

# Re-engineering the Survey and Mapping Office for the Smart City Development in Hong Kong

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**Key words:** 3D Digital Map, BIM Data Repository, Common Spatial Data Infrastructure, Digital Twin, Smart City

## SUMMARY

The Survey and Mapping Office (SMO) of the Lands Department is the Survey, Mapping and Geospatial Data Authority of the Government of the Hong Kong Special Administrative Region (the HKSAR Government). It updates maps and plans of Hong Kong for use by both the public and private sectors. With the advent of geospatial data technology, SMO is upgrading the existing two-dimensional digital map into a full-fledged three-dimensional digital map (3D Digital Map) and supporting the development of the Common Spatial Data Infrastructure (CSDI) in Hong Kong. To transform SMO from a traditional mapping office to a geospatial data agency and the authority for coordinating the collection, sharing and management of spatial data, and thereby contributing to the development of Smart City and Digital Hong Kong, SMO has undertaken a series of business management reviews since late 2019 and repositioned its roles and work. During the review, SMO has redefined its vision and mission as well as identifying five key roles when steering the organisation towards its new position.

SMO and its associated services have a long history. To cater for the functional and cultural changes beyond the legacy and fuse the existing professional functions and new mission of SMO, the management team consolidated the talent and experiences from both administrators' and professionals' perspectives in its governance review and set priorities in the restructuring of SMO. This paper will walk through the journey of SMO in transforming itself from a traditional local mapping agency to the Survey, Mapping and Geospatial Data Authority which fosters the development of a Digital Hong Kong with 3D Digital Map, and enables the seamless flow and integration of spatial data through the CSDI. This helps lay down a critical digital infrastructure for Hong Kong in pursuing the Smart City development.

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## 1. Introduction

With land size of about 1100 square kilometres, Hong Kong is an Asian world city with more than 7 million citizens and ranks in the top five most densely populated city in the world<sup>1</sup>. These statistical figures imply that city space management is important in this city for supporting its continued growth. Effective city space management would indeed be essential to make Hong Kong a spatially enabled smart city. The HKSAR Government launched the Smart City Blueprint with a series of initiatives, including but not limited to development of CSDI and 3D Digital Map, for making Hong Kong a world class smart city. The geospatial ecosystem in Hong Kong has been fundamentally changed along with the government's determination in Smart City development and the technological disruption all over the world.

## 2. Conventional Role of SMO

The Survey and Mapping Office (SMO) of the Lands Department in the HKSAR Government is the central authority for land survey and mapping in Hong Kong. SMO is responsible for establishment and maintenance of a geodetic network, provision of land boundary surveys and photogrammetric surveys, maintenance of a Land Information System for keeping mapping data and land boundary records of Hong Kong, production and revision of maps at different scales for various purposes, and administration of various Ordinances. The aforesaid services and products of SMO have long been used in city planning, infrastructure projects, land management, etc. by both public and private organisations.

To accommodate the new government policies and better serve the community, SMO is determined to extending its traditional role to the Survey, Mapping and Geospatial Data Authority, i.e. the Extended SMO. In addition to its original roles, the Extended SMO also undertakes three key digital infrastructure projects, which are:-

1. supporting CSDI portal development,
2. upgrading of existing 2D digital map into a full-fledged 3D Digital Map, and
3. developing a Building Information Modelling (BIM) Data Repository,

They are in support of innovation and development of Digital Hong Kong, which is a digital replica of Hong Kong (a.k.a. Digital Twin), and related geospatial analytics by both public and private sectors as laid down in the "Hong Kong Smart City Blueprint".

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<sup>1</sup> The World Bank. (2021) *Population density statistic of year 2018*.

### 3. The need for SMO transformation

Technology has rapidly progressed in the past few decades. Thanks to the technology advancement, data collection can be accelerated up to near real time; and the spatial data can be presented and analysed in multi-dimensional ways. The technology revolution enables us to reform our mapping service from 2D paper form to constructing a 3D (or even 4D with time) digital model of our city, allowing us to move closer to Digital Twin. This double-edged sword creates a bloodbath, in which only the outperforming companies can survive and make use of the technology as their competitive advantages in leading the respective industries. The digital era demands both private and public organisations to plan ahead for changes and to apply new technologies in their businesses so as to cater for new ideas, values and market expectations. There is no exception for National Mapping and Cadastral Agencies (NMCA) which encounter the same challenge in this ever-changing world. The concept of the map itself has evolved to increasingly be embedded in systems that are essential for our daily lives. NMCAs are required to fundamentally re-evaluate their roles in government and society<sup>2</sup>. Indeed, popularity of smartphone particularly exerts great impact on the geospatial industry. Smartphone combining mobile internet access, embedded digital map and positioning function leads to booming of location-based applications and services. The global Location-based Services and Real-time Location Systems market are expected to grow from USD 17,776 million in 2020 to USD 39,190 million by 2025<sup>3</sup>. The massive outbreak of COVID-19 across the world in 2020 has caused abrupt changes in the global IT environment and people's expectations. The need of real-time spatial data acquisition and anti-pandemic analysis has set the requirements on either private or public geospatial organisations to new high. In Hong Kong, the number of smartphone users in 2019 was estimated to be 6.5 million<sup>4</sup>. It is predicted that about 93 percent of the population in Hong Kong would use smartphones by 2025. It is obvious that Location-based applications and services would become parts of people's daily lives, and there will be a soaring need in application of spatial data in Hong Kong. The technological disruption requires SMO to reengineer itself.

The HKSAR Government endeavours to embrace innovation and technology to build a world-famed Smart Hong Kong, and to offer strong policy support on Smart City development. This Governmental policy is another booster of SMO reengineering. The HKSAR Government published two sets of "Hong Kong Smart City Blueprint" in December 2017 and December 2020 respectively putting forth over 200 initiatives to enhance and expand existing city management measures and services with the use of technology and spatial data. All those new initiatives are consistent with the major geospatial trend and support the geospatial development in Hong Kong, which particularly involves the implementation of CSDI, the launch of 3D Digital Map, the establishment of BIM Data Repository and the development of

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<sup>2</sup> Cory, M. (12 November 2020) *The Evolving Role of National Mapping and Cadastral Agencies*.

<sup>3</sup> Globe Newswire. (25 August 2020) *Location-Based Services (LBS) and Real-Time Location Systems (RTLS) Market Outlook to 2025 - COVID-19 Impact Assessment*.

<sup>4</sup> Statista. (24 November 2020) *Smartphone users in Hong Kong 2015-2025*.

precise and seamless positioning infrastructure connecting indoor and outdoor. Upon the completion of the said key initiatives, the fundamental building blocks would be available for Digital Hong Kong, which is vital for linking and applying unconnected datasets among different data stakeholders and supporting all Smart City applications.

Similar to many other governments all over the world, the HKSAR Government is also investing extra resources since 2020 on fighting the pandemic and stabilising the local economy. It gives a further hard push to SMO to reengineer itself and to cultivate work smart culture so as to discharge its original duties whilst accomplishing the committed geospatial development with limited resources.

#### **4. Reengineering the SMO**

In the 21<sup>st</sup> century, data is infrastructure<sup>5</sup> and data is also the oil of the digital era<sup>6</sup>. Data itself has become an increasingly important part of the infrastructure of a nation or a city. NMCA are expected to cooperate with various spatial data owners from different sectors, including but not limited to utilities companies, to maximise the value of spatial data for the wider benefits of society.

Data driven approach is also adopted in Hong Kong's Smart City development because all related applications are highly dependent on up-to-date or even real time spatial data. SMO is currently playing a dual role of data creator and provider for releasing geospatial information as spatial data and facilitating public participation, innovation as well as socio-economic development. To further support the government policy on open data, SMO has made most of its digital maps free of charge. Meanwhile, SMO is proactively cooperating with all stakeholders, including government departments, private companies, academic institutions and professional bodies, to explore the potentials and optimal values of the geospatial information and to promote data co-creation culture for establishing a Digital Twin of Hong Kong. The Extended SMO endeavours to complete three mega projects relating to CSDI, 3D Digital Map and BIM Data Repository so as to support the application of geospatial data in Digital Hong Kong.

CSDI aims at providing government departments as well as Non-governmental Organisations and private companies with an infrastructure to share geospatial data. It is envisaged that the common data standards of CSDI would facilitate linkage and integration of geospatial data starting from various government departments to all geospatial data owners in the long run. All the aforesaid stakeholders, therefore, can make use of reliable geospatial data in their analyses, operations, application developments and provision of various spatial data services, which would contribute to the success of Smart City development in Hong Kong.

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<sup>5</sup> Kawalek P., Bayat, A. (23 September 2020) *Data as infrastructure*.

<sup>6</sup> The Economist. (6 May 2017) *The world's most valuable resource is no longer oil, but data*.

3D Digital Map shall be one of the prime building blocks of Digital Twin of Hong Kong. The new form of 3D Digital Map is not just a digital surface model but a full-fledged 3D Digital Map transformed from the existing 2D Digital Map. The 3D Digital Map will also cover the accessible interior space of buildings and structures which is essential for the ubiquitous location-based applications and services. The attribute-based spatial objects, including floor-level and unit-level geometries and attributes, will definitely be the core components in the next generation of geospatial applications. The development of 3D Digital Map consists of three phases. They are 3D maps for visualization, 3D maps for unit-based indoor applications and 3D maps for city modelling.



Figure 1 - Three-phase development of 3D Digital Map in Hong Kong

Upon completion of this three-phase development, the 3D Digital Map would become a comprehensive three dimensional digital framework model of real Hong Kong in support of numerous geospatial applications and city management.

Whilst GIS emphasises on analysis and application of geospatial information in a holistic geographical context, BIM, with the use of rich information of built assets and internal space, focuses on achieving better efficiency during design, construction and the entire development cycle. Although the integration of BIM and GIS is always a complicated topic, it is unquestionable that bringing BIM and GIS together could bring tremendous value to the society. BIM harmonization and BIM Data Repository are two major areas that SMO has been actively spearheading. BIM harmonisation is to align the standards of simplifying BIM model, which pave the way for effective information exchange across the domains of BIM and GIS. Besides, the Extended SMO is promoting the establishment of cloud-based BIM Data Repository to ensure the coherence with development of 3D Digital Map and sharing of BIM data through collaboration. In addition to data obtained from CSDI, the harmonised BIM model will also be one of the major data sources in the creation and ongoing maintenance of 3D Digital Map.

The Extended SMO will not only act as the authority in survey and mapping, but also facilitate the sharing of reliable and standardised geospatial data from known sources and supporting government operations involving the use of geographical information. New roles of the Extended SMO include:-

- i. Survey, Mapping and Spatial Data Office  
To develop, support and manage a Digital Hong Kong (Digital Twin) with spatial data from various sources and data analytics
- ii. Land Status and Cadastral Office  
To enhance land boundary records to an updated cadastral system with legal backup by combining the existing land boundary information in SMO with other land parcel information in other government offices and registry
- iii. Spatial Data Agency  
To define and align spatial data standards and data sharing workflow among government departments and other geospatial data owners to build a digital infrastructure of Hong Kong
- iv. Positioning Infrastructure Agency  
To define and align the standards for GNSS positioning and indoor positioning systems for a ubiquitous Digital Hong Kong
- v. Land Data Bank Holder & Geographical Information Office  
To gather and validate data for enhancing SMO's Land Information System so as to support the search and exploration of land and geographical information.

SMO has undertaken a series of internal business reviews since November 2019 and plans to reengineer itself in two stages with the following objectives: -

#### Stage 1

- strengthening the management team,
- forming dedicated teams for new initiatives, and
- reshuffling and rebalancing work functions

#### Stage 2

- uniting SMO to achieve new goals,
- equipping staff members to accomplish SMO new mission, and
- enhancing corporate efficiency of SMO

The Stage 1 reengineering was accomplished in late 2020. In addition to the original Assistant Director, another Assistant Director has been on board since May 2020. The two Assistant Directors are responsible for leading four divisions in SMO. Various dedicated teams were formed for the new functions, such as CSDI, 3D Digital Map and BIM Data Repository. The work portfolios of all four divisions were reviewed and reshuffled in aspects of workload and types of work so that all divisions would discharge both new and conventional duties. While the four divisions have their respective core functions, they also need to perform certain tasks requiring cross-divisions collaboration. This facilitates knowledge and experience sharing among them.

SMO commissioned a consultant, which was experienced in both human capital management and Smart City development, to assist in Stage 2 reengineering. The consultant assists in

arranging a series of staff engagement activities, such as townhall meetings, focus groups, interviews and workshops, for all staff so that the management can explain the rationale of reengineering, collect comments and feedbacks, and get their buy-in. The consultant would also assist in capability analysis to identify staff training that should be provided or measures that should be taken for effectively performing new functions of the Extended SMO. Upon the consultant's review on SMO business and completion of staff engagement activities, it would suggest which of the existing functions of SMO could be outsourced, streamlined, scaled down or replaced with IT solutions in response to both staff feedbacks and the roles of Extended SMO so that operational effectiveness and efficiency could be maximised. The consultant would also suggest new key performance indicators for the Extended SMO in new work areas. The Stage 2 reengineering would be completed in mid-2021. These reforms are essential for SMO to become a new government office in the digital era acting as a geospatial data hub and taking new roles in the realisation of Digital Hong Kong.

## **5. Major challenges in SMO reengineering**

### **5.1 Institutional challenge among geospatial ecosystem stakeholders**

The HKSAR Government formulates new policies on open data and CSDI which generate changes in the geospatial ecosystem. It is natural to see institutional challenges among stakeholders taking part in this ecosystem. To overcome teething problems, the Government established the Spatial Data Office (SDO) to get rid of inconsistencies or even inefficiencies among the stakeholders in the development of CSDI. SDO consists of multi-disciplinary staff and serves as the executive arm of the HKSAR Government in handling CSDI related matters, such as formulation of CSDI-related strategies, coordination of different spatial data owners for effective sharing of spatial data, outreach and partnership initiatives with external parties on the development of CSDI.

Since the SMO reengineering is to support the initiatives on CSDI and Smart City development, it is designed in line with those new government policies. The Extended SMO works hand in hand with SDO for developing the CSDI portal and providing technical advices to other government departments to facilitate their sharing of spatial data in CSDI.

### **5.2 Cultural challenge within SMO**

Corporate restructuring usually comes with uncertainties and challenges for staff. Because people naturally tend to stay in their comfort zone, the uncertainty associated with organisational and cultural changes could result in staff resistance. If the staff mindset and the organisational vision and mission are not in accord, the goals of reengineering would unlikely be accomplished. SMO is well aware of the situation and therefore arranged a series of staff briefings in Stage 1 reengineering to introduce the idea of Extended SMO and commissioned a consultant in stage 2 reengineering for reinforcing staff engagement so as to boost team morale and secure staff buy-in on SMO reengineering for all staff.

It is crucial to communicate with all staff and not to put change processes just within a small group. To convey the key message that the change process is ongoing and every staff member is empowered to participate and contribute in the organisational development, staff engagement activities have been arranged for all ranks of staff so that the SMO management can hear voices from all levels. Instead of top-down or instructional style seminar, staff-centric approach has been adopted for these engagement activities so as to allow staff members expressing the assistance required for coping with various changes in the workspace. Anonymous online survey has also be made available so that staff can express their views and ideas without hesitation.

Upon the expansion of roles of SMO in the geospatial ecosystem, SMO staff are no longer simply working as one way “doer” by taking instructions but are expected to frequently interact with other spatial data stakeholders. Some staff members may not have sufficient experience or soft skill to adapt to the change. The consultant will hence assist SMO to perform a capability analysis and recommend training or support measures required.

### **5.3 Keeping pace with endless technological advancement**

Surveyors are more than just surveyors<sup>7</sup>. Surveyors need to embrace modern technologies in order to excel themselves. The geospatial industry has been disrupted by technologies, such as application of unmanned aerial vehicles, combination of LiDAR, laser scanning and photogrammetry, ubiquitous positioning and reality modelling. Due to the drastic technological advancement, there are high expectations on NMCA, especially in the context of data-driven trend in the society. NMCA are undergoing rapid changes and their ability to swiftly and accurately respond to the need of society has become more critical than ever. Similarly, how SMO can continuously keep pace with the latest technologies would be a key topic in this reengineering exercise.

To ensure that SMO can embrace the technology change, SMO would prepare Work and Development (W&D) Plans for all divisions. Similar to “SWOT” and Porter’s Five Forces analysis, the W&D Plans formulate the framework of business reviews from both internal and external perspectives so as to make sure that SMO would continuously upgrade itself and improve services for fulfilling the society’s needs.

## **6. Sustainable evolution for SMO**

The Stage 2 reengineering work would be completed in mid-2021. This, however, should not be the Finish Line of SMO organisational development because SMO always strives to keep pace with the rapid advancement of geospatial data development and positioning technologies.

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<sup>7</sup> Hill, C. (8 May 2020) *The Evolution of the Smart Surveyor - 5 Trends Affecting Surveying, Bringing about the Next-generation Surveyor.*



Manpower is always the greatest asset of an organisation. SMO will empower its staff as the driver in this ongoing organisational development. To achieve this, SMO applies 360-degree approach for communications among all staff. SMO management would keep close communication with the staff on the mindset required for working in the new geospatial ecosystem and help the staff get adapted to new changes. Meanwhile, SMO also identifies “Change Champion” from different ranks of staff to proactively cultivate the organisational development culture and stimulate ripple effect at all levels.

As reported in the Future Trends in Geospatial Information Management: the five to ten year vision (draft Third Edition) by United Nations Committee of Experts on Global Geospatial Information Management, Governments continue to remain highly relevant in the geospatial industry by providing high quality, reliable, trusted and maintained geospatial information for a wide range of applications from national resilience to the effective administration of property and land use. The next five to ten years will see significant developments in the maturity and application of already well-established technologies across the geospatial industry.<sup>8</sup> SMO will make every endeavour to unite the entire organisation with a common goal of continued up-lifting by making reference to international trends for the betterment of the city.

“SMO United” may not be a good football team but it will be a team with high morale sharing a common vision and new missions for taking the leading role in applications relating to topography, cadastre and geographic information in Hong Kong.

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<sup>8</sup> Walter, C. (August 2020) *Future Trends in geospatial information management: the five to ten year vision* (3<sup>rd</sup> ed.)

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## BIOGRAPHICAL NOTES

**Mr Andrew LAI** has been the Director of Lands of the HKSAR Government since August 2020. Mr Lai joined the Administrative Service in July 1992. He has served in various bureaux and departments of the HKSAR Government, including the former City and New Territories Administration, the former Planning, Environment and Lands Branch, the Housing Department, the Civil Service Bureau and the Home Affairs Department. He was Deputy Commissioner for Innovation and Technology from February 2009 to April 2012, Deputy Director of Environmental Protection from April 2012 to July 2016, and Deputy Secretary for Financial Services and the Treasury from August 2016 to August 2020.

**Mr Ben CHAN** is the Deputy Director/Survey and Mapping of the Lands Department of the Government of Hong Kong Special Administrative Region. He received his MSc degree in Geographical Information System from the University of Edinburgh in 1993, and MSc degree in Geodetic Surveying from the University of Nottingham in 2003. He is a professional member of both the Hong Kong Institute of Surveyors (HKIS) and the Royal Institution of Chartered Surveyors (RICS).

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