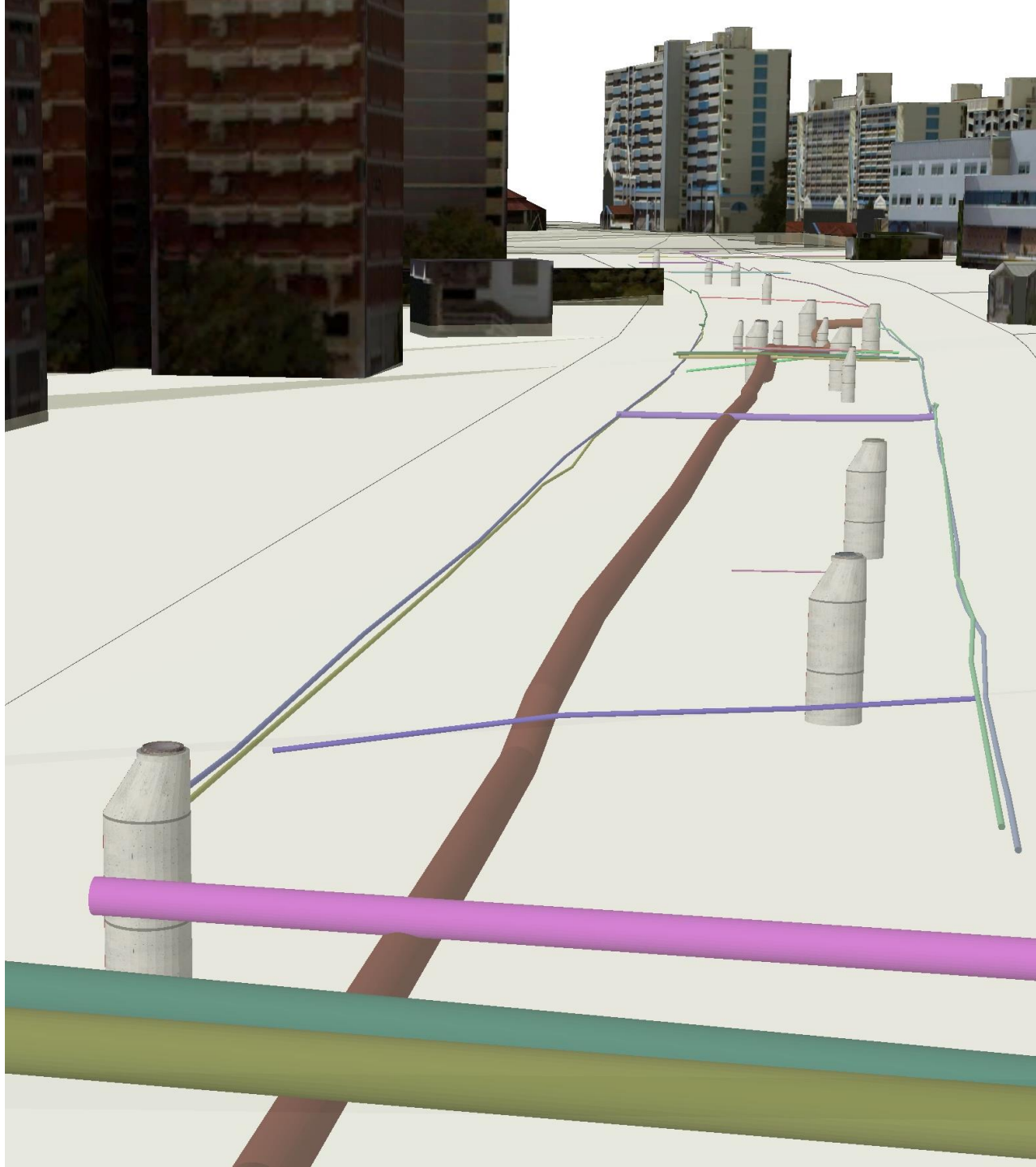
Visual comparison with existing map data based on overlap, proximity, and similarity




Leica

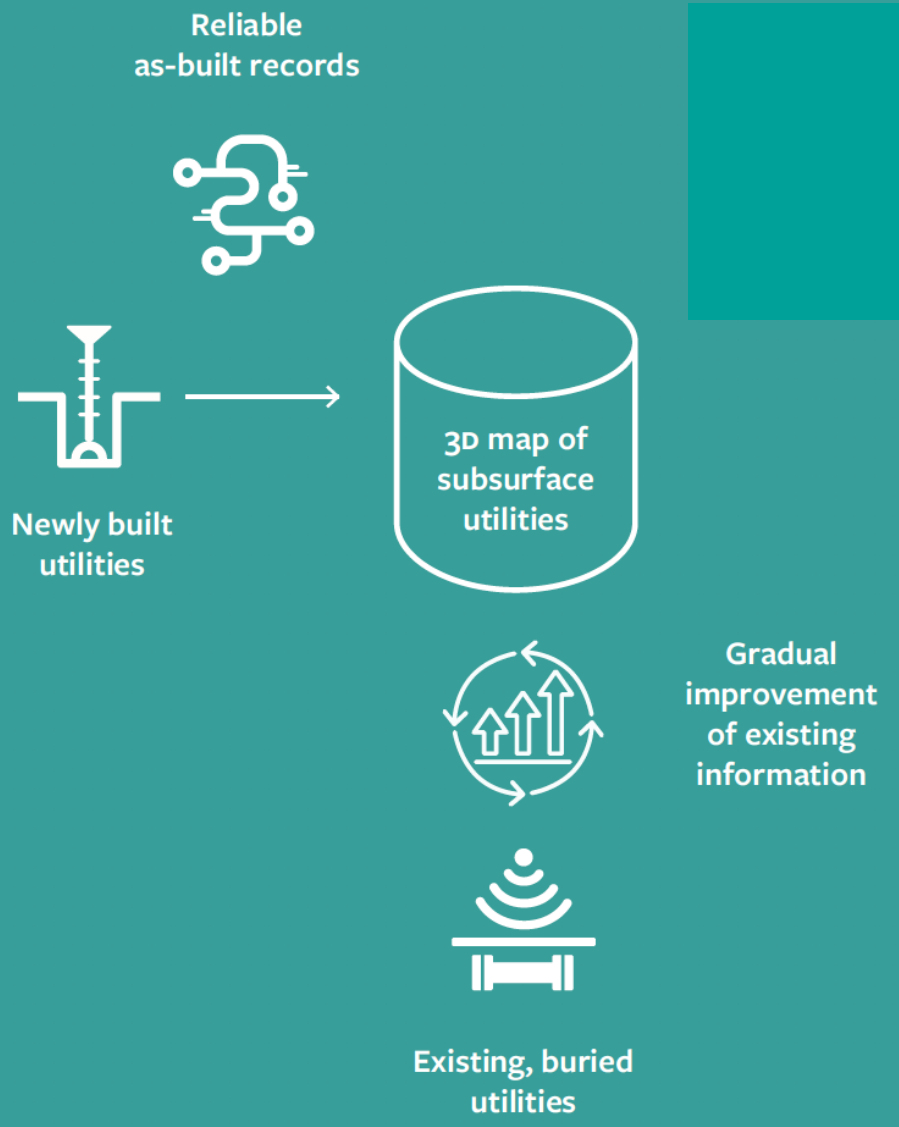

3D Viewer
File Edit View Target
Cut1
Tomography (Top View)
A (V)
4.000
2.000
0.000
Cut2
Transversal View
-1.25
-2.50 Z (m)
-3.75
Cut3
Slice: 2
Swath: 73 - Scan: 73
Array: HH_200MHz_L
FileName: LA070073
A (V)
4.000
0.000
-4.000

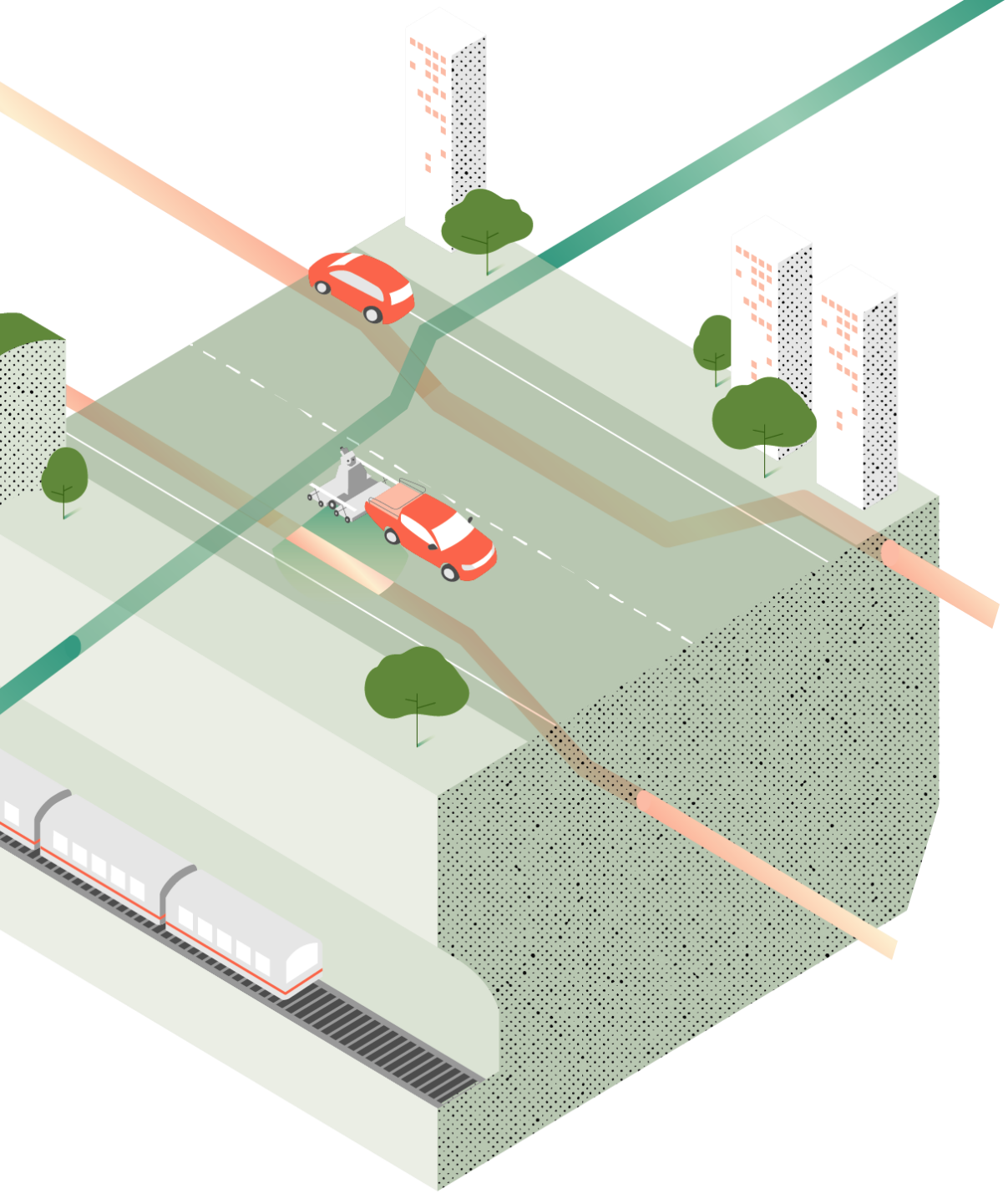




A national mapping strategy for subsurface utilities

- Ensure reliable as-built records for newly built utilities
- Capitalize on opportunities (e.g. capital underground infrastructure projects, trial trenches) to reconcile quality of legacy information
- Strong quality controls at the front-end of the information supply chain
- A central repository to assess and understand information quality patterns, issues, and potential interventions





Roadmap

Integrated approach towards a thriving utility mapping ecosystem

Coordination
Coordination of a national mapping strategy

Consolidation
Consolidation of subsurface utility information in a national map

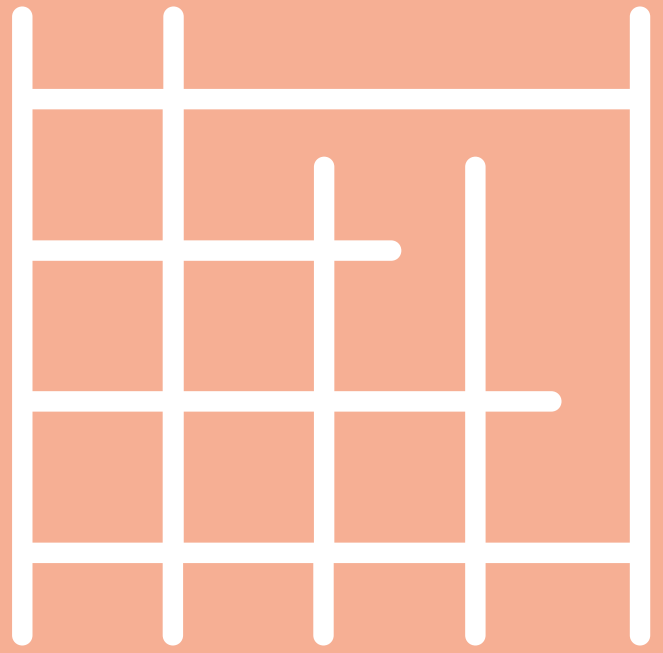
Capture
Reliable data capture for newly built and existing utilities

Capacity
Develop the required capacity

Community
Engage a community of practice from industry, government, and academia

Phase 2: Foundations of an ecosystem

(2019 - 2021)



Phase 2 work package structure

WP1 GOVERNANCE

Development of a framework for the governance of data quality

WP2 DATA COLLECTION AND MANAGEMENT PLATFORM

Development of a proof of concept database and data management infrastructure

WP3 DATA CAPTURE

Development of a proposal for improved and extended survey standards

WP4 CAPACITY DEVELOPMENT

Development of proposals for capacity development instruments (training and certification framework, testbed for research and training, Community of Practice)

WP1 Governance

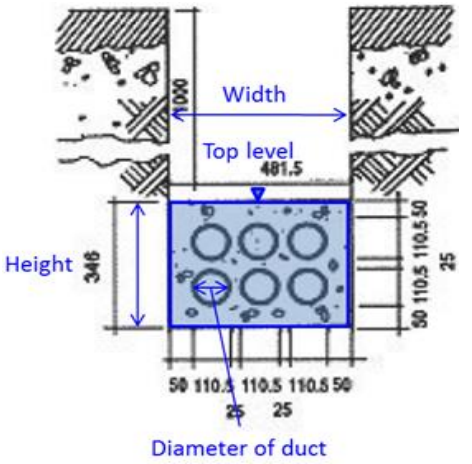
Our Approach

Whole ecosystem engagement of asset owners, contractors, and surveyors to understand current practices and challenges

Desktop study on overseas data quality governance and data availability governance

Conduct learning visits to selected overseas jurisdictions i.e. Japan, Malaysia

Best practices & guidelines



Preliminary outlines of governance framework

Data capture responsibility

Accountability of Registered Surveyors for data quality, supported by technological innovation and smart capacity increase

Data quality improvement responsibility

Key role for asset owners, questions to be resolved about (technical) feasibility

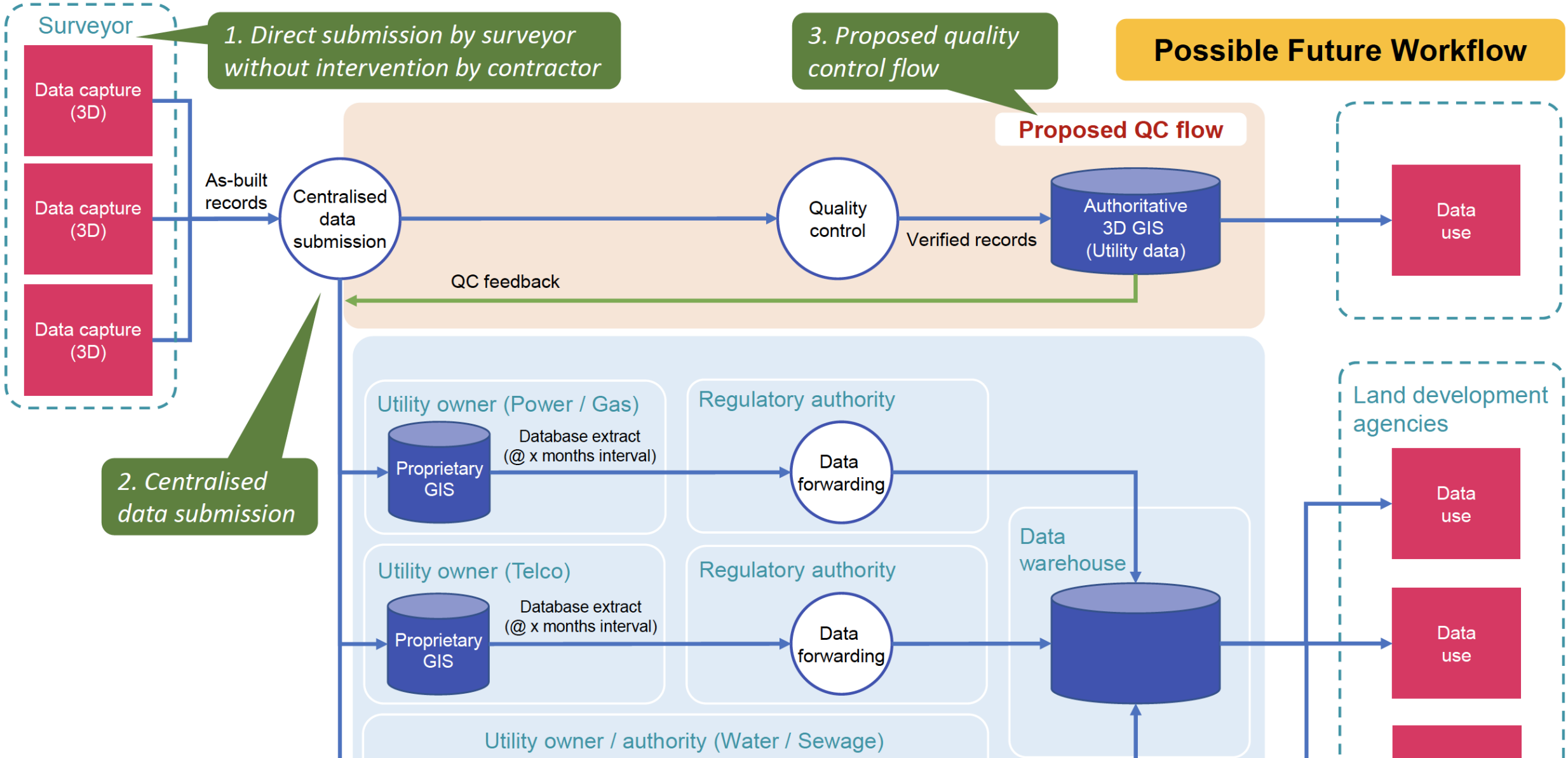
Data quality management responsibility

- Whole-of-government task force to oversee data quality governance and guide evidence-driven quality improvement efforts
- Dedicated and central capacity + infrastructure to collect and consolidate data and regulate data quality

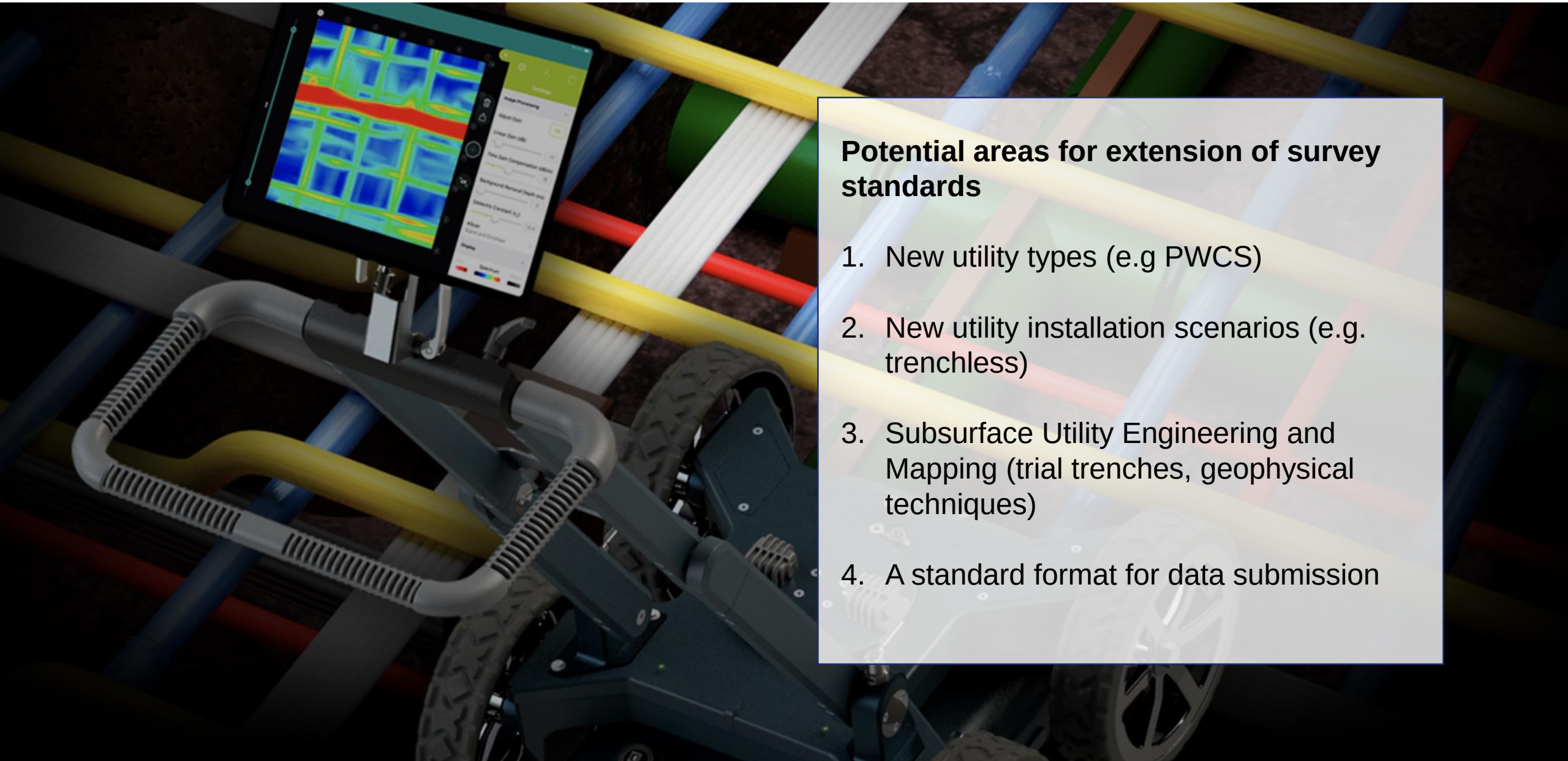
SLA’s role

- Regulation of surveyors and data capture
- Critical value-add to whole-of-government effort through geomatics engineering expertise

WP2 Data Collection and Management Platform



WP3 Data capture



Potential areas for extension of survey standards

1. New utility types (e.g PWCS)
2. New utility installation scenarios (e.g. trenchless)
3. Subsurface Utility Engineering and Mapping (trial trenches, geophysical techniques)
4. A standard format for data submission

Exploring new workflows for newly built utilities and trial trenches

HSC Pipeline Engineering Pte Ltd
Subsidiary of Pipeline Engineering Holdings Limited (HKSE Stock Code: 1865)

JTRS REGISTERED SURVEYOR

AVUS

Measurable and traceable

Usable from a distance

A thriving community of practice as key enabler

www.duconnect.org

DIGITAL UNDERGROUND CONNECT

Meet. Learn. Improve.

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Bentley Institute Digital Advancement Academies

Singapore Institute of Surveyors and Valuers

DIGITAL UNDERGROUND

With gratitude to our partners:

SLA Singapore Land Authority

Leica Geosystems

Stadt Zürich

Bentley Institute
Digital Advancement Academies

Between the Poles
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