

# **Spatial Data Exchange within the HKSAR Government – from a Perspective of a Data Agent**

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**Key words:** spatial data, data exchange, common spatial unit, data dissemination, data alignment, spatial data infrastructure.

## **SUMMARY**

Under the Digital 21 Information Technology (IT) Strategy, the HKSAR Government has been making substantial progress towards making Hong Kong a leading e-business community and digital city in the globally connected world. The Lands Department (LandsD), as the primary digital map data supply agency in Hong Kong, is in the position to help the establishment of the Hong Kong Spatial Data Infrastructure (HKSDI).

As a first step, a project namely “The Implementation of Data Alignment Measures (DAM)” has commenced in early 2004 aiming at improving the efficiency and effectiveness in exchange of spatial data among government departments and at addressing deficiencies arising from data definition, compatibility of data format, data quality, data cost and turn around time (HPLB, 2004a).

Under the DAM project, LandsD has been assigned to be the Data Agent of three Common Spatial Units (CSUs) (namely, Building, Lot and Road Centreline) and is responsible for the related spatial data collection, creation, conversion, integration and dissemination. LandsD has been carrying out continuous enhancements and revamping work including both technical measures and administrative controls relating to the spatial data.

LandsD has been setting up the Data Dissemination System (DDS) as part of the data-sharing framework within the e-Government. The DDS will facilitate the effective management and sharing of spatial data amongst government departments, with potential to extending the framework to external local and international parties.

This paper would share the experiences gained in spatial data exchange within the HKSAR Government from a perspective of a Data Agent.

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## **1. INTRODUCTION**

Under the Digital 21 Information Technology (IT) Strategy, the HKSAR Government has been making substantial progress towards making Hong Kong a leading e-business community and digital city in the globally connected world (ITBB, 2001). The Lands Department (LandsD), as the primary digital map data supply agency in Hong Kong, is in the position to help the establishment of the Hong Kong Spatial Data Infrastructure (HKSDI) initiative.

As a first step, a project namely “The Implementation of Data Alignment Measures (DAM)” has commenced in early 2004 aiming at improving the efficiency and effectiveness in exchange of spatial data among government departments and at addressing deficiencies arising from data definition, compatibility of data format, data quality, data cost and turn around time (HPLB, 2004a).

## **2. SPATIAL DATA EXCHANGE PROBLEMS**

The overlap between information managed by subject-specific communities in possibly parallel infrastructures can compound problems of data discovery and access (GSDI, 2004). Within the HKSAR Government, the spatial data have been produced with varying data definitions, accuracy, standards, formats and structures among various departments. They require much effort, if it is even possible, in data conversions, translations and exchange. Various kinds of spatial data are held under different departments. Although spatial data have been created, they are prepared for different specific applications, business needs and have different data definitions. For example, there are different linear road referencing networks in Hong Kong. The LandsD maintains the network of roads as single road centrelines for mapping purpose. The road network managed by Fire Services Department is based on the traffic direction. Highways Department prepares the road network routes for road inspections. Without considerable effort, these road network data and their connected information cannot be directly related to each other at present and this has given difficulties in effective data exchange.

Currently, most of the spatial Data Users in Hong Kong are within the government departments that actively use the spatial data in supporting their government service activities. In recent years, significant progress has been made in the HKSAR Government in employing geographic information systems (GIS) in capturing, updating, disseminating, performing query and analyzing spatial data. Some departments might have already implemented several GISs while at the same time there are quite a few GISs which are at different stages of

development. These individual systems provide facilities which would serve the business needs of individual departments and/or service other departments and public. However, maintenance of spatial data could be a costly exercise, as it would incur considerable costs to collect relevant data, in particular when the data are scattered among departments. Also, departments need to train up their own personnel to maintain the spatial data and the related systems. This is a particular problem for the departments who are minor GIS users (or even non-GIS users) and the GIS literacy within the departments is not high. The investment could have been better synergised if the resources could be shared, while at the same time, the data quality and the level of service are not compromised (HPLB, 2004b, Section 3.3.3.4.2, page 3.3-38).

Since the HKSAR Government needs effective management of spatially related assets and a sound strategy for future development, it has taken the initiative to improve the quality and efficiency of its services delivery through effective data exchange. Under this circumstance, the DAM project is put into action.

### **3. DATA ALIGNMENT MEASURES (DAM)**

The DAM project is led by Housing, Planning and Lands Bureau (HPLB) of the HKSAR Government. The project is aimed at improving the efficiency and effectiveness in exchange of spatial data among government departments. LandsD has been assigned to be the Data Agent of three Common Spatial Units (CSUs), namely, Building, Lot and Road Centreline. The CSU is the standard unit for exchange of spatial data, comprising spatial data and a set of common attributes. LandsD is responsible for the related spatial data collection, creation, conversion, integration and dissemination.

LandsD takes the responsibility for maintaining the topographic mapping data and the land boundary data in digital form, covering the whole territory of Hong Kong. These two sets of data were converted into digital form in the period of 1989 to 1996 from the original 1:1,000 scale paper-based survey sheets and land boundary plans. Being as foundation datasets, these data are then widely used within government departments and by associated consultants in infrastructure projects free of any charges. The data, which are copyrighted and licensed, are also used by other public and private organisations as a common spatial reference for end-users and for value-adding users. As the Data Owner of the foundation datasets (i.e. topographic mapping data and the land boundary data), it is quite natural that LandsD has been nominated as the Data Agent of three Common Spatial Units (CSUs), namely, Building, Lot and Road Centreline under the DAM project.

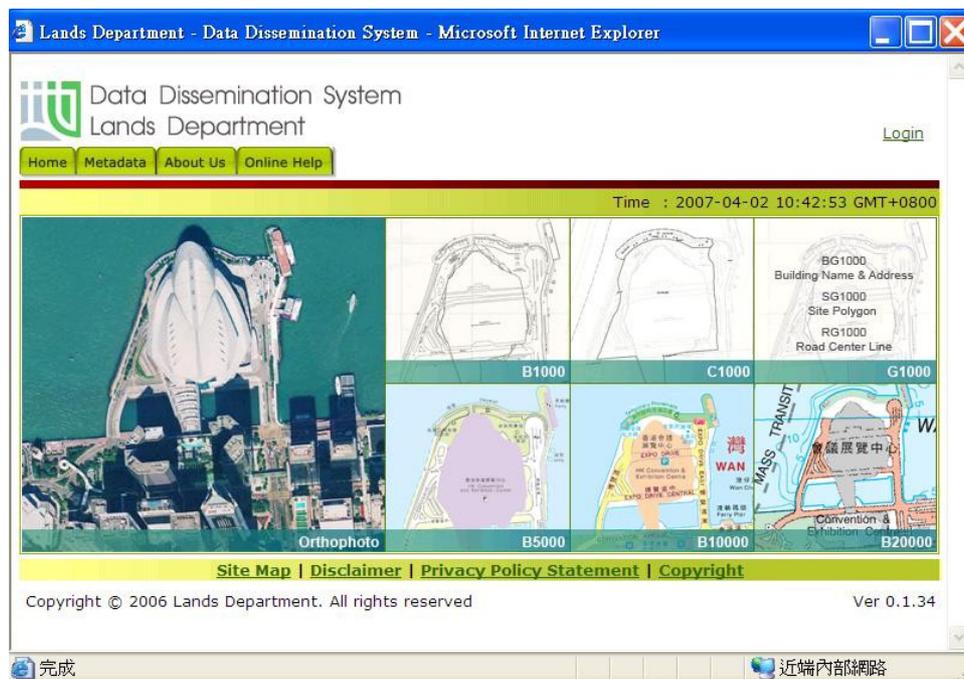
To meet the requirements of the DAM project, LandsD has been carrying out continuous enhancements and revamping work including both technical measures and administrative controls relating to the spatial data. In order to provide a more effective and efficient platform for the implementation of the DAM initiative, LandsD, with the support of HPLB, launched a Data Dissemination System (DDS) in February 2007.

#### 4. DATA DISSEMINATION SYSTEM (DDS)

Before the implementation of the DDS, the conventional method for data exchange in LandsD was unable to keep pace with the tremendous growth of demand for consolidated spatial data. Neither there exists a system that can automate the data validation, manipulation and integration of spatial data from LandsD and the associated attributes from various government departments. In order to support LandsD in its role as Data Agent of the Building, Lot and Road Centreline CSUs in the DAM initiatives and to sustain the continuous development of government's policy on data alignment, the development of the DDS becomes essential.

The DDS is a web-based Intranet/Internet system for two main purposes (see Figure 1). The first purpose, as mentioned above, is to provide an operation arm in the DAM implementation to support the required data importing, manipulation, integration and dissemination functions for the CSU data. Through the continuous contribution of data from CSU Data Owners to the Data Agent, the DDS automatically manipulates and integrates them with the spatial component and disseminates up-to-date and high quality CSU data to Data Users regularly.

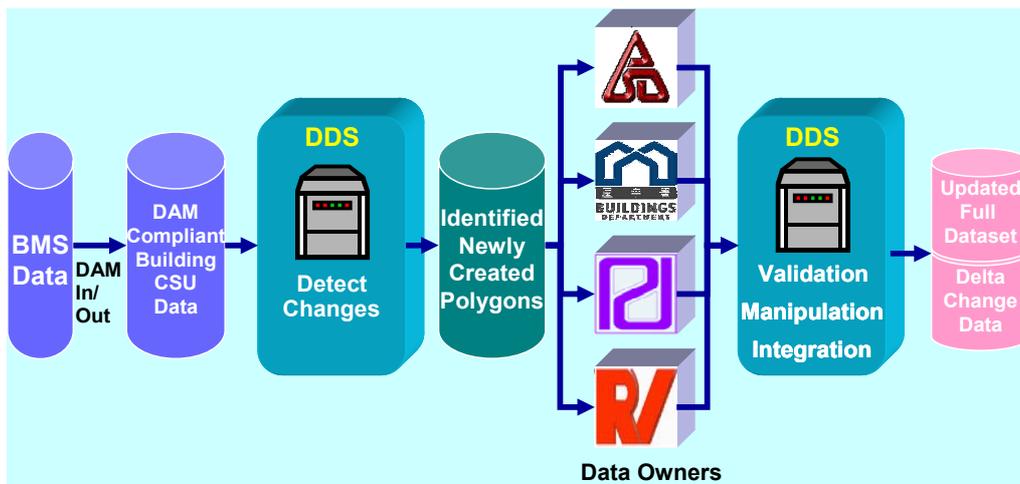
**Figure 1** – Data Dissemination System (DDS)



An established mechanism has been implemented in the DDS to cope with change detection, data validation, data manipulation and data integration of the CSUs under control by LandsD. Communication between the Data Agent and the respective Data Owners has also been set up to ensure the correctness and updateness of the CSU data. The DDS also has exceptional handling mechanism for 'peculiar' or 'odd' data contributed by the Data Owners. Figure 2 gives an overview of the workflow of the DDS in preparing the up-to-date Building CSU data among the Data Agent and the Data Owners.



**Figure 2 – Workflow of Preparing the Up-to-date Building CSU Data in the DDS**



Another main objective is to provide e-government service to the public in searching, browsing, ordering and delivery of digital map products. The related system development is in progress and is anticipated to be completed in the third quarter of 2007. Details of it are outside the scope of this paper.

With the implementation of the DDS, it has facilitated LandsD to enhance mutual data sharing and accessibility of the land related information and to provide better services for government departments and private sectors. Establishment of the DDS strengthens the position of LandsD as the central gateway in the supply of up-to-date spatial information for business growth and academic research to the GIS user community.

## 5. ROLE OF DATA AGENT

LandsD, upon the successful operation of the DDS, fulfills its Data Agent role for the three assigned CSU data under the DAM project. It becomes the central point of contact for disseminating the Building, Lot and Road Centreline CSU data. It is responsible to maintain an information system infrastructure (i.e. the DDS) good for data dissemination purpose. The DDS should conform to guidelines for proper data handling in the context of CSU data, e.g. data privacy and data sensitivity, when applicable. Also, LandsD is responsible for data availability to concerned users at specified time intervals.

As a Data Agent, LandsD is required to work with the Data Owners to implement the CSU standards. This includes (HPLB, 2004a, Volume 2I, page 1-3):

- Enforce the specification of CSU;
- Ensure the data from the Data Owners conform to specification requirements with respect to data completeness, timeliness, symbology standard and file formats standard;
- Prepare metadata of each CSU and disseminate the information through Metadata Catalogue System (MCS);
- Respond to enquiries on exchanged data from Data Owners/Data Users;

- Issue and maintain CSU IDs for the dataset, and ensure the ID's uniqueness to allow the users to perform translation and matching of their data with respect to the CSU dataset;
- Administer dataset ownership;
- Observe license arrangement;
- Report the effectiveness of CSU data exchange to HPLB
- Resolve CSU related issues brought up by Data Users and/or Data Owners, if possible or refer the issues to DAM Management Committee if needed.

## **6. METADATA CATALOGUE SYSTEM (MCS)**

Metadata are data about data. They describe the content, quality, condition, and other characteristics of data (FGDC, 2000). Metadata are a key ingredient in supporting the discovery, evaluation, and application of spatial data beyond the originating organization or project (GSDI, 2004). The MCS of LandsD was designed on this basis to allow the government departments and the public to browse the metadata of spatial data kept in the HKSAR Government. The system adopts the FGDC standard. The metadata services of the MCS include querying, searching and browsing the metadata documentation. To ensure that the submitted metadata documentation by the other government departments conforms to the standard, the MCS validates every updated metadata documentation before it is released for use.

To meet the customer satisfaction, it is expected that the Data Users are able to easily ascertain the quality of existing spatial data and its fitness to meet their needs. Availability of metadata through the MCS is considered as the key to providing users with documentation about data quality. It provides a very effective tool for the Data Users to discover, explore, understand and locate their concerned spatial data.

As the MCS includes provision of metadata services for CSU data, the DDS has provided an automated tool that facilitates maintenance (create, update and delete) of the CSU metadata. The tool is for the production of documentation of each CSU metadata (Building, Lot and Road Centreline) conforming to American Society for Testing and Materials (ASTM) Specification, "Standard Specification for Content of Digital Geospatial Metadata" as adopted by the HKSAR Government (HPLB, 2004a). The CSU metadata documentation is updated automatically with the change of spatial properties/contents of the CSU data. Facility has also been provided such that the updated CSU metadata documentation can be automatically published on the web sites of the MCS and the DDS.

## **7. EXPERIENCES GAINED**

Upon implementation of the DAM project and the associated DDS, LandsD has gained valuable experiences in the role of a Data Agent in data exchange. The following subsections summarize these experiences:

## **7.1 Data Quality**

To maintain the updateness of the CSU data continuously under the DAM project is a challenging task for a Data Agent. It involves provision of change detection information to the concerned Data Owners for verification. Then, LandsD is required to collect the updating information from various sources of the Data Owners; to consolidate and incorporate them into the existing datasets with proper quality checking procedures; and to disseminate the compiled data through an effective means (i.e. the DDS) with an agreed schedule. Throughout the processes, assurance of data quality is a very important factor.

Actually, quite a number of irregularities of the data provided by the Data Owners have been identified during the course of the implementation of the DAM. With the concerted efforts, these irregularities have been amended and in general the quality of the data, from the original data kept by the Data Owners to the final compiled CSU data, have been improved.

It is also noted that due to absence of sufficient resources, a cut-off date approach in data capturing exercise has been adopted by the DAM project. To this end, some of the data items in the CSUs may be left incomplete in a short term. This has made the on-going data maintenance a difficult task in terms of change detection and subsequent data updating. LandsD would take the opportunity to review the effectiveness and implication of this approach in order to set up as a reference for similar project in terms of data quality.

## **7.2 Participation among Data Owners, Data Agents and Data Users**

Active participation from stakeholders is essential for the success of DAM implementation. The Data Agent should play a leading role to discuss with the Data Owners on the implementation details from the file management, error handling to the coordination amongst them. It is noted that frequent communications among Data Owners, Data Agents and Data Users are effective measures to improve the data quality and enhance the dissemination mechanism in data exchange. Data Agent should also address the concerns raised by other stakeholders, in the context of the DAM and the DDS, in order to get a consensus among them on the implementation details. Specific working groups have been set up to exchange views on improving the data integration and dissemination processes of the DDS, the related data quality and data integrity issues as well as the underlying DAM initiative.

## **7.3 Development of XML Schema for DAM Data**

Sharing data between systems had always been difficult with many organizations having their data locked in proprietary formats. The situation had been a major hurdle in building an effective means of data exchange. Under the DDS, an XML schema for each of the CSU data has been developed upon incorporating the comments from the concerned parties, i.e. the Data Owners, the Data Agents and the Data Users. The availability of the XML schemas has tackled most of the issues in spatial data interoperability.

## 7.4 Data Custodianship

Data custodianship plays a major role in spatial data management, in particular in the DAM initiative. It defines and provides for accountability for maintenance of CSUs integrity and identifies the duty of care for Data Agent, Data Owners and Data Users to ensure the integrity, accuracy, validity, quality, timeliness and consistency of CSU data. A well coordinated custodianship will help (HPLB, 2004a, Volume 2I, page 1-1):

- (a) Eliminating unnecessary duplication in the collection and maintenance of the most common types of spatial information;
- (b) Managing information on behalf of others;
- (c) Providing a sound spatial information infrastructure;
- (d) Assisting the production and management of spatial information products; and
- (e) Facilitating the collection of fundamental datasets and spatial information.

## 7.5 Copyrights Issues

Under the DAM project, all the concerned parties in the data exchange process between Data Owners and Data Users through the Data Agent shall conform to the conditions laid down on the license arrangement, when applicable, in particular for issues relating to copyrights. The concerned parties should also observe the guidelines for proper data handling in the context of CSU data, e.g. data privacy and data sensitivity, when applicable (HPLB, 2004a).

The DAM Final Report (HPLB, 2004a) stated that *“Data privacy law in Hong Kong is governed by the Personal Data (Privacy) Ordinance, Cap. 486 (PDPO). It regulates the collection, storage and use of data related to living individuals from which it is reasonably practicable to identify the individuals. Such data are those that describe an individual and attribute things to an individual so that others can identify a particular individual. It applies to Data Users in Hong Kong, whether they are individuals, private companies or public bodies”*.

In the context of the CSU data kept by LandsD, all common data attributes contained in the CSU specification are neither privacy data nor sensitive data. As such, PDPO is not applicable to these CSU data (HPLB, 2004a).

Since the CSU data are integrated from data contributed by various Data Owners, the copyright issue of the CSU data needs to be properly handled. Neither the Data Agent nor Data Owners have the sole ownership of the integrated CSU data. Fortunately, the Data Agent and the Data Owners of the CSU data are government departments. The copyright of CSU data belongs to the Hong Kong Government.

It has been a usual practice that Data Users would be required to sign a kind of license agreement prepared by Data Owner (i.e. a government department). The signed agreement will mean confirmation of the acceptance of the terms and conditions laid down on the agreement by the Data Users (HPLB, 2004a). However, there is no coherent practice in the detailed arrangement such that some department might adopt a loosen approach releasing its

data freely used within a user department while the other might apply a more stringent approach requiring the data strictly used for a specific purpose.

To streamline the process, it is also considered that block consent from the Data Owners might be required for releasing their contributed data to the Data Users concerned. Further, the detailed arrangement for handling the data requests in a consistent and standardized approach should be applied in the release and licence arrangements across government departments.

## **8. RECOMMENDATIONS**

Based on the experience gained in the DAM project and during the development of the DDS, the following recommendations are considered suitable to further investigation:

### **8.1 One Stop Solution**

From the viewpoint of a Data Agent, the One-Stop Solution for spatial data exchange is worth considering. The One-Stop Solution is meant to provide a convenient, user-friendly and easily accessible centralized gateway or platform that can facilitate efficient CSU data searching, data request and data download by the Data Users with a view to further extending such service to across all departments within the HKSAR Government. The One-Stop Solution would offer facilities that could foster collaboration among government departments, in particular non-GIS users who are “enabled” to view CSU data via facilities hosted by a designated agent and their investment on GIS personnel and own infrastructure for GIS applications can be kept to the minimum. When applicable, some of the existing LandsD systems can be consolidated together with this One-Stop Solution and such consolidation could bring synergised saving to the Data Agent who will host the system. Multi-level access to those spatial data may be provided to government and the private sector, when required. Without compromising the requirements from the departments, departments can also benefit from avoiding the costs of redundant data collection and repetitive development work on a similar initiative (HPLB, 2004b, Section 3.3.3.4.3, page 3.3-38)

By implementing the One-Stop Solution, LandsD could be appointed as a GIS service provider, in particular for minor GIS users who could minimize their investment cost for their own GIS infrastructure and GIS personnel. The HKSAR Government could use the One-Stop solution as a pioneer project to advance the DAM at an affordable cost and also a good marketing tool to promote the DAM to the other spatial Data Users. On its successful implementation, government departments would be motivated to advise how the One-Stop Solution could be expanded to include other value added services for the benefit of the other departments and the government as a whole. Investment could then be synergized. In this regard, the scope and requirements for its implementation should be well defined. Policy support for the implementation should be required (HPLB, 2004b, Section 3.3.3.4.3, page 3.3-39).

## **8.2 Interoperable GIS Solution**

In the future interoperable GIS solution, once a desired source dataset is identified, it may be accessed directly by the Data Agent across a distributed file system. The virtual internal translation will enable the accessing software to directly read and translate the dataset into desired format, projection and datum. The resulting dataset can be used directly within a GIS application. Therefore, no human intervention or intermediate exchange file formats will be needed (HPLB, 2004a, Volume 1, Section 8.2.1, page 8-4). To achieve this, standardised format and description of spatial data are also crucial to facilitate the spatial data exchange and sharing.

## **8.3 Collaboration and Awareness**

Collaboration among the stakeholders is nearly a critical success factor for any project or initiative. They should have a common and shared interest and vision and realize that the project or the initiative would bring effectiveness, benefits, cost sharing/reduction and risk mitigation to their organization. A participative approach to cooperation and coordination throughout the implementation process would help to raise the awareness and build the common interest. Metadata is positioned as the gateway for searching the available spatial data. Apart from the metadata standard, quality metadata is also very important. As the metadata is prepared by the data providers, their awareness of the importance of metadata should be raised to prepare rich and quality metadata documentation.

## **8.4 HKSDI**

Hong Kong needs to retain its competitive edge and drive its overall economic growth with help of using information technology. Citizen should have access to a wealth of information and knowledge to enhance its own personal, educational, social and working lives. With the acceptance of spatial data as one of the important assets and resources, Hong Kong should develop shared spatial data and broader applications of GIS within society. The development of the HKSDI is inevitable in order to facilitate spatial data sharing and dissemination.

One of the objectives for establishing the HKSDI is to improve the availability of spatial data to the users and to raise the awareness of the policy makers. The DAM and the DDS can be a bridge to foster the awareness of existing spatial data and to enhance their consistency, broader use and sharing.

- END-

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