# Development of Multi-Purpose Cadastre in Sabah

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**Key words**: Cadastre, Multi-Purpose Cadastre

## SUMMARY

The integration of the Land Title Information System, the Digital Cadastral Data Base, the Valuation and Land Acquisition Data base and the Digital Sabah System in the Department of Lands and Surveys is the main framework for development of a Multipurpose Cadastre Model for Sabah. The legal, cultural and the physical information of any land parcel could be easily available on a single common platform. The Integration of these accurate up-to-data text, vector and raster data sets over 3D Digital Terrain Model (DTM) has provide an effective tool for the Sabah Lands and Surveys Department towards a more efficient administration and management of land in Sabah

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## 1. INTRODUCTION

Sabah (known as North Borneo until Independence in 1963) was ruled by the North Borneo Chartered Company from 1881–1941. After World War II, from 1946 until Independence, North Borneo was a Crown Colony of England.

The Sabah Land Ordinance (SLO) that came into force in 1930. Before the Land Ordinance was introduced, land tenure was determined by the Adat. It was not possible to give a precise description of the Adat in pre-colonial time, since the system was too arbitrary and highly flexible. The Adat also varied from village to village and tended to change over time. The Adat in fact encompassed a number of useful and interesting elements that could be central to our understanding of the land tenure issues at hand *(Doolittle, 1999)*. Over the period of time the system of land tenure was characterised by a negotiated coexistence between the Sabah Land Ordinance and the traditional Adat rules, customary system of rules, norms and values.

The Land Ordinance, although it was partly based on the recognition of customary rights, often took taking precedence over the traditional system. It was slowly replacing the Adat, allowing land to be privatised, inherited, and commoditised. On the other hand, the Adat prevailed on land for which a title had not been granted *(Brian Long, Jonas Henriques, Heidi Skov Andersen, Quentin Gausset, and Kelvin Egay, 2003).*

## 2. SABAH MULTI-PURPOSE CADASTRE MODEL

A Cadastre is normally a parcel based, and up-to-date land information system containing a record of interests in land (e.g. rights, restrictions and responsibilities). It usually includes a geometric description of land parcels linked to other records describing the nature of the interests, the ownership or control of those interests, and often the value of the parcel and its improvements. It may be established for fiscal purposes (e.g. valuation and equitable taxation), legal purposes (conveyancing), to assist in the management of land and land use (e.g. for planning and other administrative purposes), and enables sustainable development and environmental protection *(FIG Commission 7, Statement on Cadastre)*.

Multi-purpose cadastre defined as an ***integrated land information system*** containing ***legal*** (e.g., property ownership or cadastre), ***physical*** (e.g., topography, man-made features), and ***cultural*** (e.g., land use, Adat, demographics) information in ***a common and accurate reference framework.***

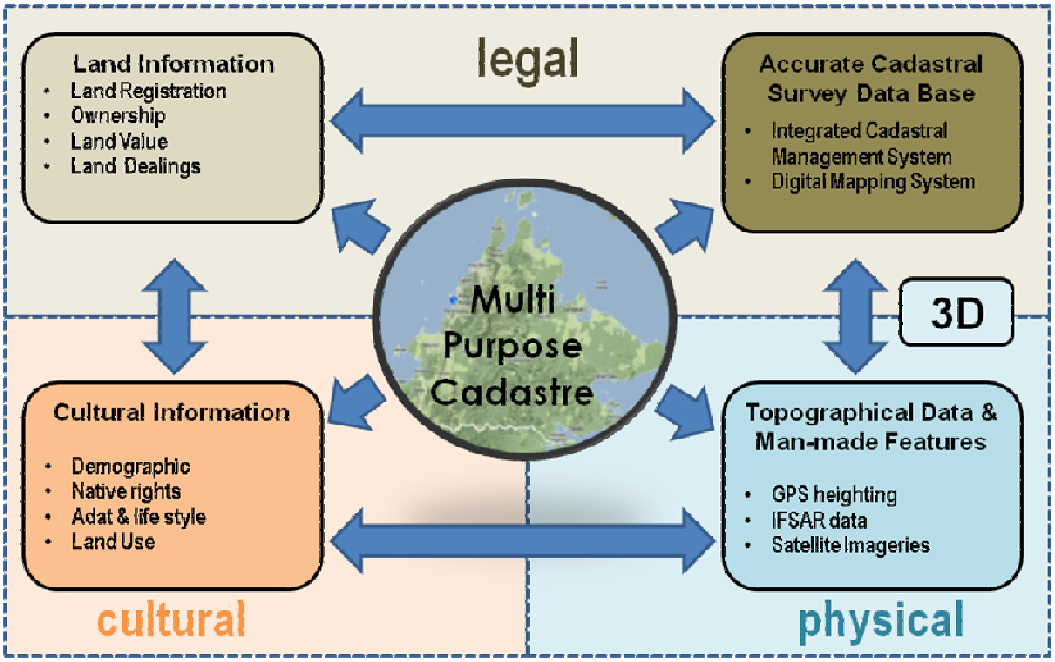

Figure 1: Sabah Multi Purpose Cadastre Model

Cadastre is commonly associated with taxation in the form of prescribed revenue provided by land laws which in the Sabah context is our Land Ordinance Chapter 68, 1930. Hence, the cadastral system in practice is also known as fiscal cadastre. Nevertheless, the structure to envisage a multi-purpose cadastre for Sabah is our very own model. Comprising three (3) major parts as depicted in Figure 1 above, various initiatives were undertaken to develop component databases that contribute to the whole model.

Both desktop and web applications implementing end-to-end functional land and cadastral processing work flow are developed to handle daily workload and in the process; populating and building up databases.

## 2.1 Legal framework

Every dataset specification encompassing scope and database schema are designed in compliance with legislations in particular Land Ordinance Chapter 68, Land Acquisition Ordinance Chapter 69, Surveyors Ordinance 1960, Survey Regulations 1989 and ISO documents and so forth described in the following sections. These datasets is the equivalence of a digital Title Register.

Sabah practices *Torrens System* where a Title Register records land alienation details including the location, extent, tenure and so forth where the legal rights of person or persons holding ownership is guaranteed by the State.

### 2.1.1 High-integrity Land Information

A complex process, land registration extensively record information detailing the tenure-ship rights over land in the alienation process as

prescribed by Land Ordinance Cap.68 outlined below:

**a) Land registration**

Land Tenure defines the form of rights to own plot of land for particular purpose and usually specific terms and conditions, including development covenant, are imposed as means to optimise usage of land resources.

Ownership to land is alienated under various land title types. Only Native Titles (NT) Field Register (FR) and now the Communal Title are perpetual while Leases including Country Lease (CL), Provisional Lease (PL), Town Lease (TL) has time limit tenure between 60 years to 99 years. On the other hand, Temporary Occupation Licenses (TOL) is short term.

Data of ownership spouse are recorded as guarantee to ownership and shares of the land.

**b) Land Valuation**

Land valuation is an integral part of fiscal cadastre structure and for that, valuation is under the jurisdiction of Sabah Department of Lands and Surveys. Premium and quit rent is calculated when offer upon alienation or subdivision while assessed value is determined for land dealings as well as government development projects involving acquisition of titled land.

**c) Land Dealings**

Land title transactions data contributed a significant volume of land information. These include transfer of title ownership, memorandum of charge, conversion of purpose or land usage, change of title conditions, quit rent revision and so forth. Such information is pre-requisite for land dealings where currency and comprehensiveness of these records is a factor to the pace of such processes.

### 2.1.2 Survey-grade Cadastral Fabric

Similarly to land, Sabah has her own cadastral survey regulations and practiceswhich is uniqueto Sabah.

**a) Cadastral Surveys**

Typically cadastral surveys practice is geared to accurately demarcate land boundaries for Title purposes as Sabah uses fixed boundary. Survey data produced includes bearings, distances, coordinates of boundary mark, area of parcel and so forth.While first class survey is inclined for geodetic surveys, boundary surveys for Title purpose normally require up to second class only.Each survey works are computed while colour survey plans generated in compliance with Sabah Survey Regulations specification.

**b) Digital Mapping Systems**

Sabah started using digital mapping technology as early as the seventies with Coradi System that was replaced by more modern technologies in the nineties to continue the digitisation of parcel fabric off standard sheets.

In a distinct milestone to improve the cadastral dataset further, this department has, in 2010 embarked on developing a comprehensive digital cadastral database (DCDB) using point-entry methodology. The DCDB shall underpin the creation of a 'survey-grade' parcel fabric through homogeneous modelling, adjustment and enhancement.

## 2.2 Physical Framework

Geospatial information compiled under Physical framework part are primarily data acquired using multiple surveying and mapping technologies that also significantly impact on the approach and outcome of SDI products.

Currently the Department is developing the following geospatial databases catering for physical domain.

### 2.2.1 Geodetic Network

Geodetic network provide the foundation for base map to be developed. This is where the cadastral surveys are based on for control or connections. To achieve consistency, this shall be the base map for Sabah to develop various mapping program.

Sabah's geodetic dataset comprises of primary, secondary and tertiary trigs, 1st class control surveys, Doppler and DGPS surveys. Every geodetic control point has the Eastings, Northings coordinates and height accurately determined.

### 2.2.2 Satellite and aerial imageries

With advent of image technologies, high resolution optical satellite imageries become comparable with aerial photography and are becoming more affordable albeit cloud cover issues. Generally aerial photography will be more up-to-date.

These imageries are widely used to generate accurate ortho-image maps which provide excellent backdrop for geospatial base map and vector features.

### 2.2.3 GPS, IFSAR DTM

To date the Department has procured up to 75% coverage of Digital Sabah IFSAR terrain data and images with the final 25% dataset currently under procurement process.

This dataset will provide Sabah with seamless, homogeneous cloud-free images while the DTM is key source for ortho-rectifying stereo

photography to generate orthophoto and for generating 10 metre contours and slope polygon for specific gradient. Besides IFSAR, DGPS is also used to provide vertical data.

### 2.2.4 Topographic features

Topographic features are compiled using photogrammetry and remote sensing techniques. Digitally formed stereo modelling allows 3D features to be extracted accurately. These may include road, rivers, building, vegetation and other physical structures, man-made and natural. On the other hand, remote sensing uses SPOT multispectral imageries to produce land cover classification dataset.

## 2.3 Cultural Framework

Dataset collected under cultural framework is largely non-spatial but vital pieces of data to envisage credible land information.

### 2.3.1 Demography

The currency and integrity for demographic data is dependent on external provider, a Federal agency. This dataset consists of population data with attributes including their distribution by EB, race, gender, age, household income, dwelling and so forth is collected once every 10 years.

The State is compartmentalised in small enumeration blocks (EB) portioning cultural entities such as urban and rural settlements into manageable sizes.

### 2.3.2 Land Use, Native rights, Adat and lifestyle

Pattern of migrating from one place to another largely due to the tradition of shifting cultivation manifested the manner early natives occupied and toiled the land, formulated lifestyle and Adat that passed down the generations. Such activities are somewhat binding to land and recognised under Native land rules as Native Customary Rights (NCR).

These rights is being closely observed in land alienation process therefore are important land information.

## 3. ENTERPRISE INTEGRATED LAND INFORMATION

The development of land information databases are being implemented over the last 20 years resulting each of these data warehouses being segregated and modular. Efforts are required to unify these data silos into seamless enterprise integrated land information frontier.

3.1 Some of the major data warehouses pre-requisite for implementation of Multi-purpose Cadastreincludes:

a) Sabah Digital Cadastral Data Base (DCDB)

b) Sabah Land Title Information System (LTIS)

c) Sabah Land Acquisition Parcel Data Base (LAPD)

d) Land Revenue Collection Information System

e) Land Cover Classification

f) Digital Sabah Terrain Dataset

3.2 Considering that these data warehouses are supporting end-to-end functional land and cadastral processing work flows for daily workload, these individual data silos are maintained to ensure no operational disruption to the functional applications.

3.3 Instead, an enterprise info-structure shall be implemented with state-of-the-art resources to tap the respective data silos and virtually host, integrate dataset into a single domain and shall automatically sync at pre-determined interval to maintain content currency to achieve high integrity land information resource.

3.4 Based on the multi-purpose Cadastre model depicted on page 2, the three individual parts will be made to fit tightly in the whole framework with such relationship between data silos to be seamlessly sync and translated to the enterprise info-structure using data models to be developed.

3.5 Having identified the key applications for serving a multi-purpose Cadastre environment, these scope and specification are used to build data modelsto satisfy the data warehousing architecture of this enterprise info-structure. It shall be this integrated land information resource that serves data miners, geospatial user groups, desktop, web, mobile and Cloud geospatial applications disseminating comprehensive land information to authorised end users.

3.6 With ever-changing social and economic pressure on society coupled with diminishingnatural resources, these will invariably impact on land regardless. Therefore there will always be newer dataset that need to be included to enriching and ensure land-based databases remain relevant, catering to newer analytical requirements. This calls for mechanism to trigger such needs to develop these dataset.

## 4. LAND-BASED APPLICATIONS

Multi-purpose Cadastre is the ultimate goal of the Department's modernisation program,keeping abreast with modern technologies today.The information-rich enterprise multi-purpose Cadastre info-structure is capable to support dynamic data mining, implementation of diversified land-based applications to serve specific individual for example land owner, user groups such as surveyors and developers and geospatial communities especially web/mobile users and so forth.

### 4.1 Seamless 3D Land Information Systems(3D-LIS)

One key application that will be focussed on is for browsing 3D land information system effortlessly, capitalising on current 3D desktop and possibly web-basedwith in-house hosting as well as limited version on public Cloud platform.Video files can be generated for custom projects requiring 3D visualisation.

This exciting application enhances the interpretability of information especially when viewed with land datasets overlaid with ortho-image maps to offer virtual-reality effect.

### 4.2 Ortho-image maps

The Department is geared to develop a complete coverage of high resolution ortho-image maps with high geo-referencing accuracy for Sabah.This shall overcome the current shortcomings of Google maps low resolution imageries for rural area of the State.

### 4.3 Mobile Applications

More applications are porting their accessibility onto the most trendy platform today including smart phones and similar devices.Such applications need to be light-weight and light-scope; a compromise over performance efficiency.

#### 4.3.1 On-line and off-line

While considering payload versus cellular bandwidth capability in the State, mobile applications shall be developed with on-line and off-line mode with the latter providing pre-downloaded data for off-line usage while application functions developed for performing typical data processes including data entry, editing and update existing datasets will also be cater for standalone and online.

#### 4.3.2 iOS, android, Win CE

Mobile applications will need to cater for popular smart device system especially iOS for iPad and iPhones, android for Samsung devices and Win CE for running Microsoft Windows-based devices.

### 4.4 Innovative products

The enterprise multi-purpose Cadastre info-structure provides rich resources for diverse product development and innovationfor example:

4.4.1 Desktop and mobile 3D cadastral data browser that can manifest land issues and problems; conceptualise analyses and statistics. This will drive a paradigm change in the manner cadastre information is

consumed;

4.4.2 fusion of satellite imageries covered by cloud with aerial photographs to provide cloud-free and 'updates' for area of interests;

4.4.3 3D Citymodel and simulation for visualisation, city planning, aesthetic evaluation, view shade;

4.4.4 monetising land data is not just about generating direct revenue through e-commerce services such as information sales but improving and creating value to in-house data such that will induce multiple tangible and intangible returns when fused with other datasets

4.4.5 virtual reality land information browsing which would be disseminated to the Chief Minister's office, State Cabinet, conference room of Ministries, departments and authorised end users to support debate and informed decision to be made.

## 5. BENEFITS

Building a multi-purpose cadastre no doubt involves expensive up-front costs, meticulous planning and a tremendous execution which nevertheless outweighs the benefits from having the efforts undertaken which among others but not limited to, includes the following major ones.

### 5.1 Monetising land information

It is only when data become consumable information that their value truly manifested. The enterprise multi-purpose cadastre info-structure presents opportunity to accomplish greater purpose for the datasets compiled insofar. Identifying key value of available datasets and value-adding required to enhance datasets so as to maximise their potentials shall become a continuous monetising exercise to increase or maximise the value of land information.

Building analytical capabilitiesfor multi-purpose Cadastre is a start but monetising shall be inclusive of end users requirements such that land information supplied is compatible with users' demand. This hence, achieved the monetising agenda. Overall, by monetising the multi-purpose Cadastre datasets will maximise their potentials, create valueas well as enabling access to required information faster.

### 5.2 Expedite land-based development

With comprehensive land information of high integrity within reach shall expedite development program that involve land matters in that, informed decision can be made in shorter time with reduced bottlenecks.

The enterprise info-structure will greatly upgrade the Department's delivery system to become efficient, resourceful and accurate in rendering services. The snowball effect from this will directly translateinto getting more land-based development projects airborne that generates to multiple tangible and intangible fringe benefits including faster development pace generating more jobs and on long term, improving socio-economic standing of the people.

### 5.3 Create wealth

Having good information is vital to solid land-based conservation, management, planning, development and implementation such that invaluable land resource is used to optimum level with maximum returns.

The demand for good data has increased exponentially to create and support business intelligence, deploying not only trained but informed workforce. Organisations are gearing towards lowering cost and higher margin while maintaining competitiveness. For that matter, creating good information generate wealth to all stakeholdersbe they custodians or consumers as all parties benefitted from good data.Monetising data can extend to all external custodians including surveyors, engineers, developers, banks and so forth that are associated with land-based transactions. This would then add further value to cause land information

### 5.4 Social services

Up-to-date geospatial data and maps is a pre-requisite to support the Government in rendering its social obligations in urban and rural socio-economic development agenda for improvingthe society and livelihood of the people.

Having a multi-purpose cadastre info-structure will better envisage sustainable land development activities through planning, infrastructure development of roads and schools, monitoring of shoreline, water catchments, agriculture, land cover and forest.

## 6. CONCLUSION

6.1 The concept for the Multi-purpose Cadastre building blocks is akin to surveyor's "whole to parts" approach, started with an integrated Master Plan approach before subsequently developing component databases to fit seamlessly into the big picture as it were; with series of reviews and changes made to ensure the Master Plan is abreast with up-to-date practices and technologies available today. Using this approach has thus far, been achieving good results.

6.2 An excellent reference Google map;after somewhat taking the lead in pushing Webmap services to even non-geospatial consumers with huge success prompting a tsunami of applications riding on this and similar Cloud infrastructure thereby changing the concept of web services and in that; delivery systems a deemed to have spatial-ready for that 'wow impact' or norm.

6.3 The key goal for Sabah Lands and Surveys Department to implement a Multi-purpose Cadastre concept is to enable the development of a truly integrated and seamless enterprise land information resource that shall potentially drive the Department's thrust into becoming the States' Geospatial powerhouse, providing base maps for the State's consumption.

6.4 Concluding, only by creating and delivering services and products required by the State's stakeholders can assures good ROI (return of investment) from 20 years' of establishing databases and continuous development.

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## BIOGRAPHICAL NOTES

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