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Unleashing the Full Potential of eKadaster on The Cadastral System of Malaysia *

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UNLEASHING THE FULL POTENTIAL OF eKADASTER ON THE CADASTRAL SYSTEM OF MALAYSIA

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ABSTRACT

Early computerized cadastral office and field system in JUPEM was developed based on automating the manual procedures and later gradually improved with the introduction of Geographical Information System (GIS) technology.

Nonetheless, the system developed was unable to capitalize on the advent of satellite based technology and hinders the practice of an absolute real time positioning cadastral survey. A complete revamp of the system is required by incorporating a coordinated cadastral survey concept to the newly developed system; eKadaster, as means to expedite JUPEM's delivery system in the Final Title Plan (B1 Plan) preparation.

The eKadaster system is developed based on a single homogenous projection system for the whole country and is an earth-centered datum. The least-square adjustment technique is used in the distribution of survey errors and coordinates to replace relative measurements as the ultimate prove of boundary mark position. A new fully GIS-ready database is established, namely the National Digital Cadastral Database (NDCDB) in preparation towards a multipurpose cadastral. The NDCDB is anticipated as a launching pad to enable B1 Plan to be issued immediately and for unleashing the full potentials of eKadaster on Malaysia Cadastral System in the future.

1. INTRODUCTION

Poor land administration system inhibits investment and hence good land use. In Malaysia, Information and Communications Technology (ICT) and the Internet in particular have opened new possibilities for better land governance, and have emerged as a critical component in overcoming obstacles to land service delivery. Intended to enhance the ease and efficiency of land delivery system to the people, several initiatives were undertaken under the Malaysian e-Government flagship namely the eTanah project for land administration.

In support to better enhance Malaysia's land administration system, JUPEM was entrusted under the 9th Malaysian Plan to expedite the survey and preparation of B1 Plan related to the issuing of land titles, which resulted inthe development of eKadaster. Both initiatives and efforts under the eTanah and eKadaster encompasses reducing

bureaucratic red tapes as well as improving and reengineering internal processes in managing and administering components involved in land administration, specifically in the issuance of Final Titles (FT).

2. MALAYSIAN CADASTRAL SYSTEM

Basically, the Malaysian cadastral system has two vital components, which are also the very pillars of the Torrens System adopted; the land registration and the cadastral survey components.

Torrens Systems is a land ownership definition system, where for each parcel of land, boundaries are defined and the area of the land stated is then measured. It aims at defining and guaranteeing legal property boundaries, as to assure an indefeasible of title to those included in the register. In other words, land titles (Qualified Titles (QT) and FT) are conclusive proof that the person mentioned therein is the owner of the land described therein. Certainty of land ownership and other rights in land, coupled with the ability to locate the land on the ground, are essential components of a stable and vibrant economy in which investment is encouraged.

A valid title requires an accurate description of boundaries shown in a B1 Plan and by itself cadastral survey plays an important role in Malaysia's land administration system. In Malaysia, the cadastral survey is a responsibility of the federal government but land is exclusively a state matter except for lands located in the Federal Territory of Kuala Lumpur, Putrajaya and Labuan. This means although JUPEM is a federal department entailed to conduct cadastral survey (with the support of Licensed Land Surveyors (LLS)), land alienation and dealings remain a prerogative of the respective state governments. Therefore close coordination between JUPEM, State Land Offices and LLS are crucial to ensure e-projects undertaken by both government agencies and private sector meet the objective of becoming a fully connected government and thus improve its public delivery system.

3. MALAYSIA CADASTRAL SURVEY MODERNISATION

Malaysian cadastral survey has undergone dramatic changes technically, operationally, structurally and institutionally over the past decades. IT has introduced a computerised system that was not only for the purpose of increasing JUPEM's efficiency and productivity of computations and plan drawings, but also to introduce the concept of digital databases.

In 1985 a Computer Assisted Land Survey System (CALS) pilot project was initiated for the state of Johor. The system has generated, for the first time ever in the history of JUPEM, a Digital Cadastral Database (DCDB) at a scale of 1:4,000. The success of the Pilot Project in meeting its stated goals, led to the implementation of another CALS in the State of Pahang in 1986.

The confidence gained by the successful implementation of the earlier CALS projects, and encouraged by the demonstrated increases in efficiency and productivity in the production line, has led to the introduction of the Mini-CALS system in all remaining State's JUPEM of Peninsular Malaysia in 1992, thus completing JUPEM initial nationwide computerisation programme.

Whilst maintaining the same objectives, the new CALS system differ from its pioneer sister in that it incorporates a decentralised "client-server" workstation configuration, boasts of a "seamless" database, and hosts a GIS suite of software for future integration with information systems of clientele departments. At a relatively cheaper cost the Mini-CALS systems is physically smaller although it has far greater computing prowess than the earlier CALS systems.

JUPEM's move to create a DCDB has put into place the foundation to encourage the development of GIS in the country. Recognizing the benefit of GIS along with the introduction of the Multimedia Super Corridor (MSC) in 1996 and the establishment of National Infrastructure for Land Information System (NaLIS) (currently known as Malaysia Centre For Geospatial Data Infrastructure (MaCGDI) in 1997, the demand for DCDB has become greater as such various initiatives were undertaken in a concerted effort to harness the power of GIS implementations to better administer and manage federal or state government agencies finite resources. In conjunction to this, JUPEM have introduced the Cadastral Data Management System (CDMS) in the year 1998, mainly to repopulate the DCDB in every State's JUPEM and allow multiple users/operators to operate the user-limited Mini-CALS system.

CDMS uses the state-of-the-art hardware and software, ATM network, embraces internet technology and thereby enhances JUPEM's capability in line with the e-Government policy. Besides, CDMS also expedite the processing of cadastral activities of the department.

Following the success of the CDMS, CDMS Upgrade is later implemented to all JUPEM States from November 2001. CDMS Upgrade used the Gigabit Ethernet (GE) backbone and coexist with the CDMS ATM backbone to work as symphony as one. The aim of the CDMS Upgrade is to upgrade the functionalities of the CDMS modules without modifying the modules to provide minimal interference on JUPEM's production line.

In tandem with the technological changes introduced in the office, modern survey equipment such as the Theodolite, Electronic Distance Measurement and Total Station were introduced to JUPEM's field surveyors to replace the obsolete land survey equipment. Subsequently, field surveyors were assisted with removable RAM/Data Cards and latter substituted with Personal Data Assistant (PDA), followed by Field Communicators (FC) as to replace the conventional and tedious booking system. Hardcopy plans, field tracings and star almanac were converted to digital format and stored in FCs to ease information retrieval, assist computation and quality verification.

Rapid IT development and globalization has enable JUPEM to further enhance the cadastral data acquisition capability in the field by implementing the "field-to-finish" (F2F) concept in 2002. The main components that were developed to achieve the F2F concept were the Total Station System (TSS), CDMS Upgrade and District Survey Office Automated System (DOAS). Its development have demonstrated significant improvement in productivity, and hence increased cost-effectiveness.

4. CADASTRAL REFORM

Despite the various modernization been made in the cadastral surveying system, the need for a paradigm shift and innovation in the rigid cadastral surveying method to a simpler yet meets the desired accuracy method is necessary in line with the National Mission Plan Thrust 5: *To strengthen the institutional and implementation capacity.*

In addition, a study on the procedures involved in preparing Title Plans in JUPEM have been made by the Malaysian Administrative Modernisation and Management Planning Unit (MAMPU) as to identify setbacks that may possibly effect specifically in the issuance of FT to the public at the Land Offices. Findings of the study were then endorsed by the Public Administration Development Panel (KertasBil 25/Tahun 2004); with the sanction for JUPEM to improvised cadastral survey workflow and shorten the duration in preparing Title Plans from two years to ten months.

Through its studies, JUPEM noticed thatthe mechanism in the existing cadastral survey has its own drawbacks and are categorized as follows:

- the method of survey and error distribution is not truly whole-to-part method and is unable to handle redundant observations,
- the bearing and distance, as the main information, as well as the Cassini projection system do not augur well with the requirement of GIS and Global Navigation Satellite System (GNSS) technologies,
- the mapping system in Malaysia uses the Rectified Skew Orthomorphic (RSO) projection, therefore, the different coordinate system employed in the cadastral system has resulted in incompatibility as far as digital databases is concerned, and
- comparison of coordinates of survey points when a survey crosses from one state into another are very tedious.

Therefore, in response to remain relevant and meets the public and stakeholders expectation, JUPEM has undergone a complete transformation in its cadastral workflow with the development and implementation of the eKadaster project. This is by far the largest ICT project carried out by JUPEM approved by the Government under the 9th Malaysian Development Plan.

The confidence for JUPEM to pursue the eKadaster project was based on findings on both Pilot and Feasibility Studies in Coordinated Cadastral System (CCS)

implementation; a cadastral reform programme to improve the current cadastral survey system. The study and pilot project took place in the state of Melaka and its success was a needed impetus for the implementation of a nationwide CCS to replace the anachronistic system for cadastral survey. The benefits identified to be accrued from the CCS implementation are:

- Utilisation of "Whole to the Part" methodology.
- Facilitation on the use of rapid data acquisition, storage, processing & management techniques.
- Improvement of the cadastral survey system.
- Establishment of a common reference system.
- Facilitation on data integration.
- CCS becoming the basis for / underpins a good Land Information System (LIS).

5. eKADASTER; JUPEM'S SOLUTION TO EXPEDITE CADASTRAL SURVEY DELIVERY SYSTEM

eKadaster optimizes current ICT, GIS and survey technologies, implicating modification in cadastral survey manner from the traditional Bowditch and Transit methods to a Survey Accurate Coordinate using Least Square Adjustment with the establishment of National Digital Cadastral Database (NDCDB) and Strata/Stratum/Marin Survey Database (SSMSD). With CCS, GNSS will be the natural tool for cadastral surveys, hence enabling absolute and real time positioning, with coordinates being given legal significance. The prominence of measured bearing and distances are reduced whereby they are considered as only a means by which the final adjusted coordinates are derived.

Previous successful ICT projects in JUPEM (i.e., Total Station System, District Office Automation System and Cadastral Data Management System) were also incorporated and adapted to the new eKadaster environment to allow flexible office and field procedure, without jeopardizing the surveyed data accuracy and its integrity, including replacing the time consuming plan production with an automated system generation that requires less human intervention. By doing so, the eKadaster environment enables various cadastral survey processes such as planning, design layout submission, field data capturing, completed job submission, quality control and plan approval to be done effectively via broadband technology and web based applications. Thus, not only eKadaster supports mobility, but more importantly the efficient and fast processing of data at anytime, anywhere and anyplace.

The eKadaster project comprises 3 main components that complement each other in order to achieve the objective of reducing the B1 Plan preparation time from 2 years to only 2 months, namely the NDCDB, Virtual Survey System (VSS) and Cadastral Data Integrity System (CDIS).

The NDCDB is actually the outcome of implementing CCS, which consists of survey accurate coordinate database. It was implemented to develop a homogeneous cadastral database based (NDCDB) on the geocentric datum with a spatial accuracy of better than 5 centimeter in urban area and better than 10 centimeter in semi-urban and rural areas. The present accuracy of the DCDB is a few meters level and is not homogeneous. This is partly due to the inherent inaccuracy found in the underlying datum and unconstrained propagation of error within the cadastral network. Aside that, the purpose of having an NDCDB is to overcome the shortcomings of the State's DCDB on several issues such as incompatibility with the current technologies, accuracy inadequacy, and difficulties resulting from the use of different projection and geo-reference system.

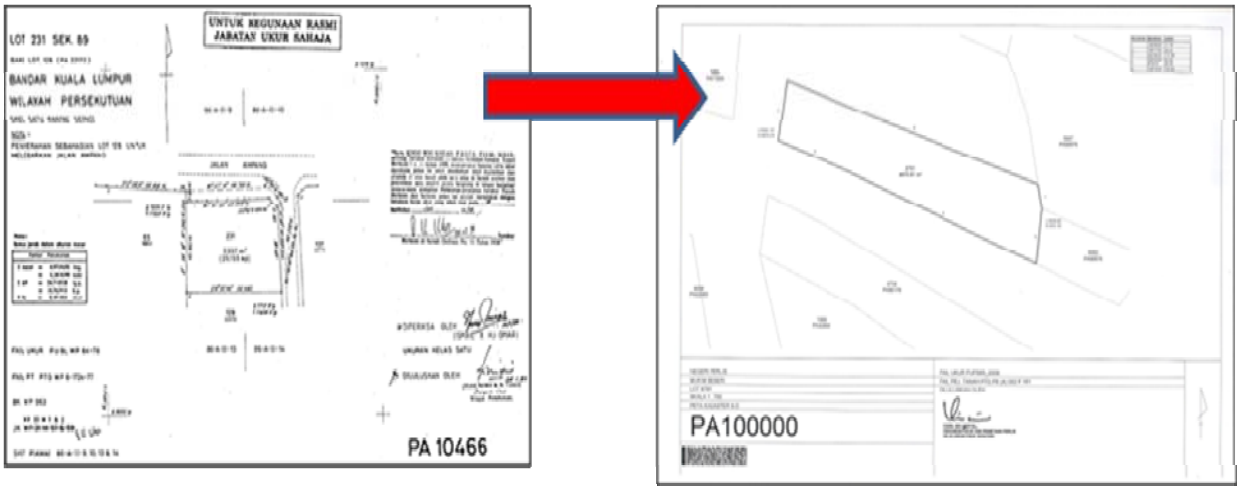
The NDCDB will open up opportunities in coping with and in accruing benefits from the advances in technology. Since coordinates are the basic input/output of most modern equipments, such as Total Station, Smart Stations and Global Positioning System, the introduction of a survey accurate NDCDB would thus be synergistic with the operations of such equipment and systems in the eKadaster environment.

The NDCDB will also rectify the peculiar State DCDBs. For instance, discrepancies or gaps exist between the graphical display and the value of bearings and distances stored within the State's DCDB as attributes. The gaps are snapped close to ensure topological integrity. Spatial analysis is limited due to the different that exit between the observed values and those extracted from the graphical display. Besides, State DCDBs is not fully "GIS-ready". Only one neighbour polygon is recorded in the Boundary tables (without associated direction). Boundaries are defined by 'polylines' instead of vertices and nodes (stone). Shared line segment between boundaries are stored twice. High level spatial queries and analysis may not be possible because of the lack of topological information such as connectivity and adjacency.

The VSS or better known as SUM (SistemUkur Maya) is developed as to automate field work computations and prevent repetition processes which previously require commuting from one place to another from happening during or after survey. The system equips the field surveyor with the state-of-the-art technology in ICT, total station, GIS and GPS, whereby surveyors will be able to interact with the system for browsing, viewing, extracting, downloading, uploading and generating information that will assist him in the field operation. It is developed as a web-based application with centralised least square adjustment software recited in the system as to cater the need to verify and validate the survey ASCII files submitted by either JUPEM's land surveyors (field surveyors) or Licensed Land Surveyors.

LLS and field surveyors may choose to work in real time environment or online through the web depending on the communication bandwidth available. Rules were coded to control workflow and decision making and subsequently minimize human intervention. The field surveyors will be informed on the acceptability of the job in near real time. This will allow the field surveyors to rectify the survey in the field if required. The most

significant change is that it allows the field surveyors the flexibility to use best practices in a totally digital environment.



Move from Conventional Certified Plan to a Certified Plan with 2D barcode generated using the Digital Raster Plan (DRP) Module under the eKadaster system

eKadaster's final component, the CDIS comprises of all the office applications which include pre-survey verification, field survey data computation and verification, digital title plans generation and approval. Its main function is to manage 'data massage' for NDCDB as well as ensures data integrity and renders it GIS-ready. Various verifications are put in place to assist users when making decision on the validity of data. The final adjusted coordinates will then be posted into the NDCDB. Finally, a digital copy of the title plans will be generated based on the coordinates stored within the NDCDB and be kept in a separate database for security purposes. The B1 Plans which are generated based on NDCDB will be delivered on-line to the Land Office.

A Public Key Infrastructure (PKI) which is a digital security solution that ensures the integrity and irrefutability of digital data submitted and received by JUPEM, is being used under the eKadaster environment especially during the purpose of approving CPs and B1 Plans. The usage is due to the sensitive and confidential nature of the data and business

Digital Signature using PKI

operations handled by JUPEM. The PKI enables paper documents and handwritten signatures to be replaced with automated workflow processes and digital documents that are secured with digital signatures and digital envelopes. A 2D barcode is also emplaced to the CP generated to deter and detect unauthorized reproduction and tampering of plan. With the security features of PKI embedded, it ensures the authenticity, data integrity and non-repudiation for the document and makes it easy to detect any tampering of the document from occurring.

6. FUTURE DIRECTION

While analogue Cadastre offers possibility of data usage for a single purpose, eKadaster can be used widely for many purposes which benefit the people as a whole. Today, with the advancement of geospatial technology, JUPEM's geospatial information is increasingly becoming very important in resolving environmental issues including disaster management. Simultaneously with the advancement of ICT, the vast geospatial information residing at JUPEM can be reached with just a click away through the development of GeoPortal, a portal that compliments the government delivery systems.

6.1 MULTIPURPOSE CADASTRE

The technology used in developing the eKadaster system as well as in other mapping and GIS systems shows that a system that works for various users and applications is inevitable, namely Multipurpose Cadastre (MPC). Although this system was proposed as early as 1970s, there are still many issues and impediments for such system to be realized, one of which is the lack of technology during those days.

MPC has the potential to support spatially enable government, the private sectors, and society in general by expanding support for processes of visualisation, organisation and management of useful land information. The GIS applications of MPC database can be divided into four main sectors namely economic, social, environment and infrastructure. Therefore, MPC will serve as the vital geospatial dataset required for economic, social and infrastructure development in this country and hence will be one of the catalyst for growth and gearing the nation towards high income economy by year 2020.

In a bid to understand the complexity and structure of the MPC concept in Malaysia, a pilot study is being conducted for the Federal Territory of Putrajaya. The main reference base-map is the survey accurate National Digital Cadastral Database (NDCDB). NDCDB provides a homogenous and seamless cadastral network for the entire Peninsular Malaysia and the Federal Territory of Labuan. The main source of large-scale geographical features for urban areas will be based on the Mobile Terrestrial Laser Scanning (MLTS) survey that is also referenced to GDM2000 and Mean Sea Level (MSL) height datum. Combined

with the latest technology in ICT and data capturing with laser scanning system, the idea of implementing MPC can be extended to add visual analysis through 3D data modelling shared with various subsystems and data sources such as topographic and utility maps. Ultimately, an MPC database will be developed together with an Online Web Access (OWA) prototype. OWA is designed to facilitate a spatially enabled system that integrate land information system which contains survey accurate cadastre, topography, man-made features and cultural (e.g., land use, demographics) information in a common reference framework through a portal site on the World Wide Web.

6.2 MARINE CADASTRE

JUPEM also aims to extend the Cadastre Survey scope offshore. In Malaysia, the introduction of Marine Cadastre is still in preliminary stage as compared to other countries such as Canada and the United States of America. The effort towards introducing Marine Cadastre is due to an increasing realisation that the interests of Malaysian do not stop at the land-sea interface. There are economic, environmental and social impacts along with the ever increasing competition for the vast array of natural resources. With the United Nations Convention on the Law of the Sea came into force in 1994, the demand for more efficient and effective maritime boundary management techniques, such as a Marine Cadastre has also been raised.

6.3 UBIQUITOUS CADASTRE

JUPEM anticipates on progressing towards a ubiquitous Cadastre by implementing Multipurpose Cadastre and instigating Marine Cadastre, which will surely benefit the land and marine markets, thus encourages sustainable developments. It encompasses the concept of ubiquitous Cadastre information services and Service Oriented Architecture (SOA). Nowadays there is an accelerating move from “wired to mobile” and beyond. In a ubiquitous environment it is possible to seamlessly connect “anytime, anywhere, by anything and anyone”, and to exchange a wide range of information by means of accessible, affordable and user friendly devices and services.

6.4 ACT TO GOVERN GEOSPATIAL ACTIVITIES

The Malaysian government is also aware of the need to implement programmes that can benefit the people. Statistic by the United Nations showed that over 80% of government business processes and decisions required geospatial information which is important information in land development, natural resource management and environmental preservation programs. As such, a Bill is being formulated for the governance and control of geospatial activities undertaken by various government and private agencies. In this regard, geospatial refers to

geographic location and characteristic of natural or constructed features on, above or below the earth surface.

This proposed Act will provide multiple benefits towards establishing Spatially Enabled Government and Spatially Enabled Society. Among benefits are to ensure the security and sovereignty of the country, to avoid duplication of geospatial activities among agencies, to produce quality geospatial information to ensure sustainable development for the country.

7. CONCLUSION

An effective cadastre has a strategic role to play in rural and urban development plans of the country. By introducing eKadaster, JUPEM has initiated a reform which has wide ranging implications for the survey community and the country as a whole. The eKadaster project is a paradigm shift of the cadastral survey process. With the implementation of eKadaster, JUPEM is able to reduce the delivery time from 2 years to 2 months for its land title survey process. The creation of NDCDB with survey-accurate coordinate has allowed JUPEM to expedite the cadastral survey process with the use of satellite technology (GNSS) and provide fully GIS-ready information. Hence, JUPEM believe the eKadaster implementation in the long run will benefit the people and support sustainable growth and development for the country.

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