

NURTURING TALENTS OF GEOMATICS SURVEYORS TO MEET THE CHALLENGES OF LAND SUPPLY, WORKS PROJECTS AND SMART CITY OF HONG KONG

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ABSTRACT:

The challenges brought by a growing number of large-scale land development projects (e.g., Northern Metropolis, Lantau Tomorrow, and related infrastructures) in Hong Kong must be met by innovative land acquisition planning and processes. A recent quick win solution to land supply for Works projects has been in trial commissioning the provisional draft land resumption plan preparations and related survey works from the government to consultants, specifically the Authorised Land Surveyor (ALS) in the private sector. The industry therefore must consider the necessary and diverse sources of expertise available, and the existing land surveying technical resources that will render support to such new initiatives. Collaboration is called for between the spheres of public sector, education, and works industry to successfully move the use of cadastral survey for land management forwards, bridging the gap between lands and works practices for efficient processing of Works projects, and smart city development of Hong Kong.

This paper will examine the new approach of professional surveying that private practicing ALSs bring, and why the overall number of ALS and engineering surveyors in the construction industry is growing so slowly. It will additionally compare Hong Kong's practice with that of the mainland China, Singapore, and the UK to grasp global learning points. The paper recommends the establishment of a Cadastral Survey Lab (CSL) firstly to explore the policy implementation of a sound cadastral system. The processing of lot boundary determination by ALS is reviewed. The regulatory roles of the Land Survey Authority (LSA) are requested in approving new land boundary plans; this both replaces the Demarcation District (DD) Sheet boundary and improves land boundary records. Secondly, the CSL can serve as a coordinating body in curating various kinds of land records from diverse sources, and aids the research and knowledge management of cadastral survey, land law, land tenure, land registration systems, land boundary record keeping, problematic lot boundary determination, etc. These topics can be considered in the refining geomatics education curriculum, and furthermore developed into guidance notes for geomatics survey practitioners.

The evolution of the traditional land surveying profession into the geomatics services has become a recent international trend that is growing in popularity in the survey profession. Combining geo-spatial data from the planning and design stages, alongside the use of standardised survey data processing in project implementation and asset management, would encourage data sharing, avoid duplicate efforts, and facilitate the formation of a digital city. The spectrums of geomatics education in universities should be widened with a refined curriculum on combining geomatics with cadastral survey that has evolved from the traditional lot boundary survey to multi-purpose cadastre, city information modelling, urban informatics, smart city administration, and a full-blown Spatial Data Infrastructure (SDI).

1. INTRODUCTION

1.1 Background

Land and housing supply are fundamental basics in the provision of necessary shelter for people and improving their standard of living. The process of 'land urbanisation' for housing purposes calls upon efficient processing of land, Works, and related infrastructure development. It is important therefore, to consider innovations that can be made in two areas: first, the rapid pace of land acquisition for Works projects; second, to maximise the full utility and capability of geo-spatial data technology to streamline the processes. The resulting synergy created here would be essential for smart surveying works, and the building of a digital twin for a smart city.

In response to the challenge brought by a growing number of large scale Works projects, the government has launched a quick win solution to the issue of land supply. They have trial commissioned

the provisional draft land resumption plan preparations and related survey works, from the government to consultants – specifically, the Authorised Land Surveyor (ALS) in the private sector ([Lands Department, 2022](#)). This paper considers the following: a review of current working processes of land development, assessment of the readiness and impact of the new initiative to the industry; how the education sector can prepare to nurture talent in geomatic surveying; how building collaboration between the government, industry, and education and research institutes is vital in meeting the challenge of land supply, Works projects, and the smart city development in Hong Kong.

1.2 Challenges ahead

Land Supply

Hong Kong is one of the most densely populated cities in the world. There has been long-standing serious imbalance in housing demand and supply here. ([Legislative Council Secretariat, 2022](#)).

The limited land supply induces a shortfall and inability to meet housing production targets, which in turn fails our population and community. To relieve the situation and meet the needed land supply, three New Development Areas (NDAs) in Yuen Long and the North Districts are being developed in full swing. The planning of additional NDAs in the northern part of the territory are also in the pipeline. ([The Government of HKSAR, 2021a](#)). According to the [Policy Address 2022](#), the government has to acquire around 500 hectares of land in the coming five years for public Works projects ([The Government of HKSAR, 2022a](#)). This may be done in two main methods. The first, with a nod to sustainable land supplying, aims to join pieces of fragmented land. Resuming the development of each individual piece will increase its value and combining their potential development into one large comprehensive area that will make it more than the sum of its parts. This method could be sped up by streamlining current land resumption processes. The second method to acquire land would be via engineering processes like reclamation. Here, the process could be enhanced by applying the latest emerging technology, and specifically, the use of smart survey technology.

Works Projects

According to the government's announcement in 2021, the Hong Kong Government's annual expenditure on capital works will exceed HK\$100 billion in the next few years. ([The Government of HKSAR, 2021b](#)). They have demonstrated a commitment towards enhancing speed, efficiency, quality and quantity in the methods, processes and techniques used to ensure an adequate supply of land. The Northern Metropolis and Kau Yi Chau Artificial Islands projects are two major items listed on the agenda ([Development Bureau, 2022a](#)).

Smart City

The smart city development in Hong Kong has been on the government's agenda, with the intention to leverage technology and spatial data to improve the efficiency and quality of life within its geography. The Hong Kong Smart City Blueprint 1.0 and 2.0 were published in 2017 and 2020 respectively as key parts of this Smart City development. ([The Government of HKSAR, 2020](#)). However, when compared globally, the International Institute for Management Development (IMD) ranks Hong Kong 41st out of 118 cities worldwide; Singapore ranks first. ([IMD, 2021](#)). In recent years, the government has commissioned the Common Spatial Data Infrastructure (CSDI) and 3-dimensional (3D) digital map project – this approach provides the basics for developing the city's digital twin successfully and efficiently.

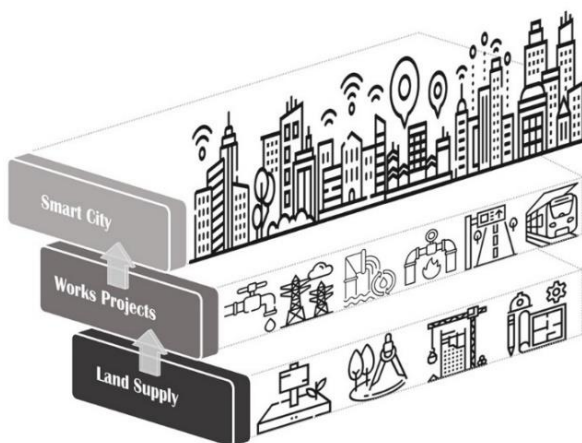


Figure 1 – The challenges ahead

1.3 Importance of nurturing talents

Insofar, a number of challenges has been addressed. The challenge of pursuing a number of developments across the territory in coming years, including the above-mentioned two mega projects and strategic railways, all in a compressed schedule calls for sufficient, qualified new talents in geomatic surveying. This will be essential for the success.

The government has a vision of charting Hong Kong to become an international Innovation and Technology (I&T) centre and is moving the city in full steam towards this vision. The national 14th Five-Year plan expressed clear support for Hong Kong to develop into an international I&T hub ([The Government of HKSAR, 2021c](#)); the 2023/24 Budget highlighted its focus on I&T development ([The Government of HKSAR, 2023](#)). To prepare Hong Kong to step into the new technology era, it's indispensable to nurture talents who will be able to support and provide innovative solutions. The workforce will be a key contributor in keeping pace with the times. Indeed, the 2022 Policy Address highlighted nurturing local talents and attracting talents to ensure a sufficient workforce to support Hong Kong's growth was essential ([The Government of HKSAR, 2022a](#)). Specifically, within the scope of a Smart City, these talents refer (non-exhaustively) to geo-spatial data scientists and data analysts in the geomatics survey profession.

Furthermore, sharing best practices for professional development and an effective transfer of knowledge in the field of geomatics will be crucial to the city's development and connection to its region. By creating opportunities for young talents in geomatic surveying to enter the private practice surveying work, change is anticipated and welcomed.

2. REVIEW

2.1 Overview of Current / Traditional Practice

Land Management and Cadastral Survey

Cadastral survey plays an important role in land management. It has far-reaching significance for the protection of national land resources, and the real property of individual owners.

Land (with its sovereignty, political sensitivity, legitimate ownership, and high capital value attributes) has long been administered by the government. This further extends to the day-to-day survey operations. Government dominance has been historical in land surveying works, with different kinds of land records being kept within the government's ownership in various departments and offices.

In 1995, Land Survey Ordinance (LSO) (Cap. 473) enactment established Authorized Land Surveyors (ALS) to serve the community in land boundary surveys and subdivision of lots. Presently, there are 34 ALSs published in the gazette ALS list of 2023 ([The Government of HKSAR Gazette, 2023](#)). The ALS workforce is currently facing an aging problem, with some not actively participating in the market at all.

Traditionally, the government has kept old land boundary records, new land grant and modification records, and section lot boundaries defined by the private practicing ALSs. Land boundary plans created from the lot boundary surveys conducted by private practicing land surveyors and ALS has long been voluntarily submitted to the government for sharing purpose; this

has been adopted for decades. Members of the public, including ALS practitioners, have access to different sorts of land boundary records through an online system, namely the Hong Kong Map Services (HKMS) 2.0 of the Lands department. They can retrieve and obtain records. However, although most of the survey data has been made accessible through HKMS 2.0 of the Lands Department, some old records and proposal information remain solely for internal reference within the government.

Lands and Works Developments

Due to the division of labour, different government departments and offices have varying ambit and areas of responsibility in land development and Works projects.

To commission a Works project (by departments such as the Civil Engineering and Development Department, Highways Department, Water Supplies Department, Drainage Services Department, etc.), there must be an initial process of land acquisition that goes through the Lands Department. So, all land requirements of Works projects must be channelled through the Lands Department before they can commence. Where Works project geographically covers private land, a further land resumption process is required. This involves topographical survey, extensive land boundary review, and an investigation on every piece of affected lot and occupation. Heavy backlog and long queue of Works projects awaiting the processes of land resumption are anticipated.

Spatial Data Sharing for Smart Works and Smart City

The government departments, each holding different disciplines of professionals serving the public in their specific areas, have individually chosen their best software kits and custom tools in their areas of expertise. This has resulted in different formats and standards of working data. However, the shared use of Building Information Modelling (BIM) standards by planning, lands, and works departments helps create a mutually understood standardisation and a harmony between them. The development of a BIM repository (for planning, lands, and works purposes) and the establishment of a Common Spatial Data Infrastructure (CSDI) has both meant better spatial data sharing in recent years.

2.2 Difficulties Encountered

Land Boundary Determination

Although the land boundary plan of a lot prepared by an ALS could be voluntarily submitted to the government for sharing purpose, it remains to count on the judgement and decision of the ALS in the determination of such boundary of the subject private lot (also as the common boundary of its adjoining lots and/or government land). It is never made clear that such boundary determination by ALS would be adopted by the government as an accepted surveyed boundary record of the private lots even though the new boundary is much more precise than the lot boundaries demarcated in the 1:3960 or 1:1980 scale Demarcation District (DD) Sheet of the New Territories with survey conducted in early 1900's or section lot assignment plans in the urban areas.

As a matter of fact, the government, having authorised the ALS to perform the survey in accordance with the Code of Practice of the Land Survey Ordinance (Cap. 473), would leave it to the professional judgement of the ALS in the boundary determination of the subject lots under survey until it involves any government applications such as application for redevelopment or boundary clarification upon any lands and works development. This

incidental way of treating the ALS's plan submission would hold up the corresponding land boundary records updating and cause hinderance to the planning of land development and Works projects. More in-depth discussion about the difficulties encountered by ALS in plan submission could be referred to *pages 155-165*, the book of "The Labyrinth of Land Boundary" (地界迷津) by Sr Leung Shou-chun (Leung, 2018).

The basic cause of the boundary uncertainty is the graphical nature of the original DD Sheet which failed to support the modern day urbanised form of development. A line in the DD Sheet simply represents an indeterminate strip of land of at least 1 to 2 metres. Further, whether the ALS has acquired sufficient and complete information for the boundary determination was doubtful as some land records being kept by the government, possibly in more than one office may not be accessible by the ALS. Hence, in unfortunate cases, the ALS may be led to decide on a boundary with missing evidence. The Land Survey Authority (LSA) as the central authority in land boundary survey and the curator of land boundary records, should be the authority and government advisor regarding cadastral survey matters involving lot boundary determination, locations and limits of encumbrances on land. Timely endorsement of ALS's plan submission or otherwise by the LSA is therefore at all important.

Pursuant to the government's Open Data Policy, the Lands Department opened up the digital land record data to the public in April 2021. Any further sharing of land-related data for cadastral survey purposes should be considered before the private practicing ALS could fully take up the cadastral survey work.

Government-dominant vs Consultant-led

Although individual government departments and offices do have their own individual ambits, the processing of Works projects requires them to communicate with each other and cross over traditional department boundaries. The lack of a formal facilitator in aiding these processes have created additional difficulties in Works projects. There has also been an inadequate sharing of knowledge and resources between the spheres of government, industry, education, and research institutes. This results in either the required information, knowledge, and skillset being confined to a small group of government practitioners, or a waste in effort with duplicated work that could be streamlined instead.

As mentioned above, land matters have historically been administered by the government, extending into their day-to-day routine survey operation. This has resulted in a government dominance in land surveying work. Conversely, Works projects have been adopting the consultant-led approach for more than three decades when it comes to the construction industry of Hong Kong. So, a facilitator or design change is required to bridge this gap between the Lands Department and the participating departments, with the aim of streamlining land acquisition processes in Works projects.

Spatial Data Sharing and Standards

On the technical side of things, data sharing between the various participating departments has neither been fully streamlined nor automated. A significant amount of effort was spent on the conversion of traditional paper records and scanned images into a suitable digital format, and CAD formatted data into a GIS format to facilitate the survey, plan preparation and data analysis. Survey standards and data specifications for specific purposes and general use are not effectively promulgated and commonly adopted.

3. NEW INITIATIVES

2.3 National and International Adoption – from Cadastral Survey to Geo-spatial Data Management

In mainland China, Cadastral Survey (地籍测量) is for natural resources (land) management. It is under the administration of the Municipal Bureau of Planning and Natural Resources (规划和自然资源局) of a city, and the Ministry of Natural Resources (自然资源部) of the country. *“The emphasis on land in our country has been greatly improved, and cadastral survey is an important work content of land management, which has far-reaching significance for the protection of national land resources.”*

“Cadastral survey plays an important role in land management, and the most important work content is the research on cadastre, using advanced technology to measure land. The management department employs specialists in relevant professions to use scientific instruments to conduct precise measurements of land area, utilization rate, ownership, etc. and draw them into maps, and then the relevant departments process the data and make plans for land use. Therefore, cadastral survey is fundamental to all later stages of work. Providing accurate data is the core of the work of surveyors. (Liu, 2018)

“As cadastral survey is closely related to the interests of the people and plays a protective role in the integrity of the country, it is necessary to conduct accurate surveys according to different geological features, so geological survey staff are required to have the ability to bear hardships, be careful, and work rigorously. At present, cadastral survey of our country meets the requirements, and provides effective data in the collection of land use tax and the registration of people's real property. To better promote economic development, further research on cadastral survey is also very important. Only by constantly improving technology and improving work experience can meet the increasingly strong demand for land, thereby meeting people's housing needs prior to the requirement of land for industrial uses.” (Liu, 2018)

In Singapore, land surveying is seen to be one of the backbones of the construction industry, and so the demand for land surveyors increases in parallel to the construction volume. The Land Surveyors Act (Cap. 156) of Singapore set up the Land Surveyors Board to enable: the registration of land surveyors; the maintenance of annual registers for practitioners and licences; and **regulating land surveyors' qualification and practice for engaging survey services.** According to the Singapore Land Authority Annual Report 2021, as of 31 December 2021, 98 land surveyors were registered. The Land Surveyors Board also issued 64 practising certificates to registered surveyors to engage in survey work over the year 2021 ([Singapore Land Authority, 2021](#)). **Amongst the practitioners, 11 are working in statutory boards, whilst 53 are practicing in the private sector.** Additionally, 18 licences were issued to corporations to provide survey services.

In the UK, the Ordnance Survey has evolved from a traditional national survey and mapping agency into a big data powerhouse for the people. At the core of their business is spatial data; they envisage the significance, influence and impact that spatial data can have to their nation's economy in order to drive the development of the country.

3.1 Survey and Provisional Draft Resumption Plan Preparation by ALS Consultants

In the mega land resumption project for the “Hong Kong Section of Guangzhou-Shenzhen-Hong Kong Express Rail Link”, about 24 hectares (ha) of private land and about 19 ha of underground strata of land were resumed for the construction of the entire XRL project. About 226 ha of government land in Yuen Long, Tsuen Wan and Kwai Tsing in the New Territories and Kowloon were affected. The land resumption and clearance affected about 160 households involving about 520 residents, and about 43 commercial/industrial undertakings. ([Transport and Housing Bureau, 2009](#)). Survey consultant /contractors were deployed in the project to expedite the land resumption survey and resumption plan preparation work.

At present, the project limit is proposed during the project's initial stage by the participating Works departments or their consultant. This proposed project limit is prepared mainly on the engineering requirements of the Works – often not taking land administration perspectives into account. However, project land boundaries should generally avoid clearing graves/urns, partial demolition/clearance of structures and occupations, resumption of house/building/problematic lots, etc. Even where the proposed project limit is made with reference to map features, the basic-detail in the maps and data used in the land requirement plan may not be fully updated or depicted in a sufficient degree of refinement to reflect the situation on the ground. This results in repetitive revisions of the project limit and wasteful spending of time needed to prepare the land resumption plans.

If, in land acquisition, the land survey and resumption plan preparation work was streamlined through engaging private sector ALSs during the early stage of engineering study, the land resumption plan preparation would be greatly expedited. The new initiative is for the ALS to carry out the groundwork for land resumption plan preparation and to provide survey information and reports in four following aspects:

- i) Updating Topographic Map
 - To identify critical features that should be included or excluded from the project limit, such as buildings, temporary structures, and boundary walls
- ii) Identifying the Grave and Urn near and within the Project Limit
 - To determine the size of the burial features, including their associate components, such as worshipping platform, incinerator, etc., for compensation purposes
 - To identify the earliest existence of the identified graves/urns from available survey records to see whether Land Acquisition (Possessory Title) Ordinance (Cap. 130) is required to resume the possessory title of the existing grave/urn on the government land
- iii) Checking the Land Status and Determining the Private Land to be Resumed
 - To review the boundary of private land and determine the area to be resumed
- iv) Preparing the Provisional Draft Land Resumption Plan
 - To propose the resumption limit based on the updated topographic details with due considerations of engineering requirements and land administrative, boundary and survey matters
 - To highlight discussion items, such as affected

structures, excessive fragmentation of land parcels, a tiny remaining portion of private land after the land resumption, etc.

- To prepare the provisional draft land resumption plan according to the required standard and specification

It is expected that by engaging ALS as a survey consultant, the proposed project limit (shown on the land requirement plan) will now be more accurate. It can reflect the actual ground occupation realistically and minimise the chance of having to do subsequent revisions. Additionally, the problematic lots with boundary/registered area mismatch issues can be identified at an earlier stage and resolved more effectively. In this way, the process of the land resumption plan preparation will be expedited, with the additional benefit of the topographic map being updated during the early stage of work.

3.2 Works Projects Collaboration – between land survey and engineering works

ALS consultants are knowledgeable in both land boundary surveying and engineering works. Outsourcing land boundary surveys and provisional draft resumption plans to them could also help build the desired 'bridge' between the gap of government-dominant land surveying, and consultant-led Works projects. The required survey standards in both land boundary surveying and plan production work could be specified by the government's Land Survey Authority (LSA). As a government consultant, the project ALS shall be provided with the required land records. The corresponding lot boundary determination by the ALS should be submitted to the LSA for agreement.

In the development process, the "geo-spatial data" of the land and its surrounding environment is passed on and linked up to different stages of works. As far as is practical, this "geo-spatial data" should be standardised in format, quality and standards. This would facilitate collaboration between different disciplines, and expedite the development progress at different stages of work. In the past few years, the government took the lead in applying BIM technology in public Works projects with an estimated value of over HK\$30M (Development Bureau, 2021). A centralised BIM Repository was established in recent years for sharing of BIM data amongst planning, lands and works professionals within the government. The design and as-built BIM model of all Works projects could furthermore update the topographical map and 3D digital map efficiently (Development Bureau, 2021).

3.3 Smart City Development

It has become an international trend for the traditional land survey profession to evolve into a geomatics service. It is growing in popularity in the survey profession. Urbanised cities in the world have been transforming into smart digital cities with adoption of new technologies, e.g. BIM, Spatial Data Infrastructure (SDI), Artificial Intelligence (AI), Big Data Analytics, etc. Geomatics surveyors have an important role in this transformation as they offer their professional support to the acquisition, manipulation, provision and maintenance of spatial data. Attracting more talents into the profession and equipping them with the new trend of the technologies will contribute to such digital transformation. The emerging ChatGPT, an AI chatbot, capable of answering questions and interacting in a conversational way is expected to have fundamental impacts to different applications.

The government launched the Common Spatial Data Infrastructure (CSDI) portal for the public free of charge in late

2022. It provided a map-based digital infrastructure – a one-stop platform to open and share the government's geo-spatial data. Allowing members of the public to search, view and download various kinds of geo-spatial data from the portal opens a wide range of possibilities for application development, in turn boosting the digital economy and improving quality of life (The Government of HKSAR, 2022b). The datasets on the CSDI portal follow certain agreed standards. This ensures reliability, accessibility, and interoperability of geo-spatial data that came originally from different sources, and thus can be confidently shared with the community (Development Bureau, 2022b).

Additionally, the government established the Geospatial Lab in 2021. This was a platform that was provided to reach out to the wider community, in particular the younger generation and start-ups. It has the viewpoint of exploring the value and applications of spatial data, serving as a linchpin in the community's drive towards a wider use of spatial data.

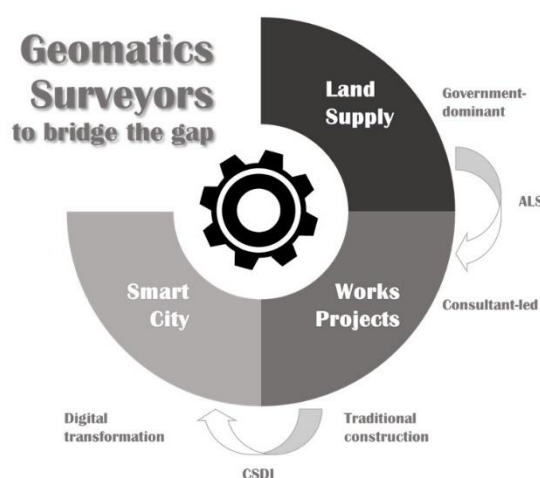


Figure 2 – Geomatics surveyors to bridge the gap

4. OPPORTUNITIES AND RECOMMENDATIONS

4.1 Short-term Recommendations

4.1.1 Proposed Establishment of a Cadastral Survey Lab

It is recommended that a Cadastral Survey Lab (CSL) is established by the government at policy level. It will have operating government departments as the executive arms, and university research institutes as its wings that connect to corresponding research developments internationally and mainland China for further development.

The main purposes of the CSL would be two-folded: first, to explore the policy implementation of a sound cadastral system; second, to serve as a coordinating body in (a) curating various kinds of land records from diverse sources, and (b) aiding the research and knowledge management of cadastral survey, land law, land tenure, land registration systems, land boundary record keeping, problematic lot boundary determination, etc. These topics can be considered in refining the geomatics education curriculum; and furthermore, developed into guidance notes for geomatics survey practitioners similar to the NICE guidance to medical doctors in the UK (National Institute for Health and Care Excellence, NICE, 2023).

(I) Exploring policy implementation of a sound cadastral system

With the recent discussion on the proposal of implementing title registration on “newly granted land” under the Land Title Ordinance (LTO) ([Development Bureau, 2022c](#)), the title register under the supervision of the Land Registry maintains the records of property ownership and information about the rights and interests. **The LSA defined in the Land Survey Ordinance, whose function is to maintain land boundary records, should take up the responsibility to maintain the new plans prepared under the process of determination of land boundaries (HKIS, 2010).** CSL could explore the implementation of a sound cadastral system at policy level.

The treating of DD Sheet boundary as the only “legal boundary” must be dismissed. It should be replaced by an enhanced survey plan. **The LTO may serve as the avenue for such an action such that upon replacing the deed system, the land title system will register a replacement plan as the record.** As this replacement plan must meet a prescribed standard, an authority must be established to endorse it. So, what would affect the current situation are (a) people including legal practitioners, surveyors and their allied professionals, land owners and developers must be alerted to realize the inadequacy of the DD Sheet, (b) ALS must observe their responsibility and standard of work; and (c) LSA must assume its role as the Survey Authority.

(II) Coordination work and Knowledge Management of CSL

The CSL would coordinate the keeping of land records from diverse sources of government departments of planning, building and works – including but not limited to the Lands Department, Land Registry, Public Records Office, as well as from consultant ALS and private practicing land surveyors. It should become a platform holding cadastral survey and various kinds of land records, with policy and funding support for different sectors. The accuracy and reliability of land boundary records will be improved with an enhanced land status information being more readily available to the private sector and ALS. This way, ALS practitioners and trainees can grasp the required knowledge, learn the necessary skillset, and acquire the information for land boundary survey from a centralised source. It is also the hope that this would **attract more young talents pursuing their careers and development in the private sectors, ensuring the future workforce, and enabling a better balance of survey professions/technicians in the public and private sector.**

4.1.2 Regulatory Roles of the LSA – a Central Survey Authority

The Land Survey Authority (LSA) shall be the central authority in determination of land boundaries in the case of land and lot boundary dispute; the curator of land boundary records; and the government advisory regarding cadastral survey issues including land boundaries, locations, and limits of encumbrances on land. The LSA is to decide that (i) whether the ground location of the boundaries are conducive with the intention of the lease, (ii) whether the re-established boundaries on ground are supported by reliable boundary evidences, and (iii) whether the new measurements of the boundaries are conducted in according to the Code of Practice issued under the Land Survey Ordinance. The land boundary plan for land subdivision shall be checked by the LSA before submission of the relevant instrument to the Land Registry for registration. **All approved land boundary information (including the new plan) should be kept by the LSA under a land boundary record system so as to make the better boundary descriptions available to the public. (HKIS, 2010)** Such land boundary records timely updated with

boundary survey details provided by ALS and government departments **shall form the cadastre base of the CSDI.**

The LSA could further assess the competencies of ALS consultants by setting up standards, guidelines and devising best practices on top of the current Code of Practice under the Land Survey Ordinance (Cap. 473). The LSA could maintain consultants' performance records by rewarding high performing consultants in a price-score tendering system of future Works projects.

4.1.3 Knowledge and Skill Transfer to ALS Consultants – a Facilitator

Upon review of the current work processes in the supply of land by resumption, it is considered that knowledge and skill transfer from government to the private sector should be carried out in parallel for the outsourcing of the land resumption survey and preparation of the provisional draft land resumption survey plan by ALS consultants. The ALS acting as government consultants in cadastral survey should be enabled with the provision of land record information to expedite the land resumption survey and preparation of the provisional draft land resumption plan for execution.

4.1.4 Assured Quality of Work by Qualified Practitioners

The necessary qualifications and working experience requirements of professionals and technicians carrying out cadastral surveys and engineering surveys should be clearly stated to prevent mismatch in skills and gaps in project management. The education sector may provide training to the new practitioners of the relevant fields in achieving the required qualification for entry to the profession.

4.1.5 Survey Standards and Spatial Data Transfer Standards

To facilitate data sharing and avoid duplicating work efforts in land development and Works projects, survey requirements, survey procedures, survey data standards, and spatial data transfer standards should be agreed among surveyors and their counterparts of the Works projects. Such agreed procedures and standards should be published as the best practice guide for the land and engineering survey industry, and downloadable on public domains. The establishment of a Survey and Spatial Data Category of Consultants under the Engineering & Associated Consultants Selection Board (EACSB) could facilitate the sharing of a common data environment for engineers and surveyors in their day-to-day operations.

4.1.6 Cadastral Data as an Essential Land Record Base of CSDI

A sharing platform holding cadastral survey and land records with input and ownership by other sectors (who contribute their data) should also be established. The recent development of the Common Spatial Data Infrastructure (CSDI) is an essence of geo-spatial data sharing. As 80% of data is locational, data relating to economic and social activities could be tagged to the CSDI; the data values could reflect its interaction, relevancy, and correlation with each other. For example, the correlation of people's visiting points with the occurrence of Covid-19 transmission provides information about contact tracing.

Cadastral surveying supports land management. The cadastral data would form an essential land record base of the CSDI. Coordinating the cadastral and land record information from diverse sources of government departments/offices and the private

practicing ALS would provide a complete set of land status records. This would help informed policy making by the government, planning and design in Works projects, and decision making by businesses and social activities.

4.1.7 Emerging AI Technology Implications

Gathering various kinds of data together creates information and develops knowledge. Big Data technology and open Artificial Intelligence (AI) have an influencing and disruptive innovation effect to the traditional survey and geographical information system. Urban informatics supported by new technologies would require participating talents from Information Technology, AI and spatial data analytics to form a slash “/” professional with multi-skill with the interests to co-create and contribute to the Smart City.

4.1.8 Pilot Project Implementation

A suitable pilot project site may be chosen to showcase the implementation of the suggested changes. This would also test the viability of the above new initiatives. A portion of the Northern Metropolis could be considered as a pilot implementation with the new initiatives speeding up the land acquisition and formulating the model for collaboration between multidisciplinary professionals and offices in developing a complete cadastral survey and land record base for the CSDI.

4.2 **Medium to Long-term Recommendations**

4.2.1 Research and Connecting Roles of the CSL

In addition to the duties of the CSL described above in exploring the implementation of a sound cadastral system, and comprehensive land records keeping and knowledge management, medium to long-term purposes of the CSL are research for the enhancement of cadastral surveys, land tenure system, land registration system; the establishment of 2D and 3D cadastres through its academic and research wings connecting their counterparts in mainland China and other countries.

The CSL could render support for the review and curriculum development of cadastral survey, land law, land boundary records, and land registration system. It could conduct workshops on land matters for Works projects and land resumption survey, widening the spectrums of geomatics education in university, and make proposals to professional institutes in accreditation of university course of related subjects.

Due to the significant relationship between cadastral survey and land management, the CSL (with its established procedures of work processes, channels of data sharing and project implementation) could be developed to a quasi-government organisation with market-driven and professional-led approach of operation in the long run. The CSL could further promote the sharing of knowledge and working experience of geomatics stakeholders of the Hong Kong Special Administrative Region and mainland China in cadastral survey and land management.

4.2.2 Review and Proposed Amendment of Section 30(4) of the LSO to Ensure that the Land Boundary Plans Prepared by ALS are Checked by the LSA before Submission for Registration under the Land Registration Ordinance (LRO).

The existing practice of submitting the unchecked land boundary plan for registration under the LRO should be discontinued ([HKIS, 2010](#)).

Section 28(4) of Cap. 473 “Authorized land surveyor who certified a land boundary plan referred to in subsection (1) or (2) shall deposit with the Authority a duplicate of the land boundary plan and the survey record plan of the relevant land boundary survey both signed and certified in the specified form, not later than 7 days after the deed, conveyance or other instrument in writing by which the land boundary plan is accompanied in accordance with subsection (1) or (2) has been delivered into the Land Registry for registration under the Land Registration Ordinance (Cap. 128).”

The existing practice may cause serious consequences as rectification of a mistake in the register cannot be effected (in a practical sense) if the land is further subdivided and sold to other purchasers. The uncorrected mistake may cause dispute among subsequent vendor and purchase of the property. ([HKIS, 2010](#))

4.2.3 Review and Proposed Amendment of Section 28(4) of the LSO Regarding the Liability of ALS

With the above review on land boundary survey and the corresponding working environment, possible reasons on why the number of ALS and engineering surveyors in the constructions industry is growing so slowly are explored. One of the reasons as expressed in the court judgement of a land boundary dispute case of The High Court of the HKSAR, Court of First Instance Action No. 181 of 2004 regarding the liability of ALS under the LSO is as follows:- ([The High Court of the HKSAR, 2004](#))

Section 28(4) of Cap. 473 “An authorized land surveyor shall be personally responsible for the accuracy and completeness of every land boundary plan signed and certified by him and produced from a land boundary survey carried out by him personally or by other persons under his supervision or direction, or partly by or under the supervision or direction of another authorized land surveyor, and he shall be liable for any loss or damage suffered by any person as a result of any inaccuracy or incompleteness of any land boundary plan so signed and certified.”

“The duty under the second limb of section 28(4) is not merely to exercise such skill and care which is ordinarily exercised by reasonably competent members of the profession who have the same rank and profess the same specialisation (if any), but to be “accurate” and “complete” in every land boundary plan signed or certified by the authorised land surveyor. ... In short, the duty is not just to be competent but to be correct. Further, if the second limb does not go beyond negligence, there is little or no need for its enactment...The duty is onerous. But it is a matter of choice for a surveyor whether or not to register under the Ordinance, whether or not to undertake survey work under the Ordinance and whether or not to sign or certify plans. A surveyor is perfectly at liberty to perform other professional work which was available before the enactment of the Ordinance.”

The section 28(4) of Cap. 473 (LSO) should be reviewed in reconsidering the liabilities of the ALS as compared to other disciplines of professionals in carrying out their legitimate duties for the community.

5. CONCLUSIONS

The spectrums of geomatics education in universities should be widened with a refined curriculum on combining geomatics with cadastral survey that has evolved from the traditional lot boundary

survey to multi-purpose cadastre, city information modelling, urban informatics, smart city administration, and a full-blown Spatial Data Infrastructure (SDI).

With the policy of “Big Market, Small Government”, many government departments uphold the principle of “market lead, government facilitate”. A broad range of work including low skill cleaning, knowledge workers such as teachers and librarians, and professional medical doctors, nurses, architects, and engineers, all with their human resources are mainly retained in the private market. Adoption of professional standards and good trade practice become self-regulatory in rendering quality services to the public.

Land with its political sensitivity, legitimate ownership and capital value attributes, has long been administered by the government. This government dominance extends into their day-to-day routine survey operations, and in the surveying workforce distribution. The limited job vacancies and relatively low salary of the private market surveyors compared to their government counterpart further weakens the position of private practicing land surveyors. Conversely, Works projects have been adopting the consultant-led approach for more than three decades in the construction industry of Hong Kong. A facilitator or design change is required to bridge the gap to streamline the processing of Works projects in land acquisition.

The government’s recent trial in commissioning the topographical survey and land boundary survey is a paradigm shift and changes the eco-system of land surveying work. The hiring of ALS consultants in land resumption survey would help communication among the consultant-led contract management and the currently government-dominant land boundary survey work. It paves the way for the survey profession being welcomed into the mainstream of Works consultancy as a new category of Survey and Spatial Data Consultant under the EACSB. The regulatory role of LSA in assessing the competencies of ALS consultants and maintaining their performance records could reward the good performers in a price-score tendering system that outsources survey work to ALS consultants.

A Cadastral Survey Lab (CSL) – exploring the implementation of a sounder cadastral system for Hong Kong – is recommended to be established by government at policy level with operating departments as the executive arm, and university research institutes as wings that connect to corresponding researches in other countries and/or the mainland China for further developments of cadastral survey and related subjects.

The main purposes of the CSL would be first, to explore the policy implementation of a sound cadastral system; second, to serve as a coordinating body in (a) curating various kinds of land records, and (b) aiding research and knowledge management of cadastral survey, land law, land tenure, land registration systems, land boundary record keeping, problematic lot boundary determination, etc. These topics can be considered in refining geomatics education curriculum; and furthermore, developed into guidance notes for geomatics survey practitioners.

Cadastral surveying supports land management. The cadastral data would form an essential land record base of the CSDI. The DD Sheet (in a plan scale of 1:1980 or 1:3960) boundary should be replaced by an enhanced survey plan. Such replacement plan must meet a prescribed standard, an authority must be established to endorse it. So, what would affect the current situation are (a) people including legal practitioners, surveyors and their allied professionals, land owners and developers must be alerted to

realize the inadequacy of the DD Sheet (b) ALS must observe their responsibility and standard of work and (c) LSA must assume its role as the Survey Authority.

LSA’s roles in specifying the required survey standards and specifications across different Works projects of the government are essential to the land and engineering survey of the works industry. Such common standard and specifications would assure the quality of the survey outputs and facilitate data sharing among works and lands departments. Moreover, with common data specification and spatial data transfer standards, construction data of CAD, BIM and GIS, 3D-model could be shared and the digital 2D or 3D map could be completed as soon as the works are as-constructed. It realises the formation of the digital replica of the built environment – the digital twin.

Geomatics surveyors should equip themselves with the required knowledge to fit in with the new working environment, from traditional land and engineering survey, to rendering of geomatics services, developing SDI for the community, and supporting informed decision making by government, business and personal social activities.

Sustainable land supply joining pieces of fragmented land and resuming the development of each individual piece (with the new approach of survey and land resumption preparation processes) would efficiently provide large project sites for new development. The Northern Metropolis given in the Policy Address 2022 and the integration of Hong Kong and the Greater Bay area are typical examples of this kind that could be considered for pilot implementation of the proposal as given in the recommendations of this paper.

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