

DIGITAL
UNDERGROUND



United Nations
World Geospatial
Information Congress
联合国世界地理信息大会

A Reliable 3D Map of Underground Utilities for Planning and Land Administration

UNWGIC 2018

Spatially Enabled Future Cities

21 November 2018

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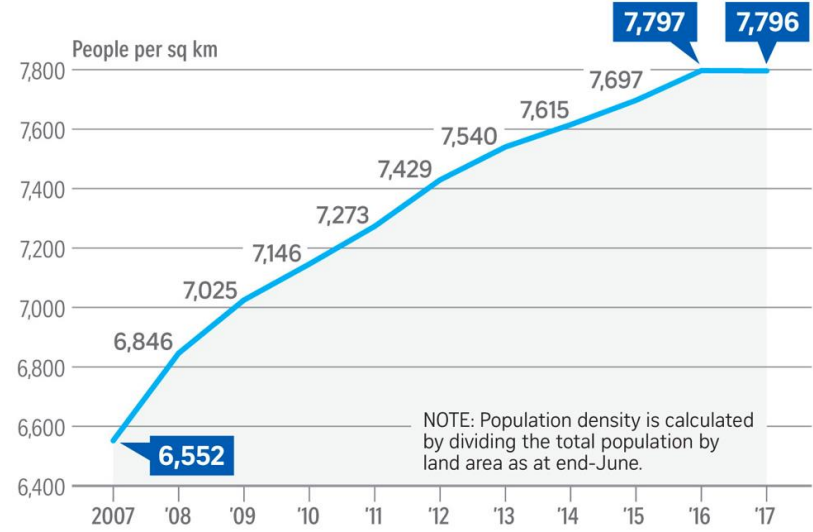
(SEC) SINGAPORE-ETH CENTRE 新加坡-ETH 研究中心



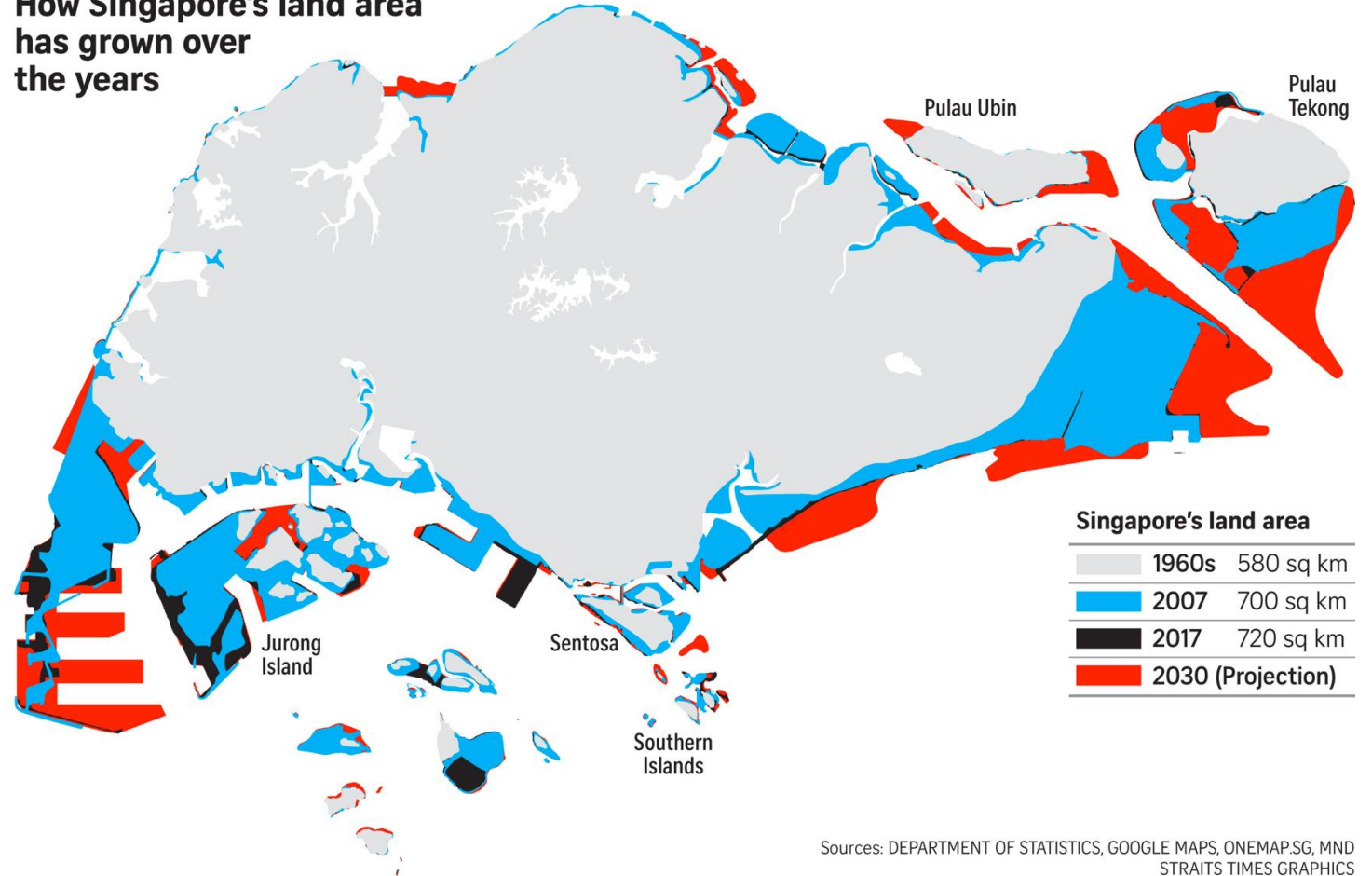


FINDING SPACE FOR THE FUTURE

Population density over a decade



How Singapore's land area has grown over the years



Sources: DEPARTMENT OF STATISTICS, GOOGLE MAPS, ONEMAP.SG, MND STRAITS TIMES GRAPHICS

Finding space for the future

To use our space more efficiently, the Government is looking to launch its Underground Master Plan in 2019. Here are some subterranean ideas that are being explored.

Substations

Electrical substations, which are essential for providing electricity to estates, currently occupy small tracts of land at the ground level, even though they are connected to the underground cabling network. To save space, these can be housed underground, and can still be serviced through access points with a smaller footprint.

Bus interchange

The new Bidadari housing estate will be home to Singapore's first underground air-conditioned bus interchange below Housing Board flats. Slated for completion by 2019, it will sit below a carpark and a garden, and will likely cater to five bus services.

Road and rail networks

To enhance our living environments, future major road and rail networks, especially those that will cut through built-up areas, will be located underground. This reduces the impact of noise and dust on homes.

Deep Tunnel Sewerage System

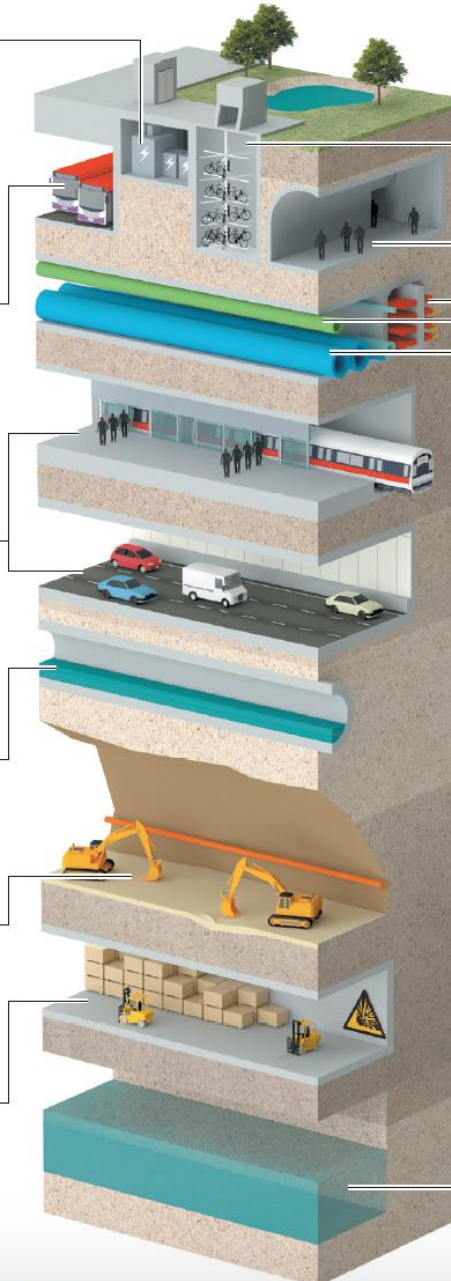
This is a network of tunnels that operates on gravity, and transports sewage and waste water across the island to two centralised water reclamation plants.

Jurong Rock Caverns

The Jurong Rock Caverns under Jurong Island is for petrochemical storage. In phase one, its five caverns are as high as nine storeys, saving approximately 60ha of land.

Ammunition facility

The underground ammunition facility built under a quarry in Mandai in 2008 stores ammunition and explosives. It frees up land about half the size of Pasir Ris town.



SecureMyBike

In Admiralty, the Land Transport Authority completed the first automated underground bicycle parking space, known as SecureMyBike. Users can leave their bikes at kiosks located above ground, which then houses them in storage cells extending up to 10m underground.

Pedestrian links

Underground pedestrian links make it easier to connect between buildings or cross busy streets. For a more extensive underground pedestrian network, the Urban Redevelopment Authority offers an incentive scheme to co-fund the construction of selected linkages in Orchard Road and the Central Business District.

Common Services Tunnel

More than just space-saving measures, underground pipes are less prone to external wear and tear. The Common Services Tunnel in Marina Bay is a creative way of housing all utilities together. This frees up land, with lesser maintenance disruptions on the roads.

Waste disposal

In housing estates, trash can be carried away to a centralised bin centre through a suction force via underground pipes, using pneumatic waste conveyance systems. Such a waste disposal network can be seen in an HDB estate in Yuhua, removing the need for refuse workers to manually collect waste from each block.

Air-conditioning pipes

Chilled water used for air-conditioning could be supplied centrally through an underground network of pipes, known as a district cooling system. This is already done in Marina Bay, and the authorities are looking to implement them in the Punggol Digital District.

Reservoirs

Water can be stored in underground reservoirs, with the national water agency PUB currently looking into an idea that can free up significant parcels of land for development. The 17 reservoirs currently occupy 3,700ha, or around 5 per cent of Singapore's total land.



MRT

Underground access to Downtown MRT Station

Straits View



MRT

Towards Marina Bay MRT Station



MRT

Underground access to future Shenton Way MRT Station

Park Street





Masterplan of Singapore's underground spaces ready by 2019

Ms Hwang said the URA is working towards having a more complete 3D map of the underground spaces and infrastructure here.

National Development Minister Lawrence Wong told The Straits Times that the Government has to take stock of what is underground, including pipes and power grids.

"We have to take stock and have a good database of information, and are compiling it as a central repository so we have a good basis plan," he said.

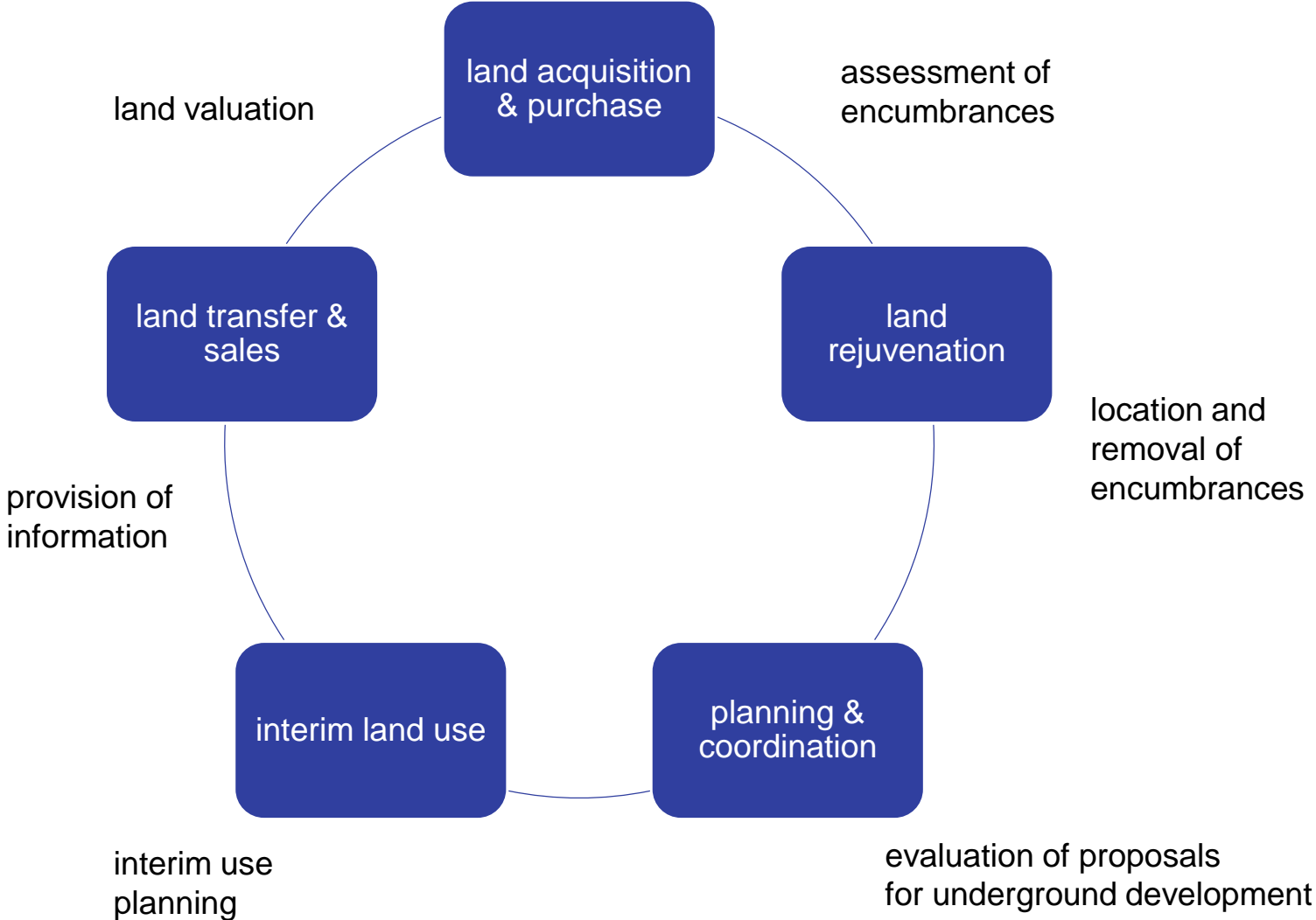


Proposed law will allow Govt to acquire specific stratum of underground space

By YVONNE LIM



THE UNDERGROUND IN THE STATE LAND DEVELOPMENT LIFE CYCLE



INFRASTRUCTURE RESILIENCE AND SAFETY

Construction work ruptures gas pipe near Lau Pa Sat

By ROBIN CHOO



Boon Tat Street was cordoned off because of the gas leak, but gas supply to the area was not affected. Photo: Robin Choo

source: Today Online, <https://www.todayonline.com/singapore/construction-work-ruptures-gas-pipe-near-lau-pa-sat>

THE STRAITS TIMES



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Cut cables disrupt fibre broadband in eastern Singapore

🕒 PUBLISHED NOV 15, 2018, 5:00 AM SGT | UPDATED NOV 15, 2018, 11:12 AM



Jan Lee ✉

Fibre broadband was disrupted in the eastern part of Singapore yesterday, affecting about 10,000 customers and some might get their services back only today.

source: <https://www.straitstimes.com/singapore/cut-cables-disrupt-fibre-broadband-in-eastern-spore>

LTA double road works fees to encourage efficiency

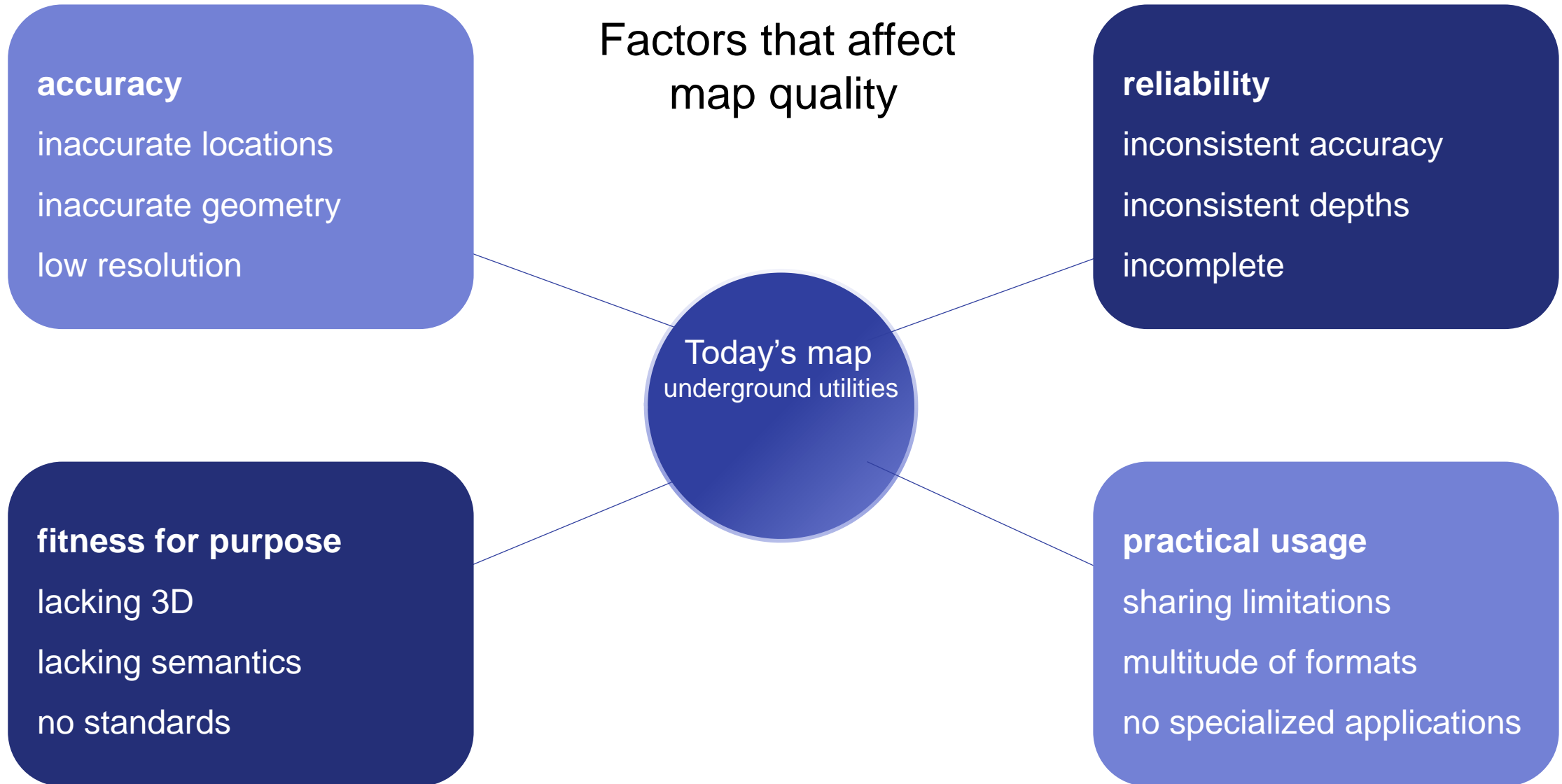
March 31, 2017

source: <http://statestimesreview.com/2017/03/31/land-transport-authority-to-double-road-works-fees/>

The smart, resilient, and sustainable future city efficiently and effectively **plans, manages and optimizes land use** above and **below** the surface, and is **resilient** and **safe**.

A good **spatial** understanding of the **underground** is a key enabler for that future city.

WHAT IS THE CURRENT SPATIAL UNDERSTANDING OF UNDERGROUND UTILITIES?





The Digital Underground project

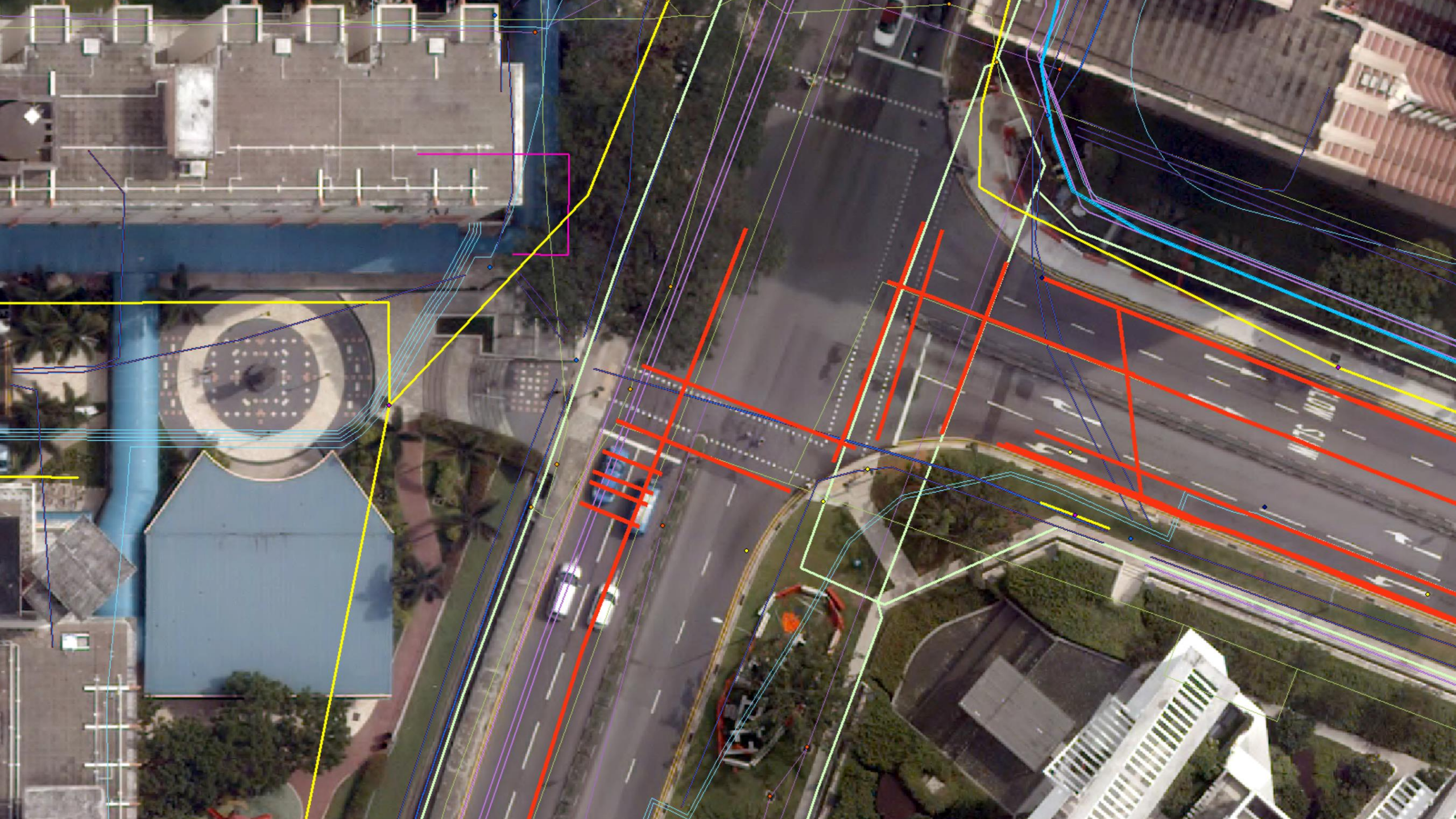
Development of a roadmap towards a reliable 3D map of underground utilities

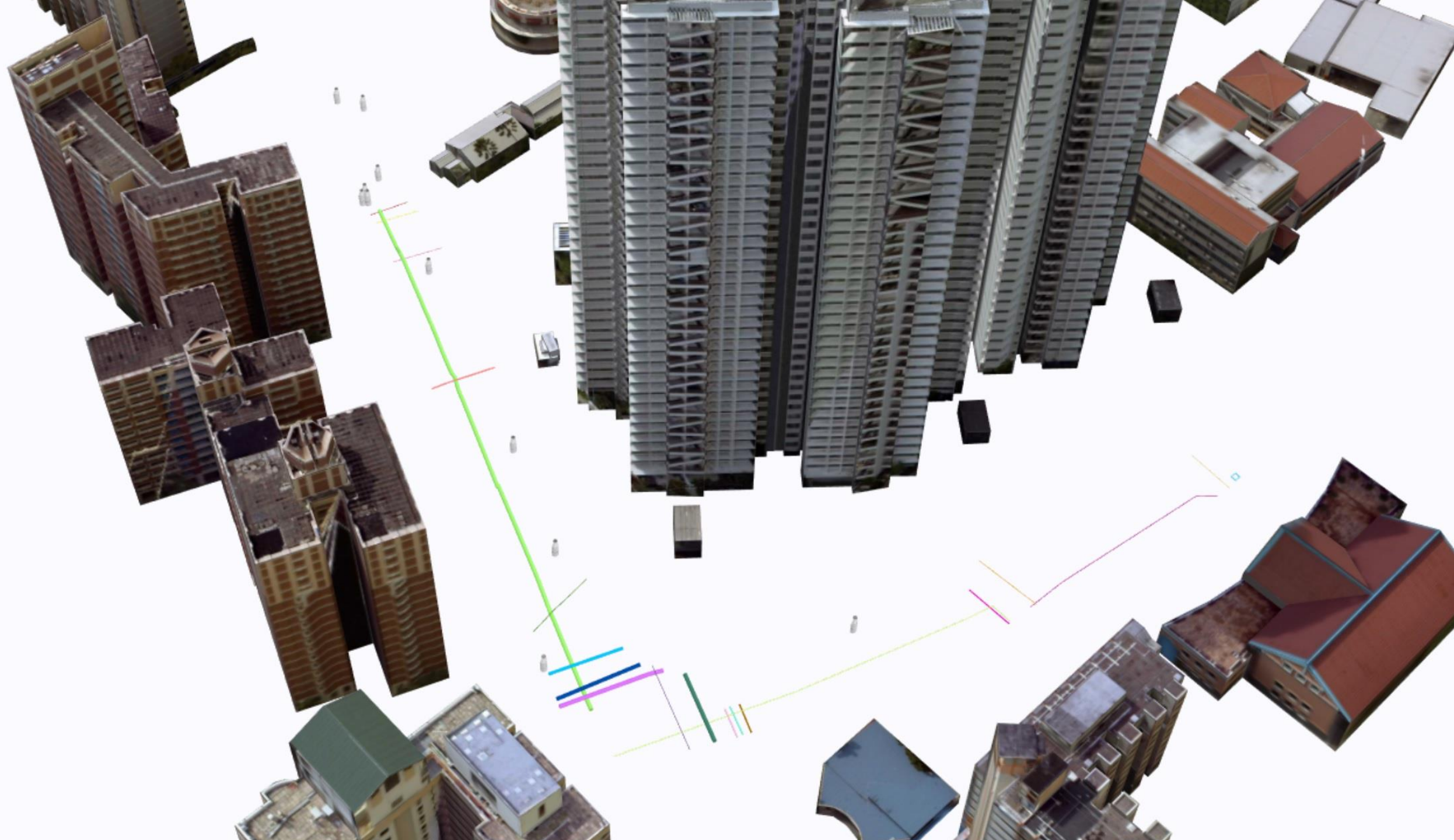


U: 370001.101m; 159791.085m; 14.972m
XYZ: -222.089 m; -29.662 m; -0.358 m

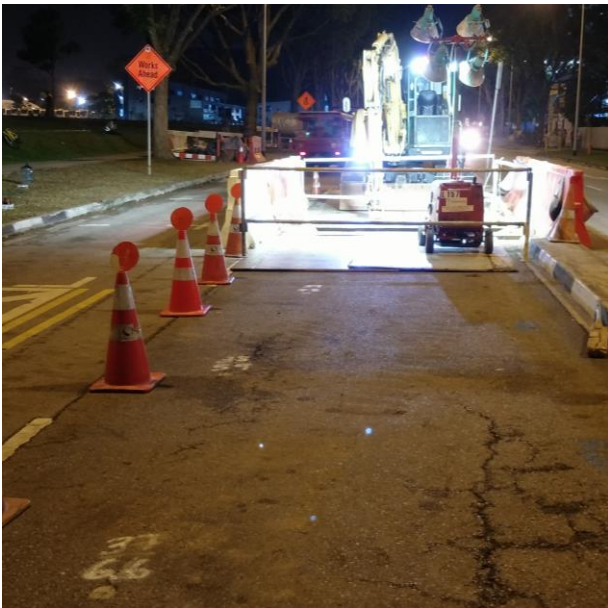
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Swath: 14 - Scan: 14
Array: ALL
Picked Point: -217.525 m; -37.057 m; -0.166 m
UTM (48N): 370283.190; 159820.747; 15.330 m





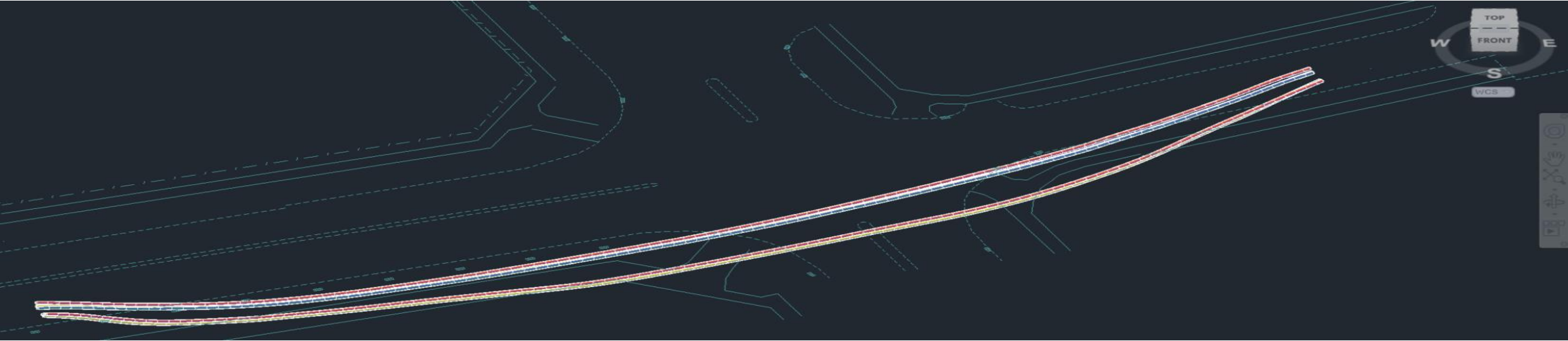
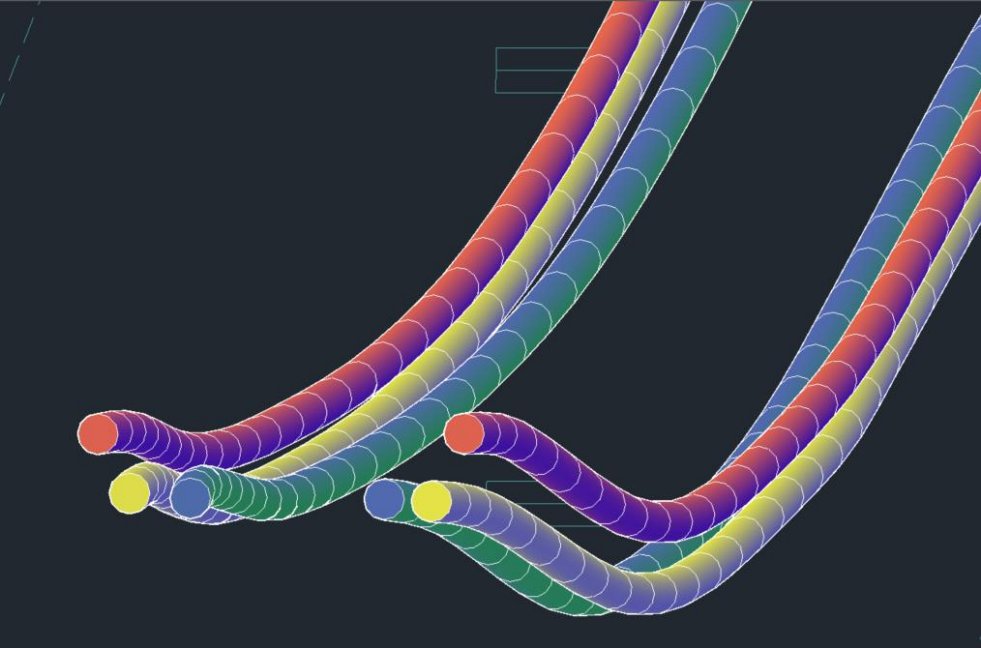
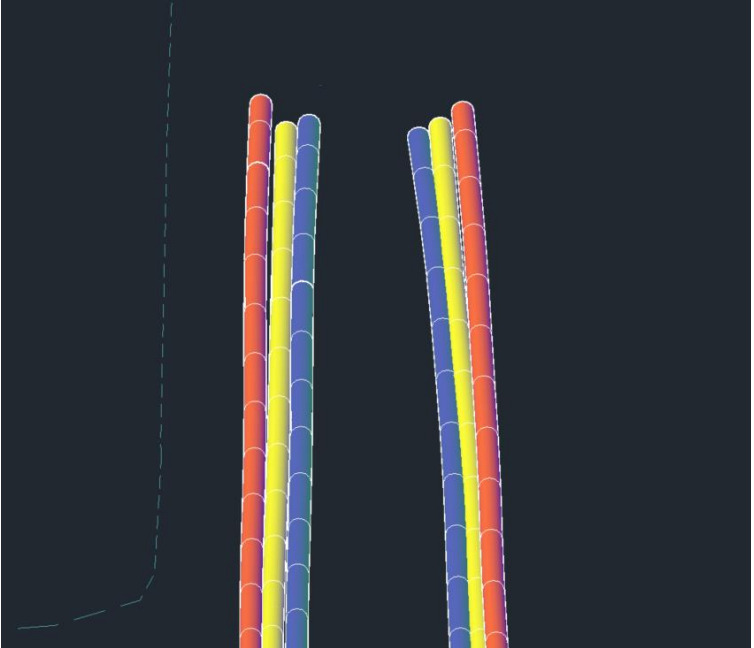
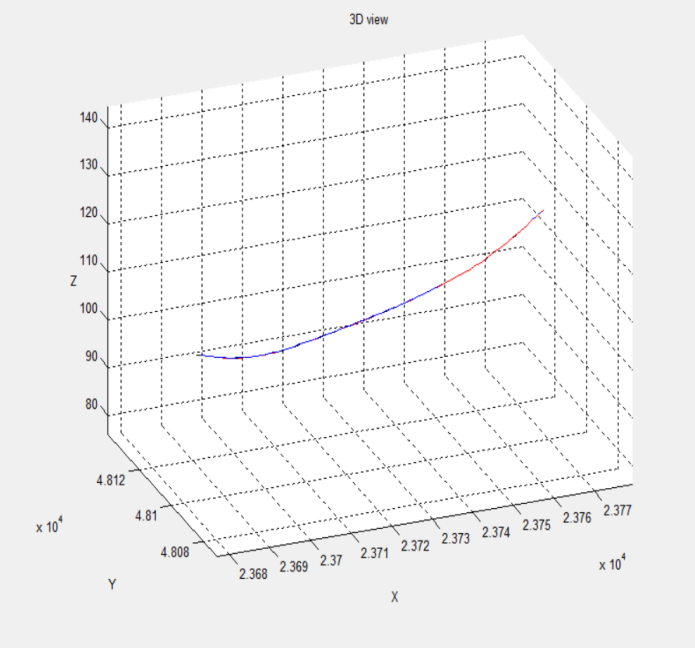


GYROSCOPIC MAPPING CASE STUDY





GYROSCOPIC MAPPING CASE STUDY



HIGHLIGHTING THE POTENTIAL OF A RELIABLE 3D MAP

Seeing The Unseen: Exploring utilities underground in Singapore using augmented reality

Displayed at URA Urban Lab Exhibition and World Cities Summit 2018



LEARNING TOGETHER

Collaboration with technology providers, surveyors, and government agencies





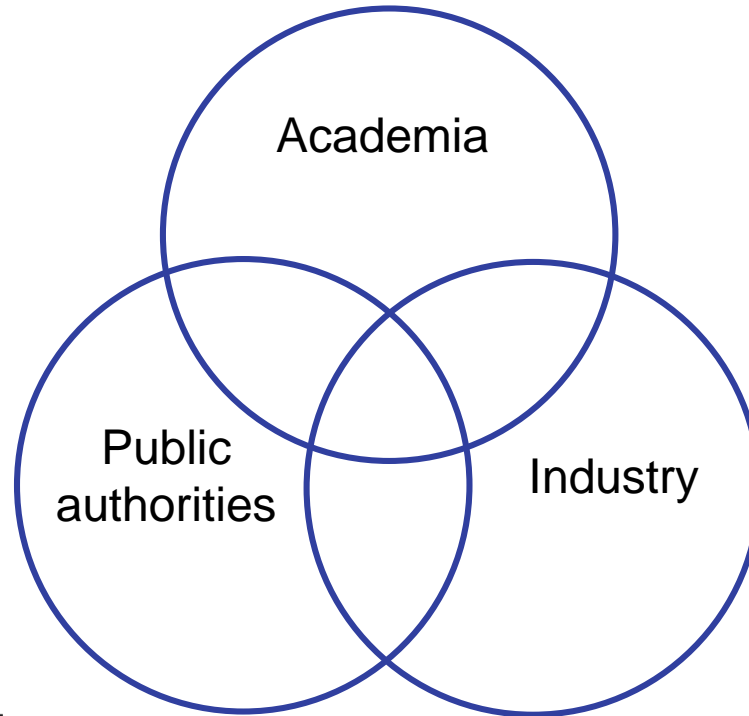
photo taken during Digital Underground Hong Kong study visit, April 2018



A WHOLE ECOSYSTEM APPROACH

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netcetera



Where will the roadmap lead to?

A reliable, 3D, digital map of underground utilities will contribute to a spatially enabled future city and will enable professionals to make informed decisions.

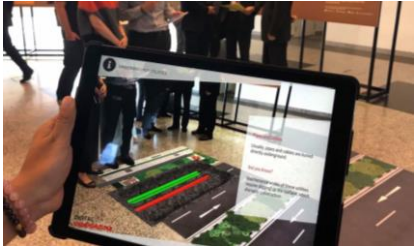
Surveyors and mappers have the capacity to produce accurate, reliable, and useful information.

Planners, land administrators and engineers have timely access to accurate, reliable, and complete information which can directly benefit their work processes.

A utility mapping ecosystem.

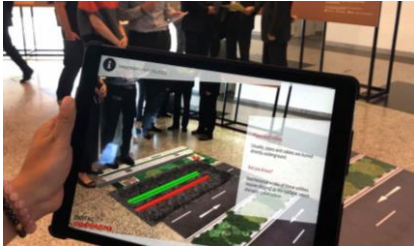
A UTILITY MAPPING ECOSYSTEM FOR FUTURE CITIES

Specialized technology



A UTILITY MAPPING ECOSYSTEM FOR FUTURE CITIES

Specialized technology



Skilled and qualified professionals

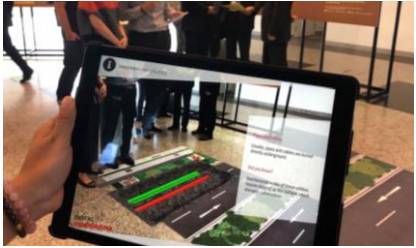


Committed organizations



A UTILITY MAPPING ECOSYSTEM FOR FUTURE CITIES

Specialized technology



Best practices & guidelines



Skilled and qualified professionals



Business models



Policies & standards

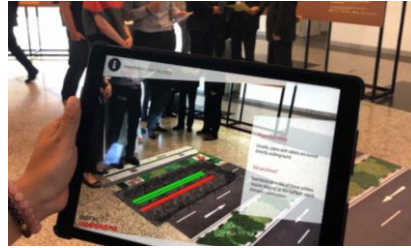


Committed organizations



A UTILITY MAPPING ECOSYSTEM FOR FUTURE CITIES

Specialized technology



Best practices & guidelines



Skilled and qualified professionals



Education

Committed organizations



Collaboration

Policies & standards

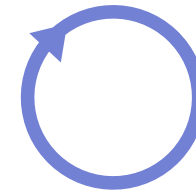
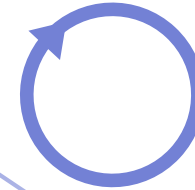
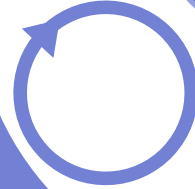


3D map
underground utilities

Quality control
& rectification
strategies

R&D

Business models



A smart and sustainable utility mapping ecosystem is an **agile, feedback-driven** ecosystem.



Thank you!

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