



***The International Trend of  
National Mapping and Cadastral Agencies (NMCA):***

***Survey and Mapping Office's role in  
building the Smart City of Hong Kong***

**Sr Ben CHAN Siu-bun**  
**Deputy Director / Survey and Mapping**

***HKIS PASS Conference Webinar***  
**27 March 2021**



***Lands Department  
Survey and Mapping Office***

# Fundamental Elements of a Smarter City



**Legal  
Framework**

**Land  
Ownership  
Information**

**Positioning  
Infrastructure**

**Spatial Data  
Infrastructure**

**Data  
Integration**

**Data &  
Information**

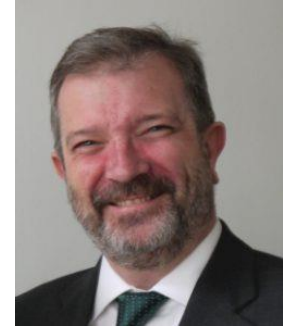
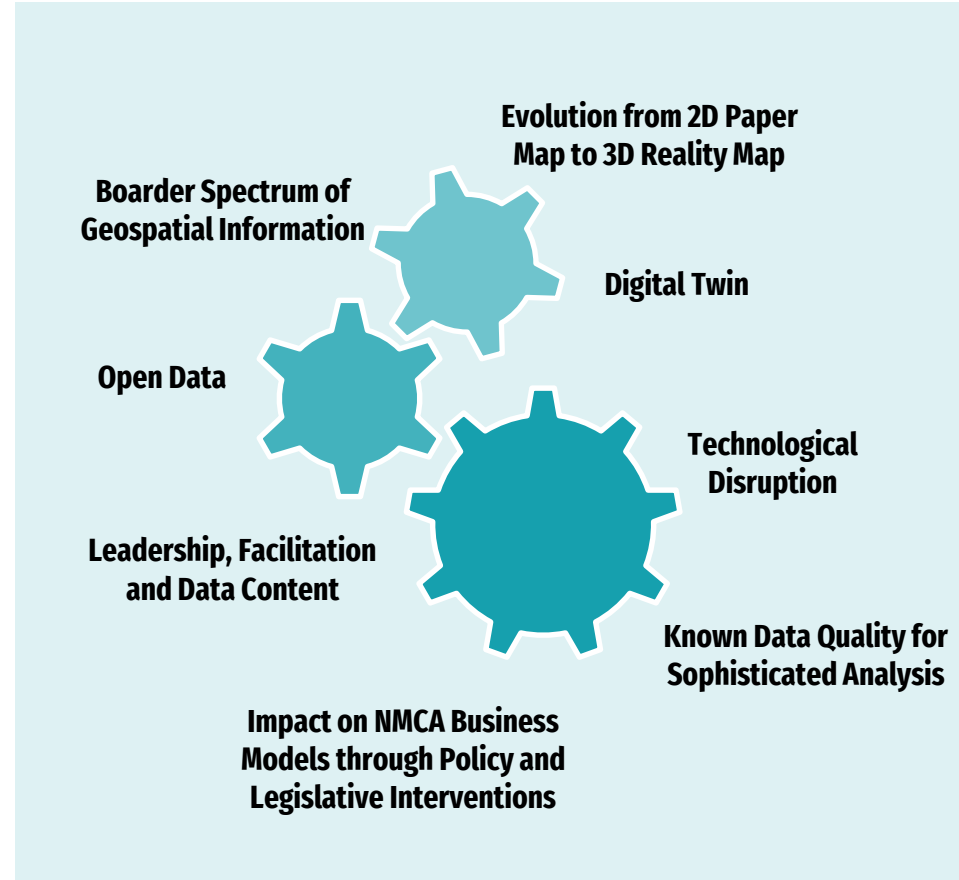
*Source: Daniel Steudler and Abbas Rajabifard (2012). "Spatially Enabled Society"*

# The Evolving Role of National Mapping and Cadastral Agencies (NMCAs)



## About The EuroGeographics

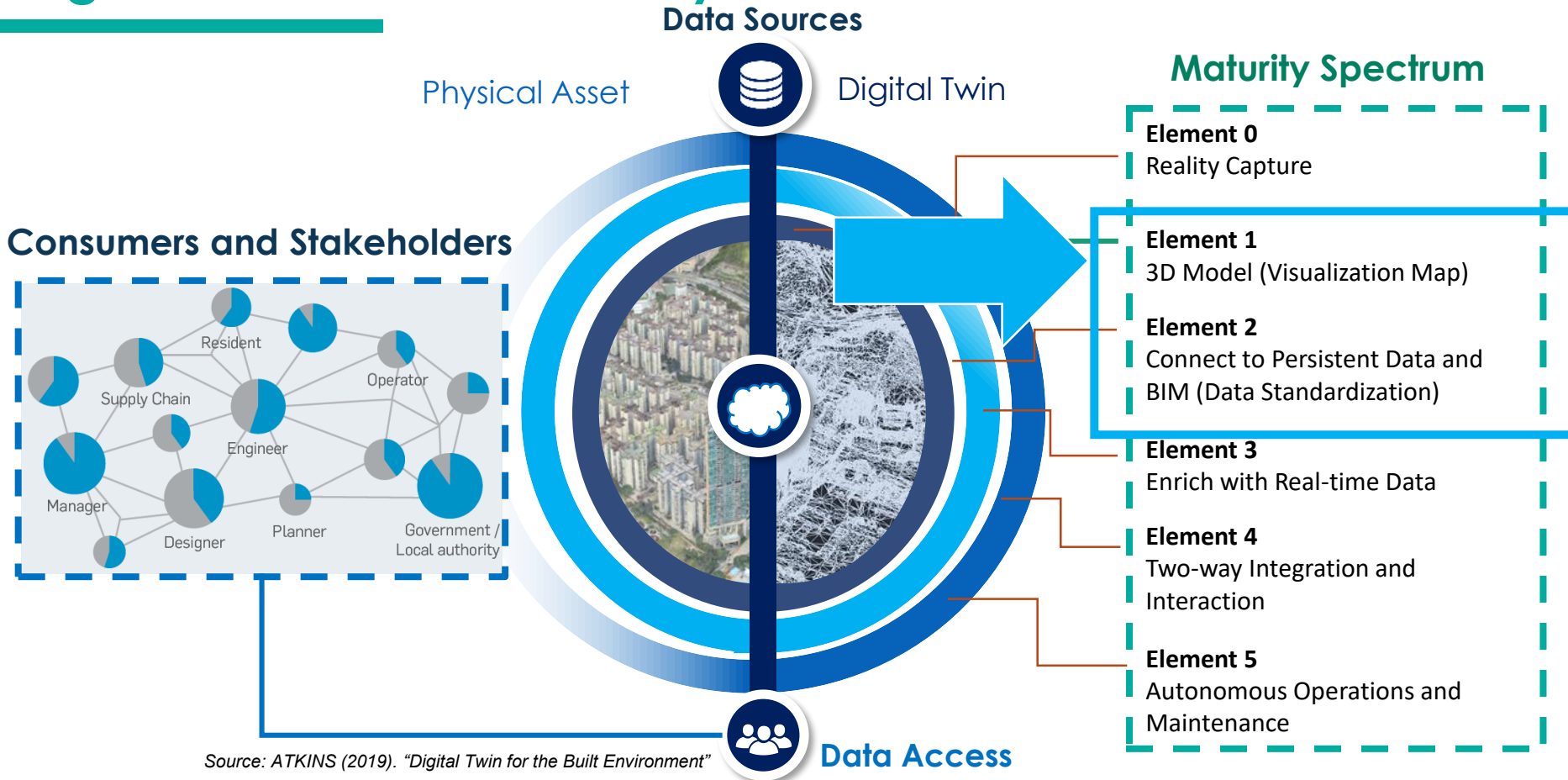
To be the voice of the European National Mapping, Cadastre and Land Registry Authorities and demonstrates their role in delivering better data for better lives.



**Mick Cory**

Former EuroGeographics  
Secretary General  
And Executive Director

# Digital Twin for A Smart City





# Centre for Digital Built Britain

[Home](#)[Who we are](#)[What we do](#)[Research](#)[Resources](#)[News](#)[Events](#)[Blog](#)[Connect](#)[Centre for Digital Built Britain](#)[What we do](#)[National Digital Twin Programme](#)[Resources: The Gemini Principles](#)[Background to the Gemini Principles](#)[Explaining the Information Management Framework \(IMF\)](#)[Digital Twin Hub](#)[Resources: The Roadmap](#)[Resources: Pathway Towards an IMF](#)[Resources: Top-Level Ontologies and Industry Data Models](#)[Resources: Approach to Delivering an](#)

## Gemini Principles

The Gemini Principles paper, released in 2018, proposes principles to guide the national digital twin and the information management framework that will enable it.

### What are the Gemini Principles?

[\[Download the report\]](#)

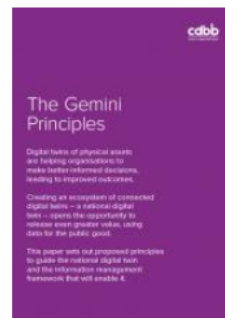
As an industry we are beginning to understand that data needs to be valued, managed effectively and shared securely. We now need a common set of definitions and principles that can be adopted across the sector to underpin the development of the national digital twin. The Digital Framework Task Group is bringing together stakeholders from government, industry and academia to build a consensus on these definitions and values, which it has called the Gemini Principles.

The Gemini Principles report was published by the Centre for Digital Built Britain in December 2018 to begin enabling alignment on the approach to information management across the built environment, as establishing agreed definitions and principles from the outset will make it easier to share data in the future.

These principles are effectively the conscience of the information management framework and the national digital twin. To ensure that these two initiatives are – and remain – for the public good, they need strong founding values to guide them.

Enshrined in these values is the notion that all digital twins must have clear purpose, must be trustworthy and must function effectively. All the Gemini Principles flow from this. They are deliberately simple, but their implications are far-reaching and challenging. They are descriptive of intent, but agnostic on solutions, to encourage innovation and development over time.

The Gemini Principles will continue to underpin the National Digital Twin and the information management framework that will enable it.



# Reference Case: The Gemini Principles



## About The Gemini Principles

Setting out proposed principles to guide the national digital twin and the information management framework that will enable it

## The Gemini Principles

**Purpose:**  
Must have clear purpose

**Public good**  
Must be used to deliver genuine public benefit in perpetuity

**Value creation**  
Must enable value creation and performance improvement

**Insight**  
Must provide determinable insight into the built environment

**Trust:**  
Must be trustworthy

**Security**  
Must enable security and be secure itself

**Openness**  
Must be as open as possible

**Quality**  
Must be built on data of an appropriate quality

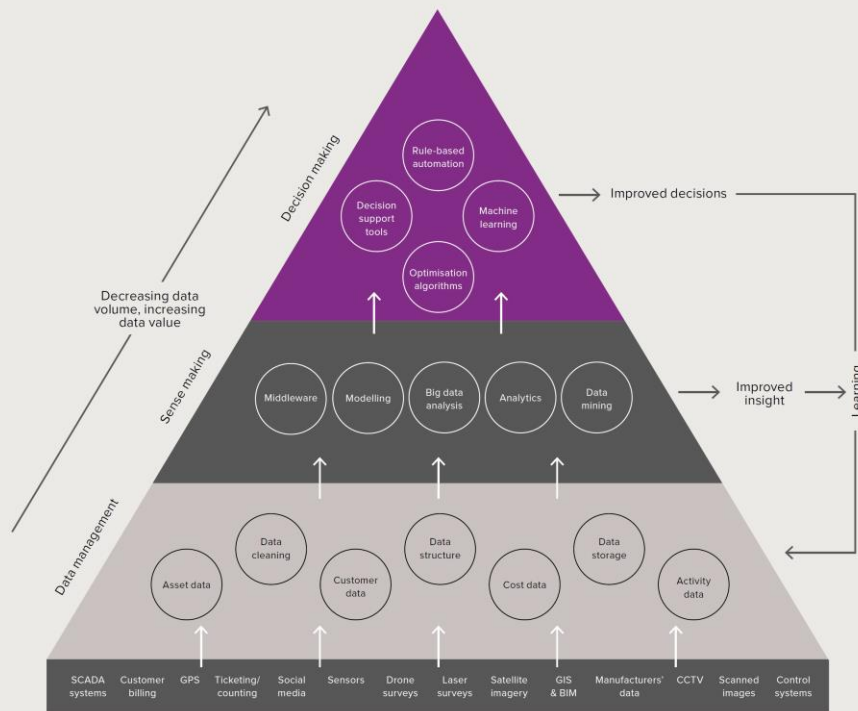
**Function:**  
Must function effectively

**Federation**  
Must be based on a standard connected environment

**Curation**  
Must have clear ownership, governance and regulation

**Evolution**  
Must be able to adapt as technology and society evolve

The information value chain:  
showing the connection between data and better decisions that lead to better outcomes.<sup>4</sup>



# Reference Case: Ordnance Survey



Ordnance Survey

## About Ordnance Survey

Ordnance Survey is the National Mapping Agency for Great Britain that curates one of the UK's key national data assets.

## What do they do?



Map the nation with highly accurate spatial information



Provide spatial data to deliver better public policy-making and drive industrial growth



Maintain sustainability of environment



Research & Development

## New Positioning

Ordnance Survey has changed from a traditional mapping agency into a **big data powerhouse**. They put spatial data at the **heart** of their business to drive the development of their nation.



## Inspiration for SMO



Lead the change in the ecosystem



Create values from spatial data



Embrace technology change

# Extended SMO – Refined Roles and Responsibilities

What will we do?



空間數據共享平台  
Common Spatial  
Data Infrastructure



LandsD has re-defined her leading role in the Geospatial Contribution to Digital Twins for Smart City of Hong Kong

## About Survey and Mapping Office, Lands Department

the land survey, mapping and geospatial authority in Hong Kong

### Possible new roles and responsibilities :



Survey, Mapping and Spatial Data Office



Spatial Data Agency



Land Data Bank Holder & Geographical Information Office



Land Status and Cadastral Office



Positioning Infrastructure Agency

# The Geospatial Contribution to Digital Twin



**Reality Capture & 3D Modelling**



**Connect to BIM**

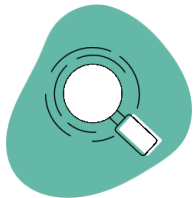


**Data & Positioning Infrastructure**

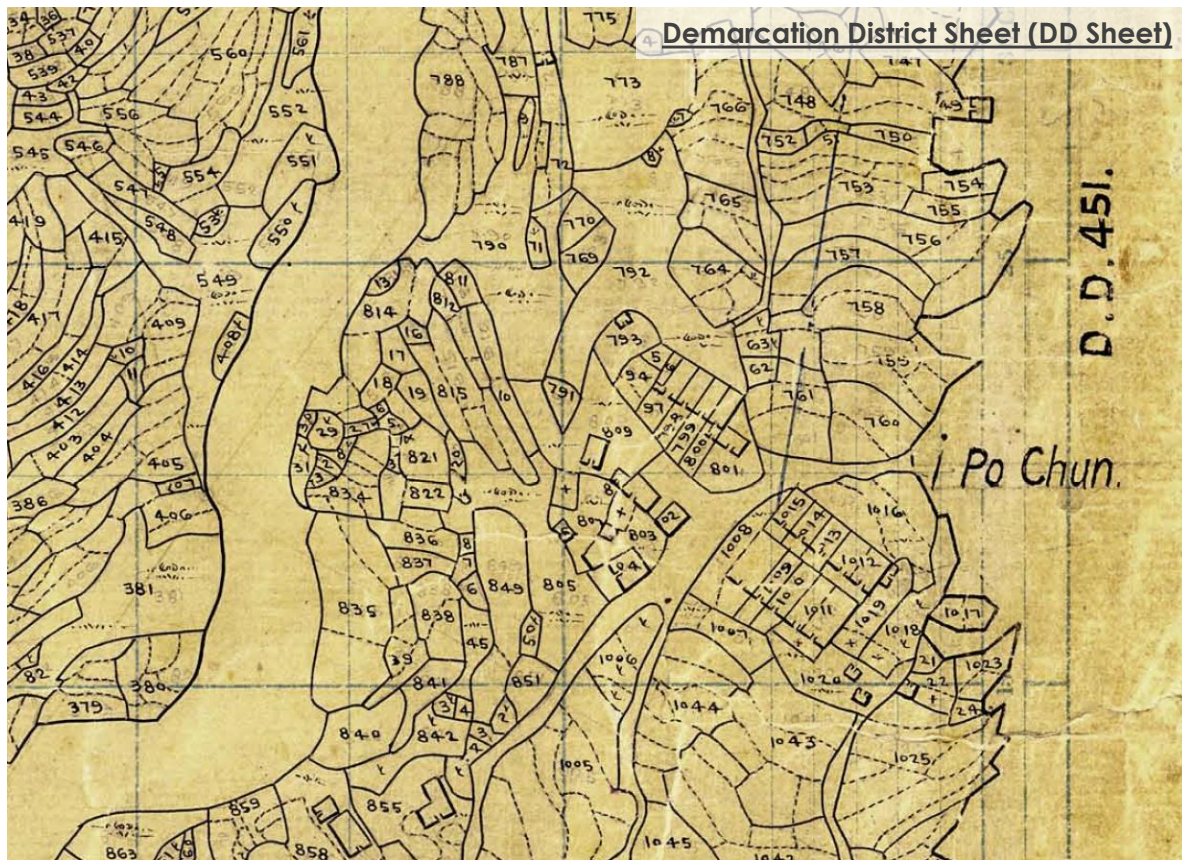


# *Legal Framework & Land Ownership Information*





# Keeping of Land Boundary Records







# Land Status Plan (internal) and Lot Index Plan (for public)



A quick reference for identification of the **APPROXIMATE** location of lot boundaries in relation to physical features on ground



It consists of 2 components:-

**a) land boundary information<sup>^</sup>**

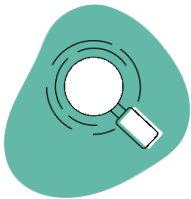
*extracted from land grant documents/  
old boundary records*

**b) topographic information**

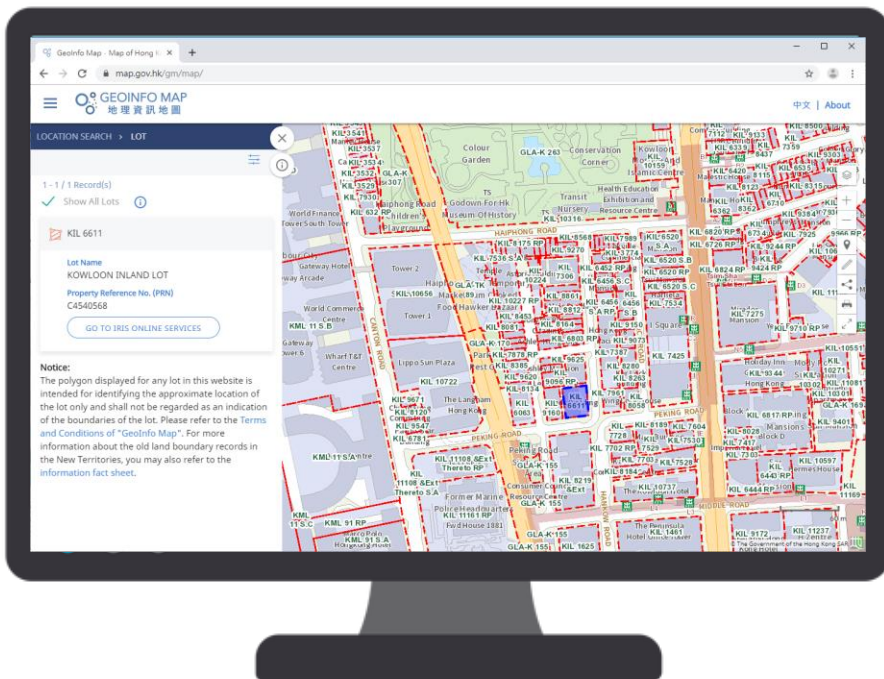
*extracted from up-to-date basic maps*



<sup>^</sup> Land boundary information may be revised when new or better land boundary information becomes available



# What we have been doing?



## GEOINFO MAP 地理資訊地圖

- ❖ To facilitate public access to the approximate location and extent of private lots and government land allocations
- ❖ Lot information displayed on GeoInfo Map is for general identification purpose

<https://www.map.gov.hk>





# Interfacing between GeoInfo Map and Land Registry's Integrated Registration Information System (IRIS)

## ❖ Property Reference Number (PRN) as the key for linkage

- Launched on 27 May 2017
- Doing Business 2018 - "Registering Property" has advanced from 61st to 55th for Hong Kong

Integrated Registration Information System Online Services  
The Land Registry

Search Land Register

Lot: IL 8572  
Development Name:  
House No.:  
Block:  
Street Name:  
Floor:  
Flat:

There is/are 1 land register(s) found.  
Please select the required register(s) and add to your order list.

☒ Show links to GeoInfo Map? [Note](#)

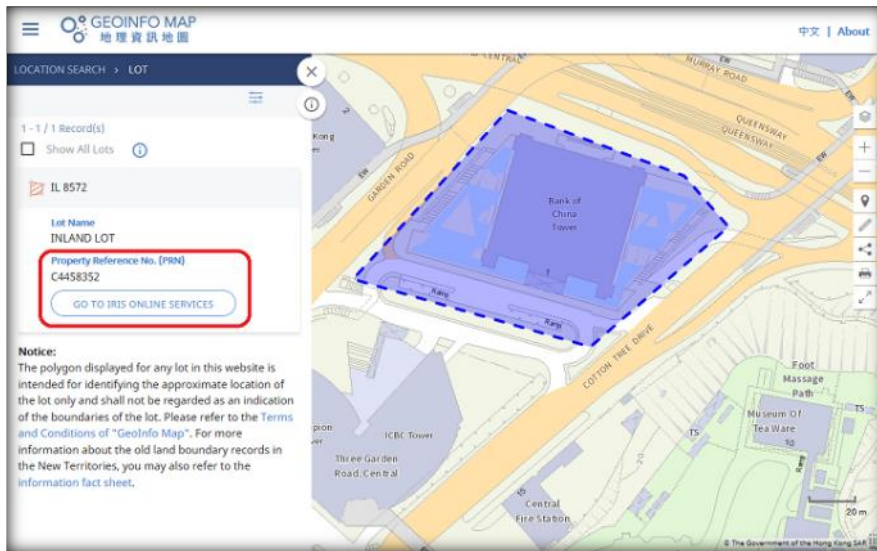
Flat	PRN	Address/Lot	Type of Enquiry	Nature / No. of Copies	GeoInfo Map (for reference only)
<input type="checkbox"/>	C4458352	INLAND LOT NO. 8572 (IL 8572)	<input checked="" type="radio"/> Current <input type="radio"/> Full	<input checked="" type="radio"/> Plan - No. of Copies: 1 <input type="radio"/> Certified - No. of Copies	<a href="#">GeoInfo Map</a>

[Back to Search Land Register](#)

Current Enquiry = Retrieves current particulars of a property only  
Full Enquiry = Retrieves historical & current particulars of a property

**Important Notice - Disclaimer**

The Land Registry may provide links to third-party websites and you should be aware that the information on third-party websites is compiled and issued by owners of those third-party websites. No warranty or guarantee, express or implied, is given by the Land Registry on the accuracy of such linkage and the accuracy or completeness of such property information. You must check carefully against your own and other sources of information to decide whether the search result of property really matches with the property intended to be searched by you. The Land Registry will not accept any liability, obligation or responsibility for any loss or damages, whatsoever arising directly or indirectly due to any error or omission of such property information so obtained therefrom, or in the use or misuse of such property information, or for any reliance thereon.



# *Common Spatial Data Infrastructure & Data Integration*



# What is Infrastructure?

General purpose infrastructure like water pipe, gas pipe, electricity network and broadband that are fundamental for daily life activities



Water



Gas



Lighting



Network

10101001001011  
10101101110010  
00010110101011

## *Data as Infrastructure*

*A strong data infrastructure would enhance the efficiency for data consumption and sharing*

# Spatial Data

>85% data refers to location and their value can be greatly enhanced through geo-enabling and integration ...

**Support applications across virtually all sectors of human activities.....**



**Topographic  
Basemaps**



**Land Records**



**Utility Management**



**Telecommunications**



**Disaster  
Management**



**Urban & Regional  
Planning**



**Census**



**Environmental  
Management**



**Health Care**



**Education**



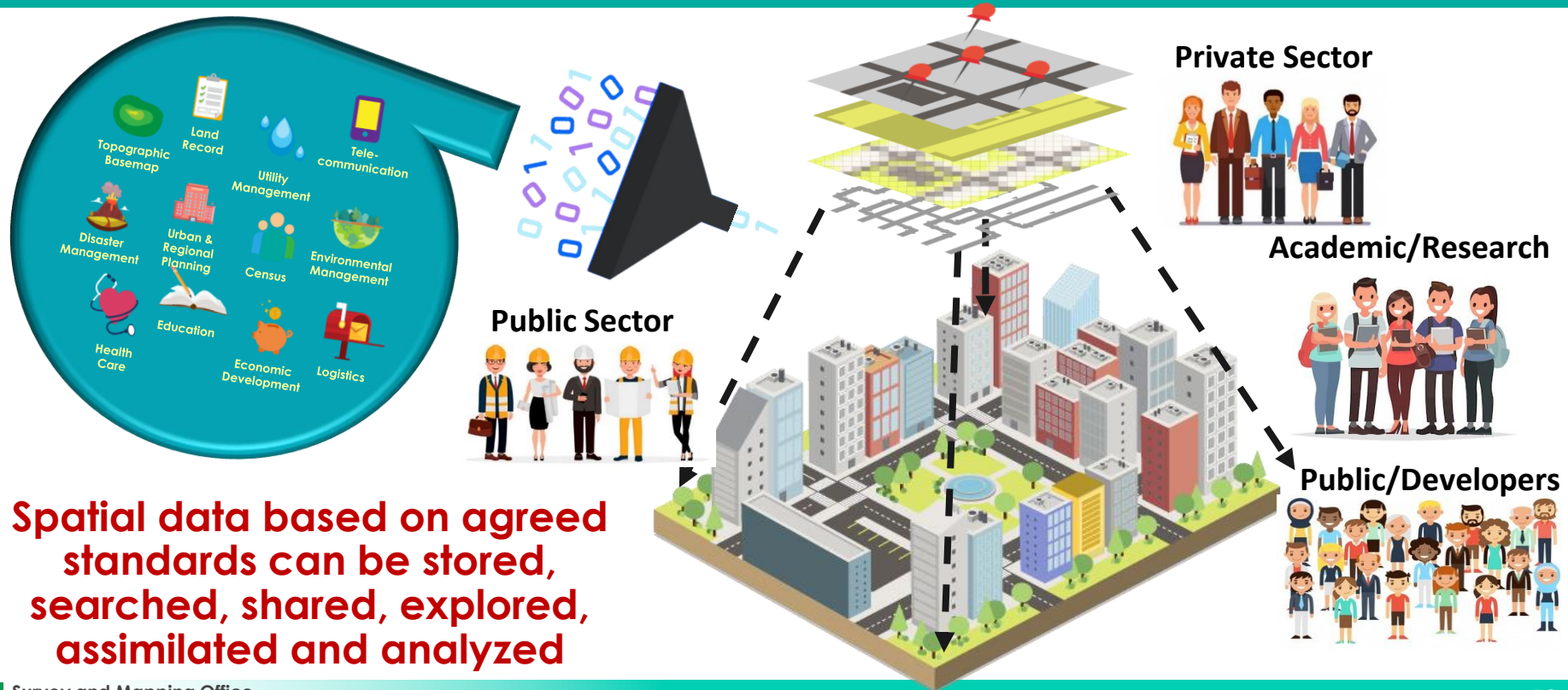
**Logistics**



**Economic  
Development**

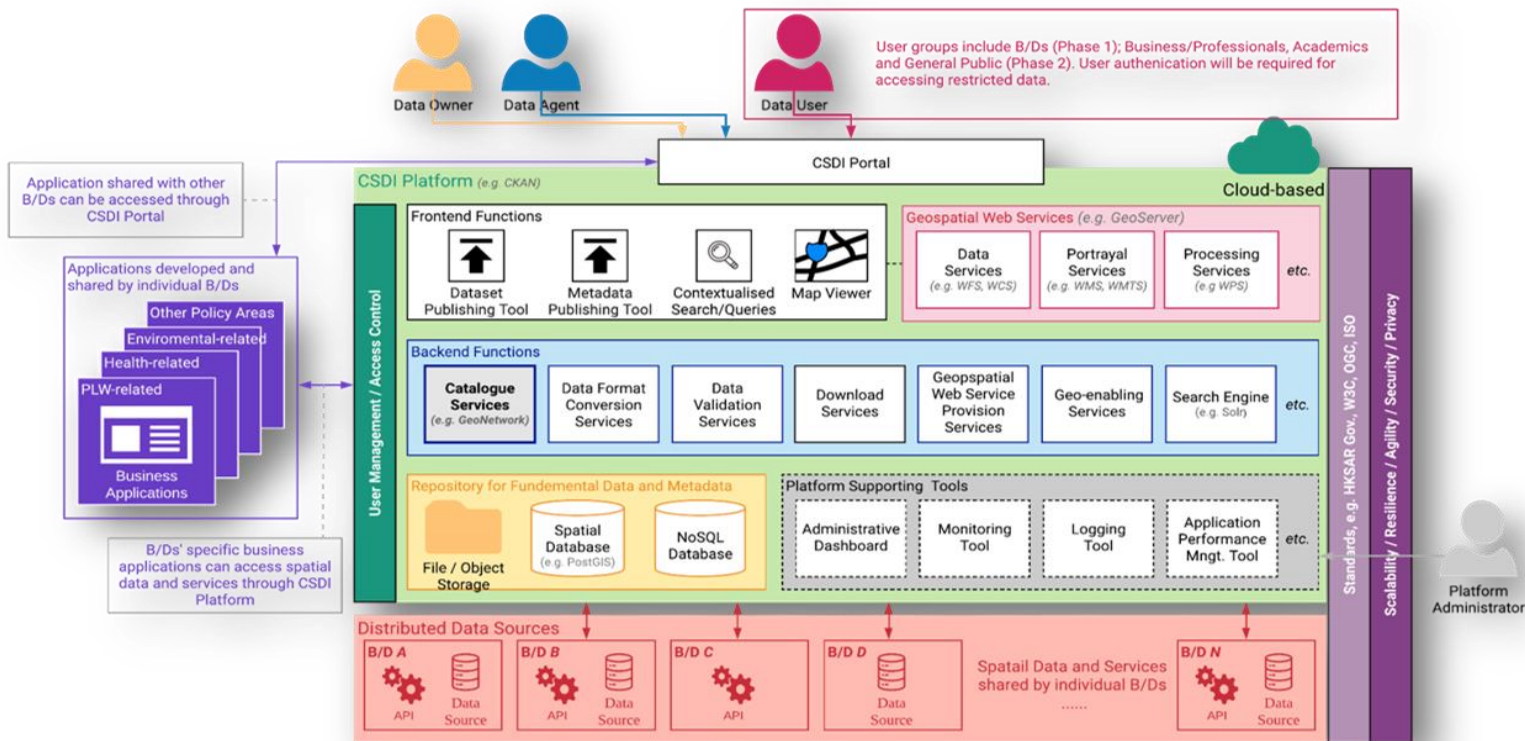
# Need for Common Spatial Data Infrastructure

A map-based information infrastructure leveraging GIS technology





# Architecture of a Common Spatial Data Infrastructure (CSDI) Platform



# *Modelling Our City in 3D*



# 3D Digital Map

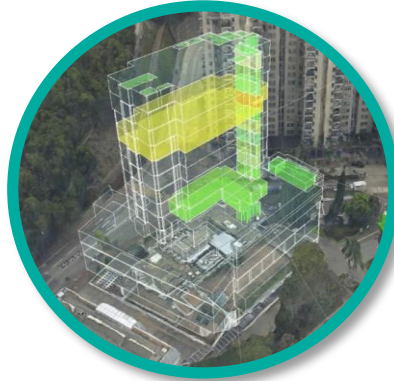
## 3 Stages of 3D Digital Map Development

Stage 1



**3D Maps  
for Visualization**

Stage 2



**3D Maps for Unit-based Indoor  
Applications**

Stage 3



**3D Maps for  
City Modelling**

# 3D Digital Mapping Project

The 3D digital mapping project comprises

- Full-fledged 3D visualisation map
- 3D indoor maps for 1,250 buildings
- 3D pedestrian network



## Generation of the Full-Fledged 3D Visualisation Map

1

## Data Capturing

Imagery  
(Aerial/Street-level)

## Point Clouds

2

## Data Post Processing

3

## Data Modelling and field verification

### 3D Digital Map



# Full-Fledged 3D Visualisation Map

- Individualised models
  - Building (about 220,000)
  - Infrastructure (about 3,000)



**Enable linkage with GIS  
database and indoor map**

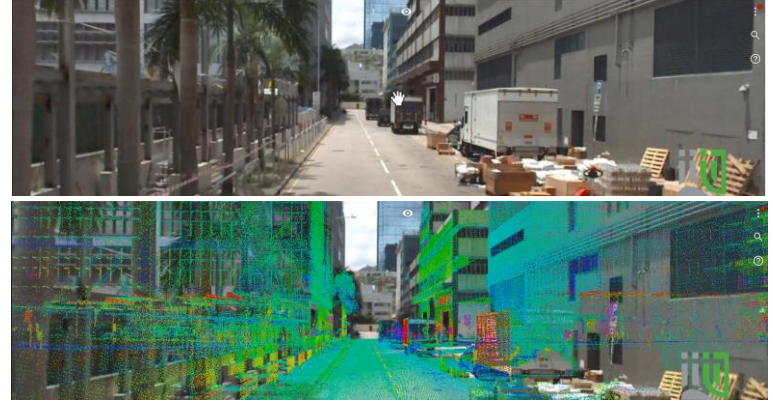
# Full-Fledged 3D Visualisation Map

- Tile based surface model
- Road
- Vegetation
- Terrain
- Waterbody
- Site



# Full-Fledged 3D Visualisation Map

- Geo-referenced 360 degree Panoramic Images
- Coloured Dense Point Cloud
- Open format Data
- CityGML



- Accurate street level information supporting a new range of application (e.g. logistics for construction plants, measurement of trees)
- Platform independent
- Support integration to BIM



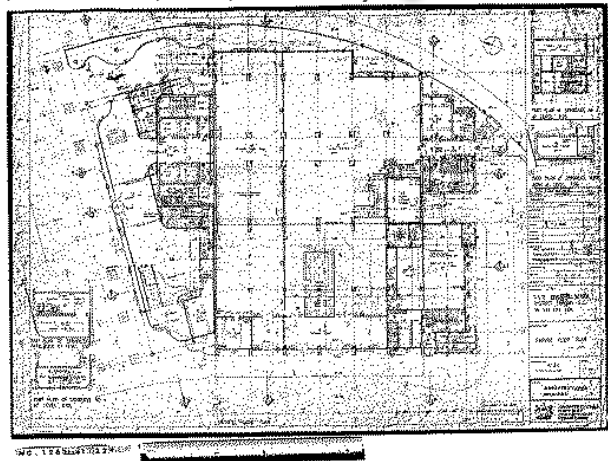
# Generation of the 3D Indoor Map

1

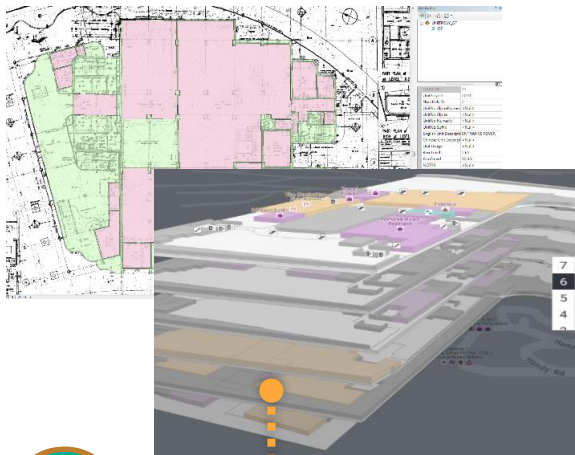
Extraction of  
Building Plan  
Information

Scanned raster drawings  
of building plans

(BD, ArchSD, HD, MTR...)



3D Indoor Map in GIS format



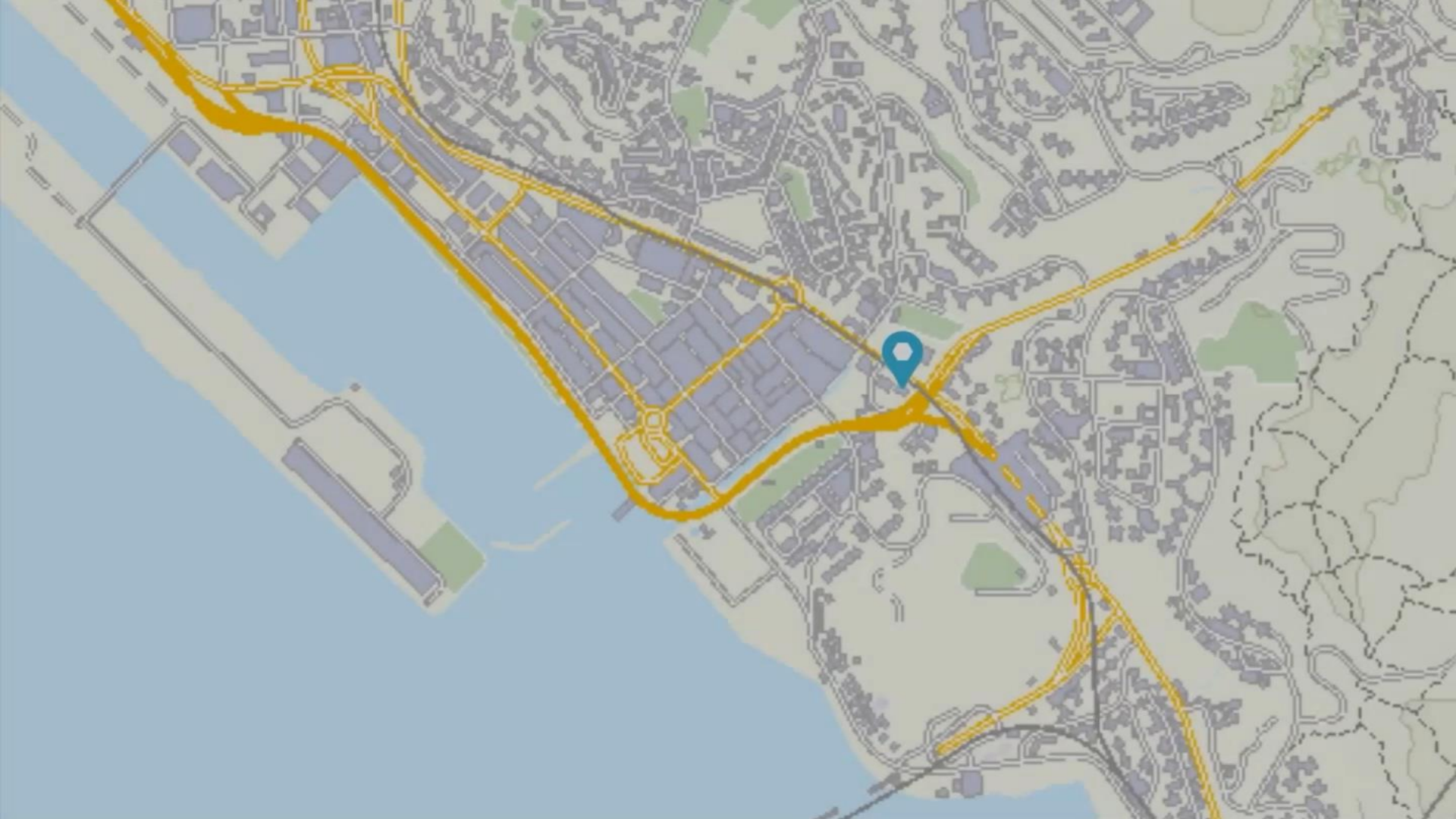
2

Create floors, units  
and network

3

Field Verification





# Generation of the 3D Pedestrian Network

1

Collection of  
reference  
information

## Base data from HKU

## Reference data

## Terrain models

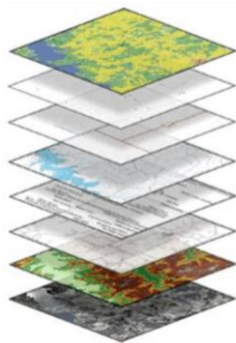
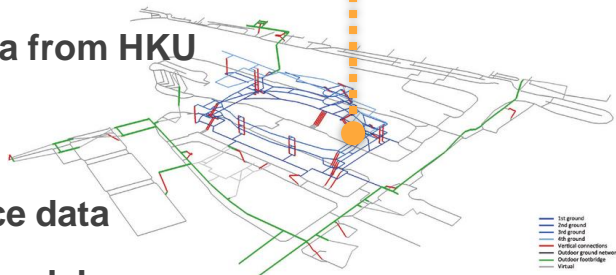
## Base maps

## Traffic aids drawings

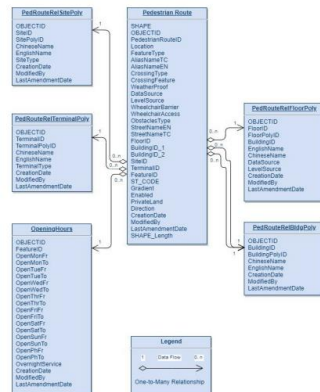
## Highway polygons

## LandsD Panoramic Images

## Building plans



## Specifications



2

## Digitisation

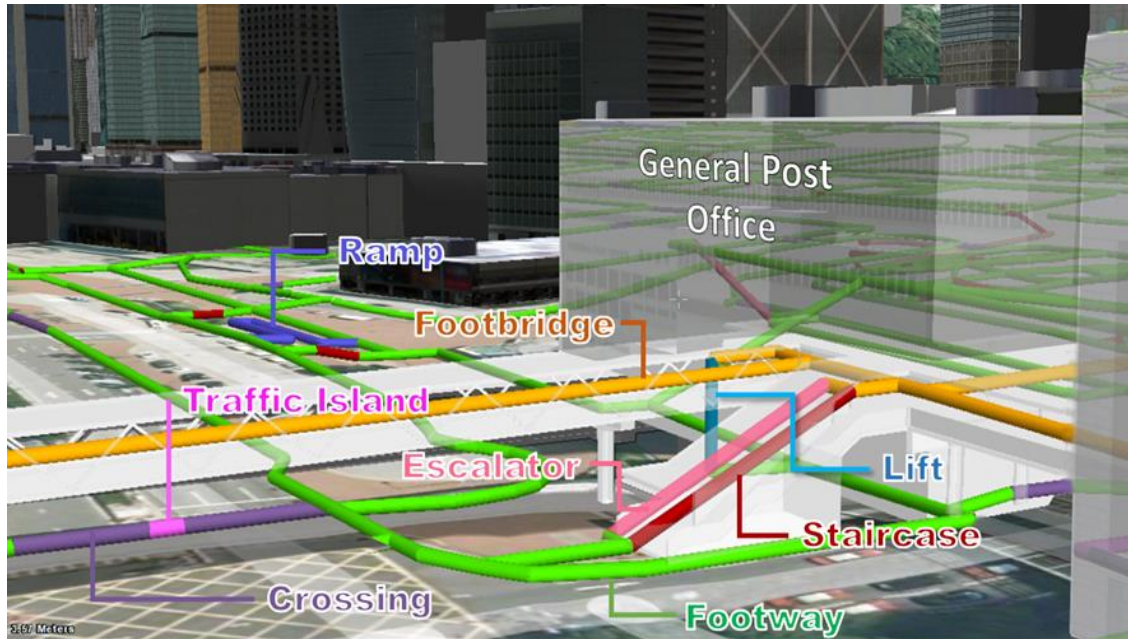
3

## Field Verification





# 3D Pedestrian Network



Serving general public and needy-groups

“universal accessibility ” information

- barrier-free
- escalator, ramp, stair
- weather proof
- elderly-friendly



Barrier-free access facilities in public buildings



Escalators, ramps, stairs, lifts



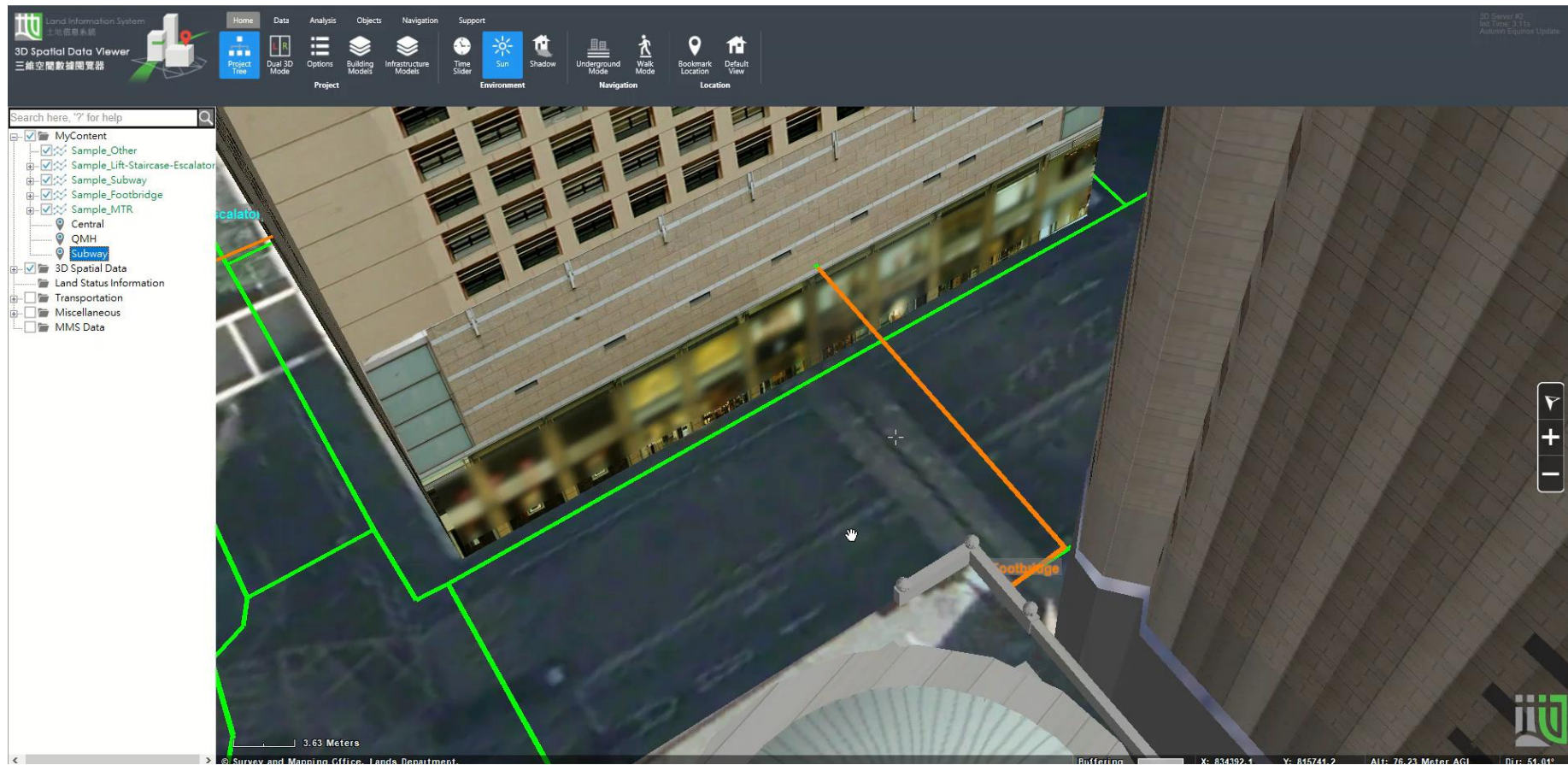
Outdoor pedestrian walkway



Indoor pedestrian walkway with free public access

# 3D Pedestrian Network

## *Indoor Routes in 800 buildings*

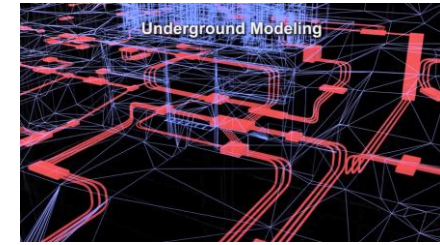
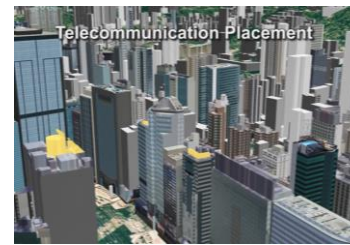
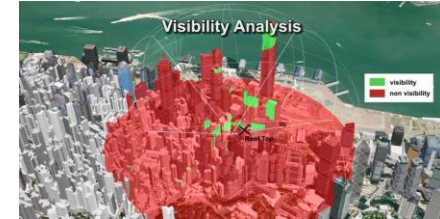
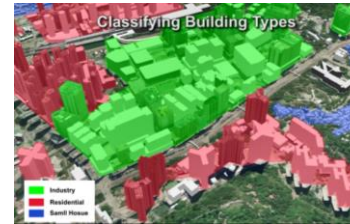




# 3D Visualisation Map

## 3D visualisation map supports

- Land use and planning
  - Site appraisal
  - Valuation
  - Visualising building types
  - Sunlight , shadow analysis
  - Placement of telecommunication equipment
  - Underground utilities
- Environment and engineering
  - Air ventilation assessment
  - Noise assessment
- Emergency planning
  - Emergency response
  - Disaster management

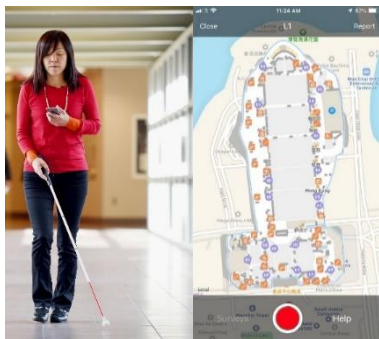


# 3D Visualisation Map

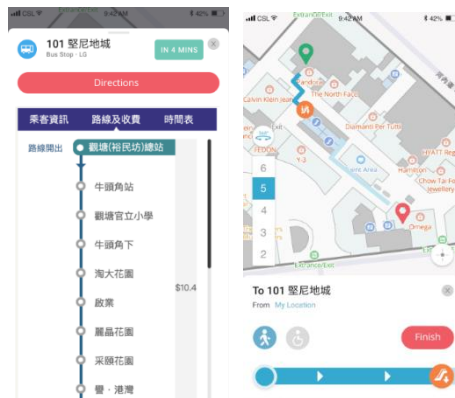




# 3D Indoor Map – potential applications



Corporate Social Responsibility  
(Barrier Free Wayfinding)



Smart Mobility



New Insight  
(Location Based Analytics)

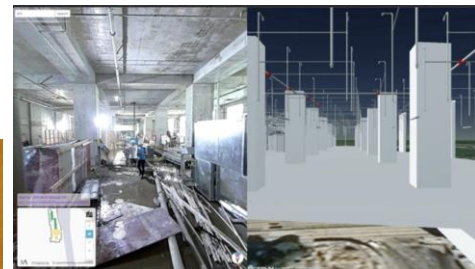


Better Service Quality  
(Digital Directory)



Emergency  
(Fire Evacuation)

3D Indoor Map

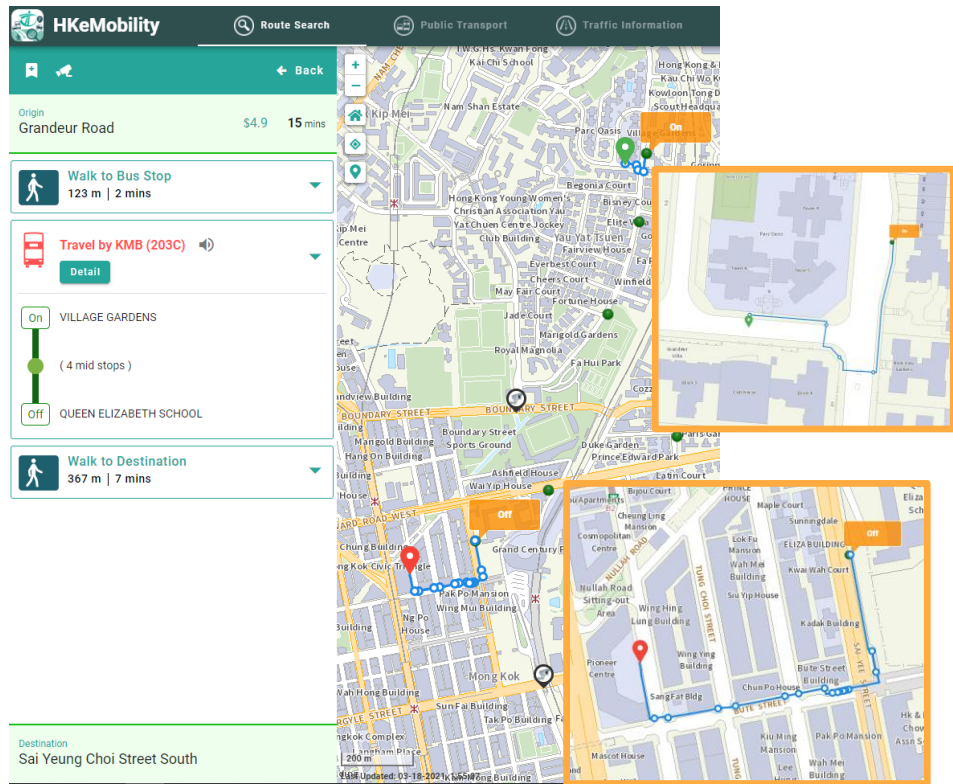


Operating Efficiency  
(Building Management / Facility Management)

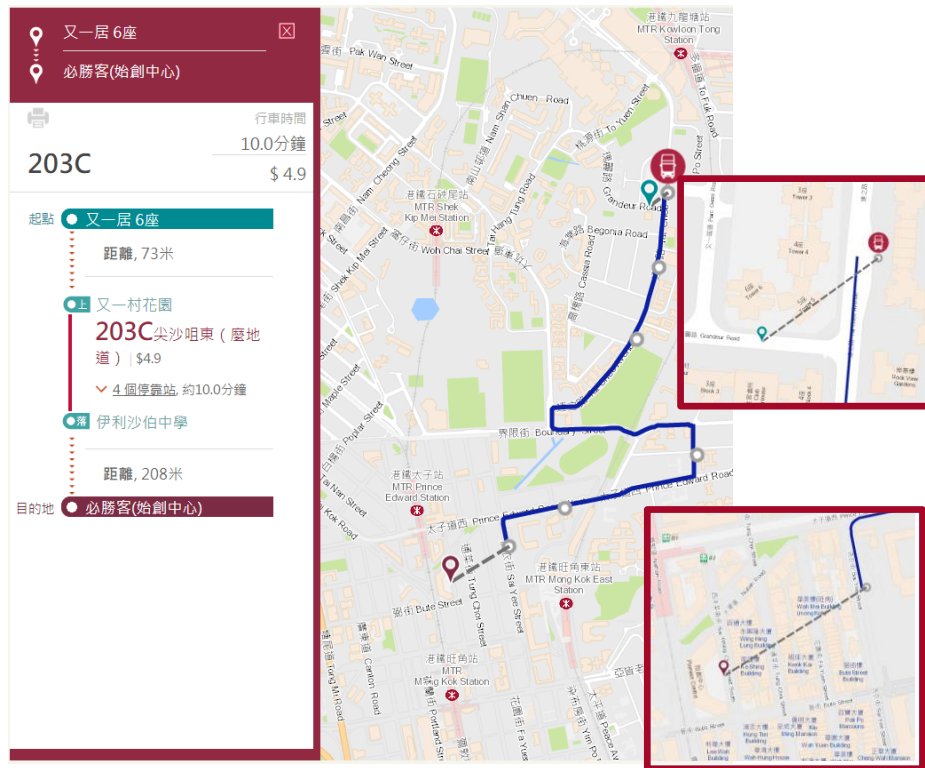
# 3D Pedestrian Network

## Infrastructure to improve multimodal transportation

HKeMobility with 3D pedestrian network



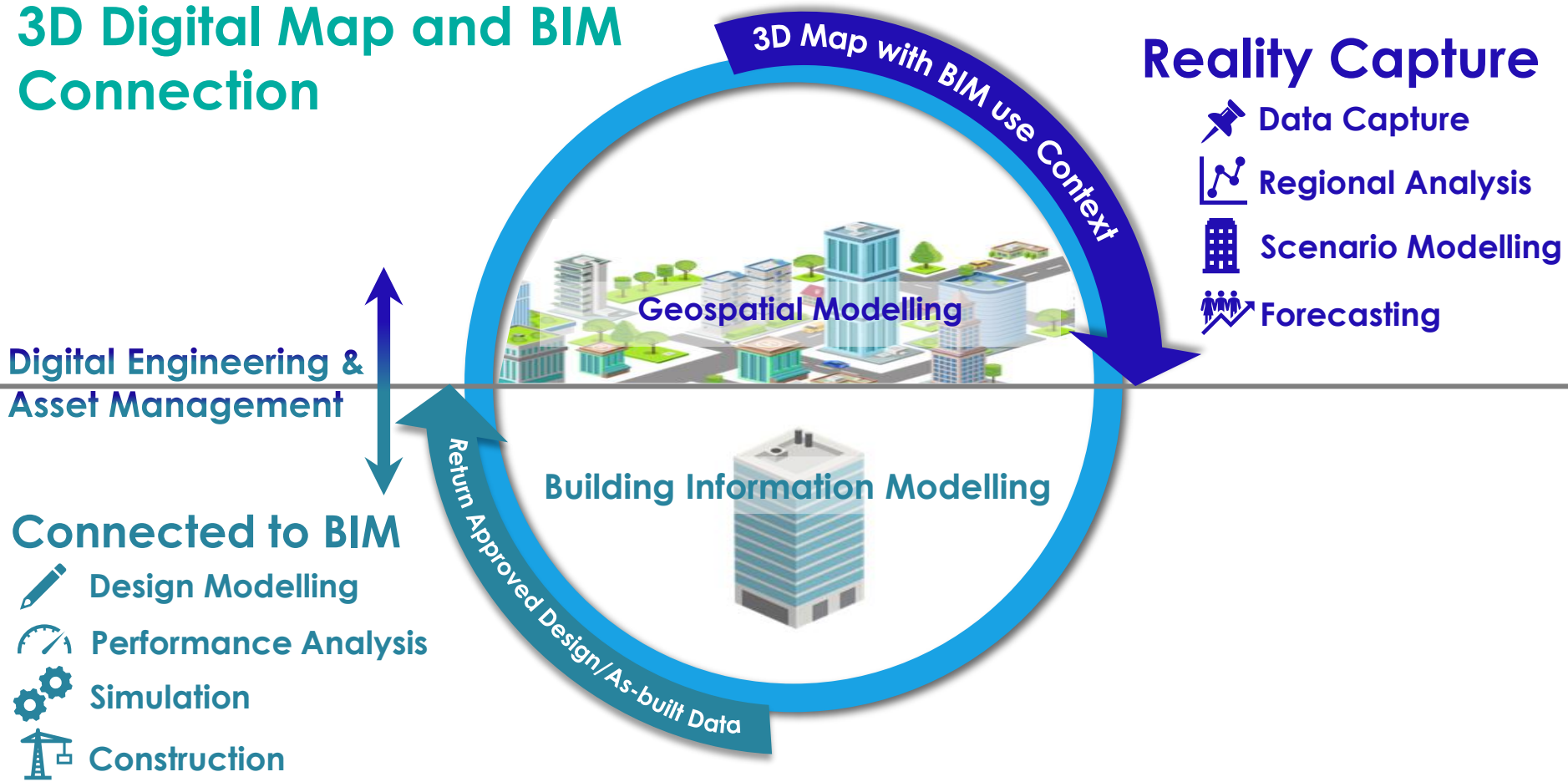
Route search without pedestrian network



# *GIS/ BIM Data Integration*



# 3D Digital Map and BIM Connection





# Government Policy on BIM Adoption

香港特別行政區政府  
The Government of the Hong Kong Special Administrative Region

政府總部  
發展局  
工務科

香港港灣花園 2 號  
政府總部西翼 16 樓

Works Branch  
Development Bureau  
Government Secretariat

18/F, West Wing,  
Central Government Offices,  
2 Tim Mei Avenue, Tsimshui,  
Hong Kong

Ref : DEVB(W) 430/80/01  
Group : 2, 5, 6

23 December 2020

Development Bureau  
Technical Circular (Works) No. 12/2020

Adoption of Building Information Modelling  
for Capital Works Projects in Hong Kong

Scope

This Circular sets out the policy and requirements on the adoption of Building Information Modelling (BIM) technology.

2. This Circular applies to works either by government staff, consultants or contractors.

Effective Date

3. This Circular takes effect on 1 January 2021.

Effect on Existing Circulars and Circular Memoranda

4. This Circular supersedes DEVB TC(W) No. 9/2019.

DEVB TC(W) No. 12/2020 Page 1 of 17



LandsD is commissioned to establish the BI Data Repository for storing BIM models from Works Departments

## Smart City Planning

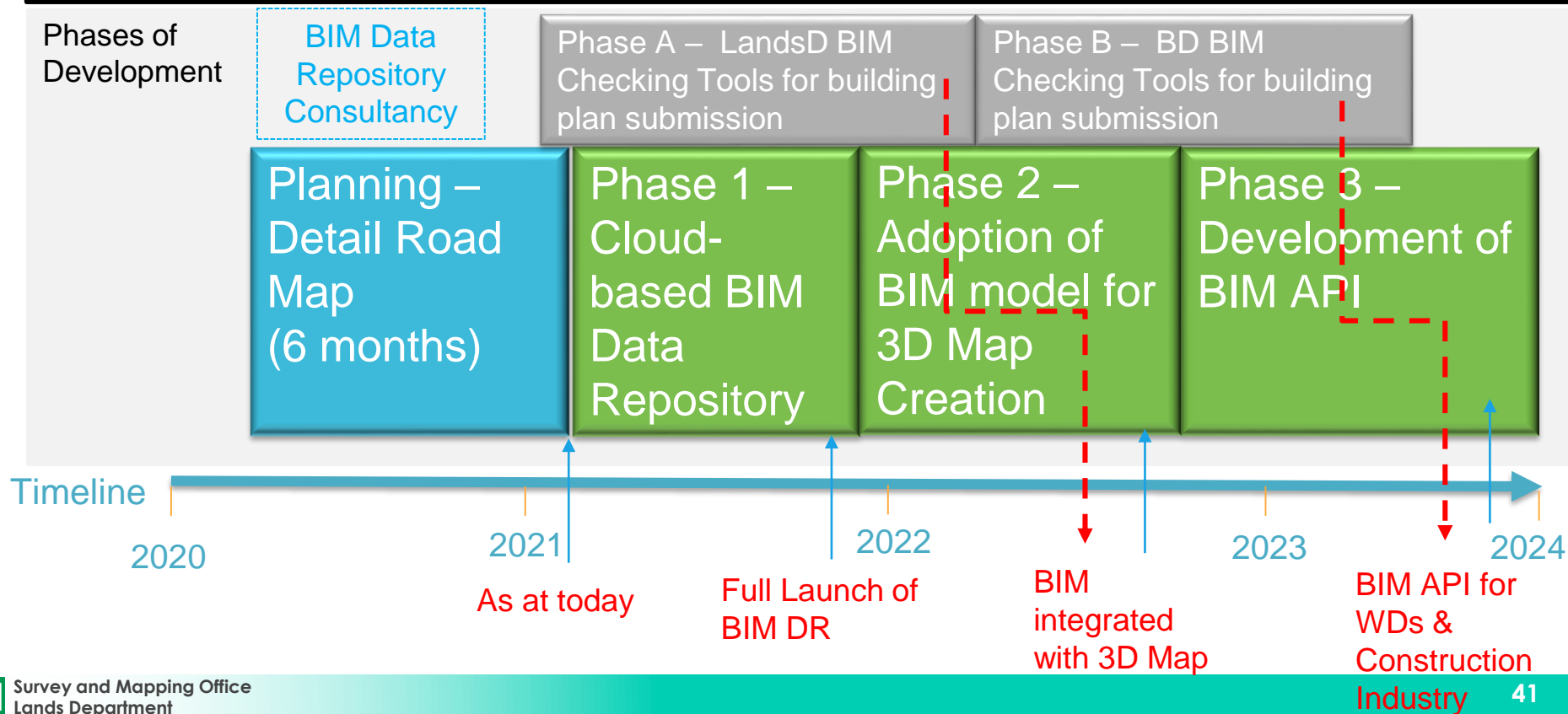
18. BIM models contain rich information of built assets which can facilitate the integration between BIM and Geographic Information System (GIS) as well as the development of Common Spatial Data Infrastructure (CSDI).
19. Therefore, WDs shall provide their design and as-built BIM models to LandsD to facilitate the development of the BIM data repository and should ensure that the models are prepared for information sharing according to the harmonised BIM standards, as far as practicable, which is being developed by CEDD and LandsD in a pilot study for a New Development Area (NDA) due for completion in 2021 tentatively.

# BIM Data Repository Consultancy

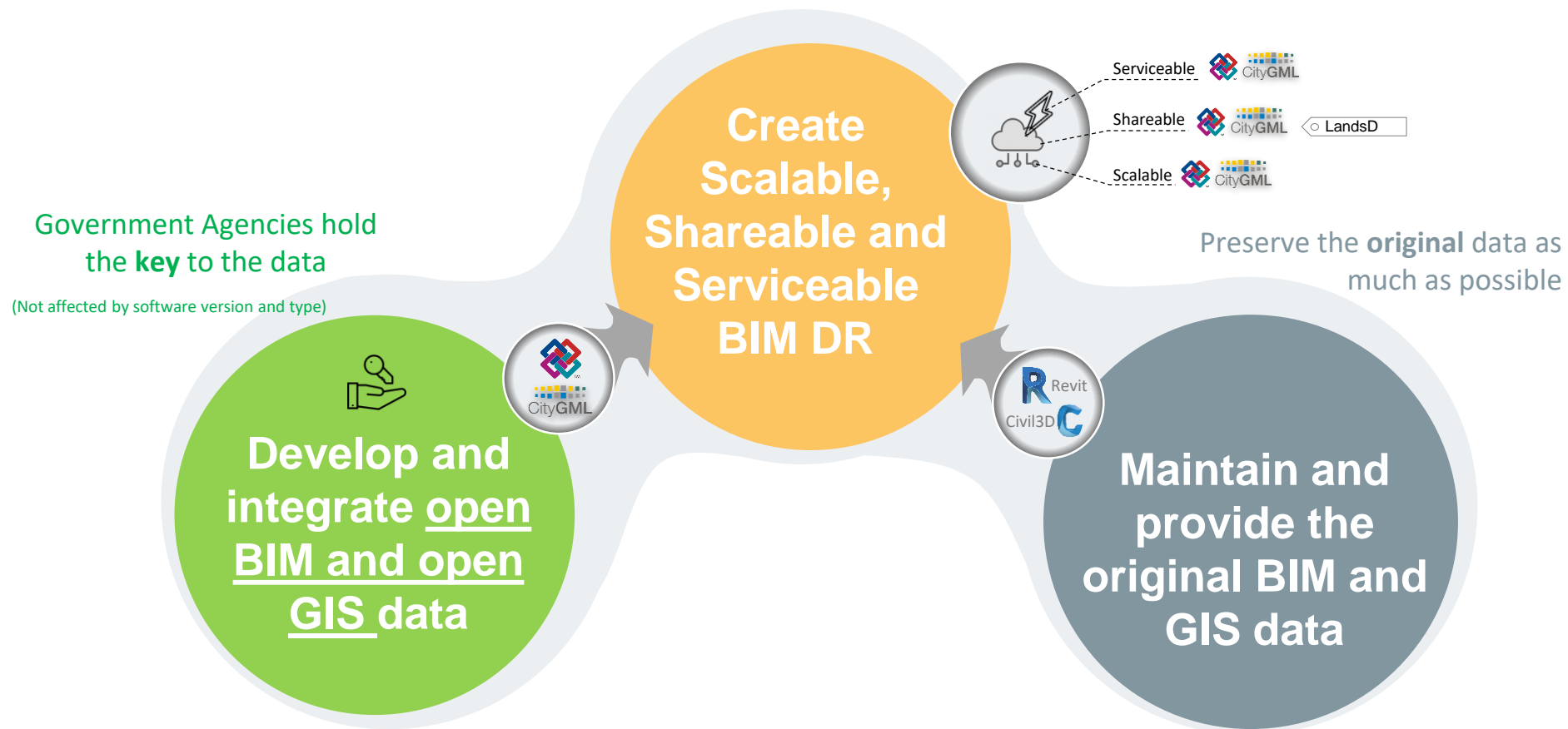


- Define Development Roadmap of BIM Data Repository System
- Recommend Data Formats
- Provide functional requirements
- Develop a Proof-of-Concept application of BIM/GIS integration

# Timeline of Development of BIM Data Repository



# Vision of BIM Data Repository





# BIM Data Repository Roadmap—Three Stages



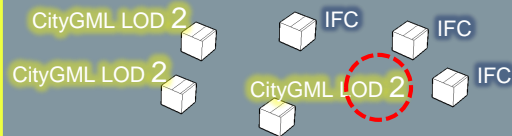
## EARLY STAGE

Use BIM DR for uploading & downloading

Integrate BIM DR with 3D Map

Provide API to stakeholders for testing

Models: Mix of IFC and CityGML Models



## GROWTH STAGE

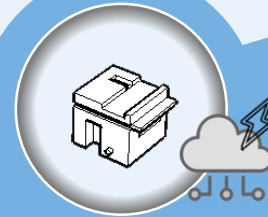
Use BIM DR for urban planning (4D)

Use BIM DR for 3D navigating

Provide BIM DR IFC API to private sector

Use BIM DR IFC for R&D (Universities)

Models: Mix of IFC and CityGML Models



## DESIRED STAGE

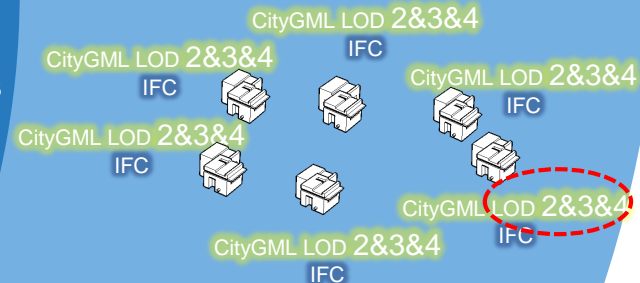
Use BIM DR for IoT monitoring

Use BIM DR for 3D navigating (+indoor)

Use BIM DR IFC for auto-plan checking

Use BIM DR for e-tendering

Models: Twins of IFC and CityGML Models

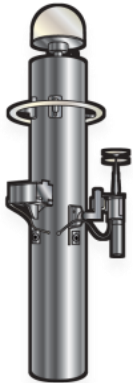


# *Positioning Infrastructure*



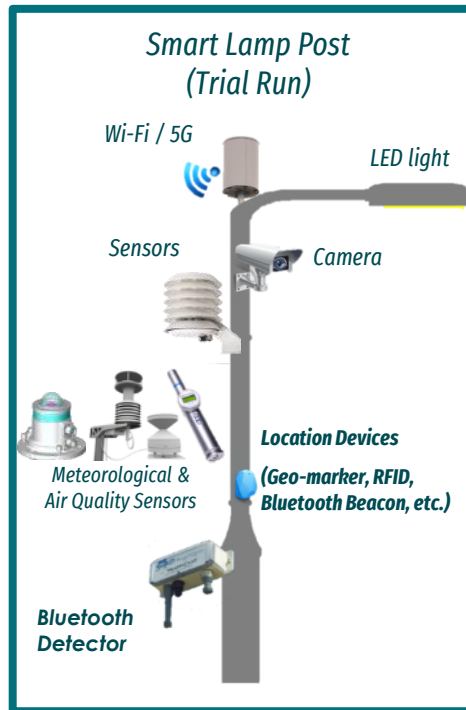
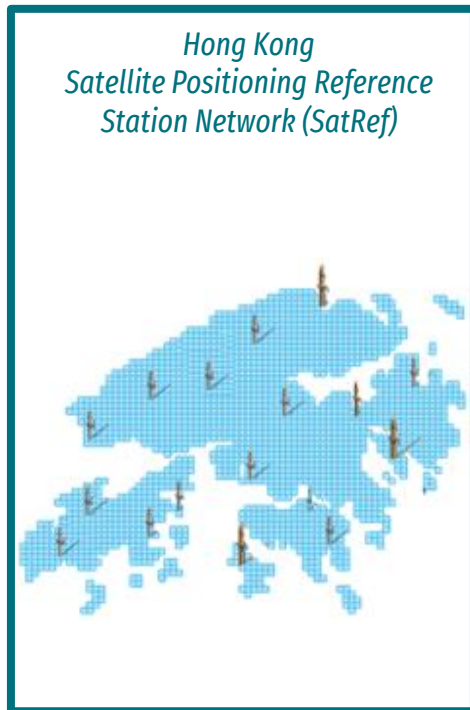
# HK Satellite Positioning Reference Station Network (SatRef) Service

- Developed by SMO since 2000s
- Currently 18 Continuously Operating Reference Stations (CORS).  
(16 Reference Stations + 2 Integrity Monitoring (IM) Stations)
- Receive GNSS satellite signals round-the-clock
  - GPS (USA)
  - GLONASS (Russia)
  - Galileo (European Union)
  - BeiDou (China)



# Positioning Infrastructure

- Outdoor



- Indoor







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

## Future trends in geospatial information management: the five to ten year vision

THIRD EDITION



**SUSTAINABLE  
DEVELOPMENT** **GOALS**



This document was produced by Ordnance Survey of Great Britain at the request of the United Nations Committee of Experts on Global Geospatial Information Management.

Lead author: Christin Walter, Ordnance Survey of Great Britain

All parts of the report may be reproduced provided the source '*Future Trends in geospatial information management: the five to ten year vision - Third Edition, August 2020*' is cited.

**Source:** <https://ggim.un.org/future-trends/>



# Smart City – City of Tomorrow

**Thank You**