Cadastral in Supporting Smart Cities in Malaysia

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Key words: JUPEM, eKadaster, SmartKADASTER, Smart Cities

SUMMARY

The Department of Survey and Mapping Malaysia (JUPEM) has gone further afield in the way it conducts its cadastral business. It has made a paradigm shift in its workflow by transforming its conventional surveying technique into its current modern system with the help of cutting edge technology. The implementation of survey accurate coordinate cadastral system known as eKadaster was achieved by adopting the latest ICT, GIS and survey technologies. The main objective of eKadaster is to expedite the delivery system of final title plan in providing services for land administration in Malaysia. At its current state, eKadaster has more than sufficient information and layers to facilitate visualisation and extraction of information according to user needs in the two-dimensional (2D) plane. However, the existing two-dimensional cadastral system does not sufficiently represent the three-dimensional (3D) real-world objects, in alignment with the increasing demand of the present urban development related to rights, restrictions and responsibilities (RRRs). With that in mind, JUPEM has successfully leveraged eKadaster and spearheaded the development of Malaysia's very own 3D City Model in line with FIG's vision of Cadastre 2.0 with a project known as SmartKADASTER. The main purpose of the project is to establish a multi-purpose cadastral system for the future with the prime objective of providing a solid cadastral-based spatial analysis platform which support services towards smart cities enablement in Malaysia. Besides being able to accommodate 3D objects, the integration of eKadaster and 3D City Model also provides an exhaustive geospatial database or information that allows the development of smart cities in a sustainable manner. Smart cities will be more than just a trend in the future; it can become an indispensable system to drive economic growth by harnessing the 3D information that will eventually lead to a better tomorrow.

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1. INTRODUCTION

As the key agency in conducting Survey and Mapping, it seems impossible for JUPEM for not to adapt to the advent of technology. The evolution of technology has played a significant role in changing the way JUPEM running its businesses; from conventional to paperless and fully automated. eKadaster, the brainchild of JUPEM was fully implemented in 2010 with the aspiration to expedite the delivery system of final title plan from previously staggering two years to only two months (in an ideal environment). Indubitably, this system was developed in accordance to FIG's recommendation to modernise cadastral system as penned in the six statements on Cadastre 2014. Throughout the years, a continuous work, maintenance and prodigious efforts have been made to ensure the information delivered from eKadaster to user are reliable. At its current state, eKadaster has more than sufficient information and layers to facilitate visualisation and extraction of information according to user needs in the two-dimensional (2D) plane. However, the existing two-dimensional cadastral system does not sufficiently represent the three-dimensional (3D) real-world objects, in alignment with the increasing demand of the present urban development related to rights, restrictions and responsibilities (RRRs). In fact, the need for sustainable development as identified in The Statement on the Cadastre (FIG, 1995) requires further action:

- Guarantee ownership and security of land tenure;
- Provide security for credits;
- Develop and monitor land matters;
- Support land and property taxation;
- Protect state lands;
- Reduce land disputes;
- Facilitate land reforms;
- Improve land use planning;
- Support environmental management;
- Produce statistical data.

Apart from that, Working Group 7 of FIG's Commissions suggested that Cadastre 2014 approach that was endorsed since 1998 must be modernised to keep pace with the current demand and technology.

2. THE TRANSITION FROM 2D TO 3D

Technology has accelerated at maximum speed and the current key trends that becomes inevitable are social networks, cloud computing, big data and Internet of things. Therefore, to avoid cadastral system in Malaysia remain ossified, a paradigm shift is required to stay germane and competitive in

order to become the predominant data provider by delivering up to date and dependable Cadastral based service to the nation. For that reason, the existing system, eKadaster, alone is not sufficient and the need for diversity and to go beyond traditional cadastre is indispensable. Thus, JUPEM has played its role by conducting a pilot study in 2011 to get the clear picture of Multi-purpose Cadastre (MPC) with the vision of implementing it in larger scale. In brief, the outcome of the pilot study was ample to guide JUPEM and provide an insight on how to bring it to the next level. Few things to consider before heading to MPC and 3D Modelling; enhanced National Digital Cadastral Database (NDCDB) (the main component of eKadaster) shall be used as base maps; shall comply with the Malaysian Geographic Information/Geomatics - Features and Attribute Codes (MS 1759); the coordinate transformation is based on parameters endorsed by JUPEM and finally the objects to be model for 3D City Model shall be at least prominent buildings or landmark (Chee Hua and Abdul Halim, 2014). The realisation of MPC and 3D Modelling is finally transpired in 2014 with a project known as SmartKADASTER. The successful implementation of SmartKADASTER is not only fulfilling the vision of Cadastre 2.0 but at the same time is supporting smart cities enablement in Malaysia.

3. SmartKADASTER

The project was successfully developed under the Malaysia's 10th Development Plan (RMKe-10) for Federal Territory (FT) of Kuala Lumpur and Putrajaya as the area of interest (see Figure 1). FT of Kuala Lumpur was chosen given the fact that it acts as the capital and commercial heart of Malaysia and central hub for many economic activities while Putrajaya is referred as a federal Government administrative centre. With that in mind, JUPEM has successfully leveraged eKadaster and spearheaded the development of Malaysia's very own 3D City Model. In line with FIG's vision of Cadastre 2.0, JUPEM has succeeded in value added the accurate NDCDB with other geospatial information to create a smart multi-purpose environment. The main purpose of SmartKADASTER is to establish a multi-purpose cadastral system for the future with the prime objective of providing a solid cadastral-based spatial analysis platform which supports multi-purpose services towards smart cities.

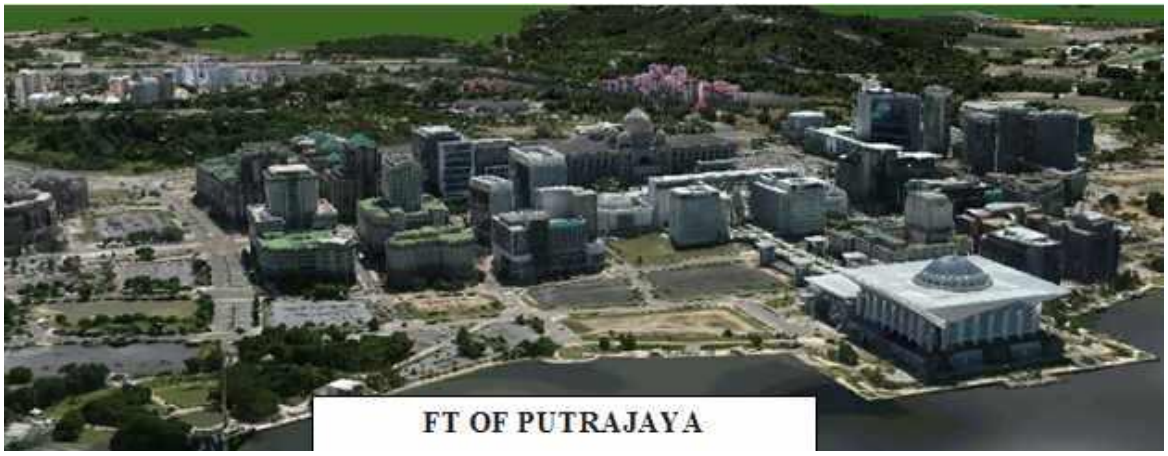

Figure 1: Area of Interest for SmartKADASTER 3D City Model view

3.1 The Fundamentals

Cadastre 2.0 is an analogy drawn from the Web 2.0 that represents the beginning of open map culture using mobile technologies through collaboration and citizen engagement (Manohar and Sharma, 2016). SmartKADASTER was established based on six fundamentals that has the similarity with the attribute of Cadastre 2.0 concept and later was enhanced by JUPEM to accommodate local requirements (Isa et.al, 2015) (see Figure 2).

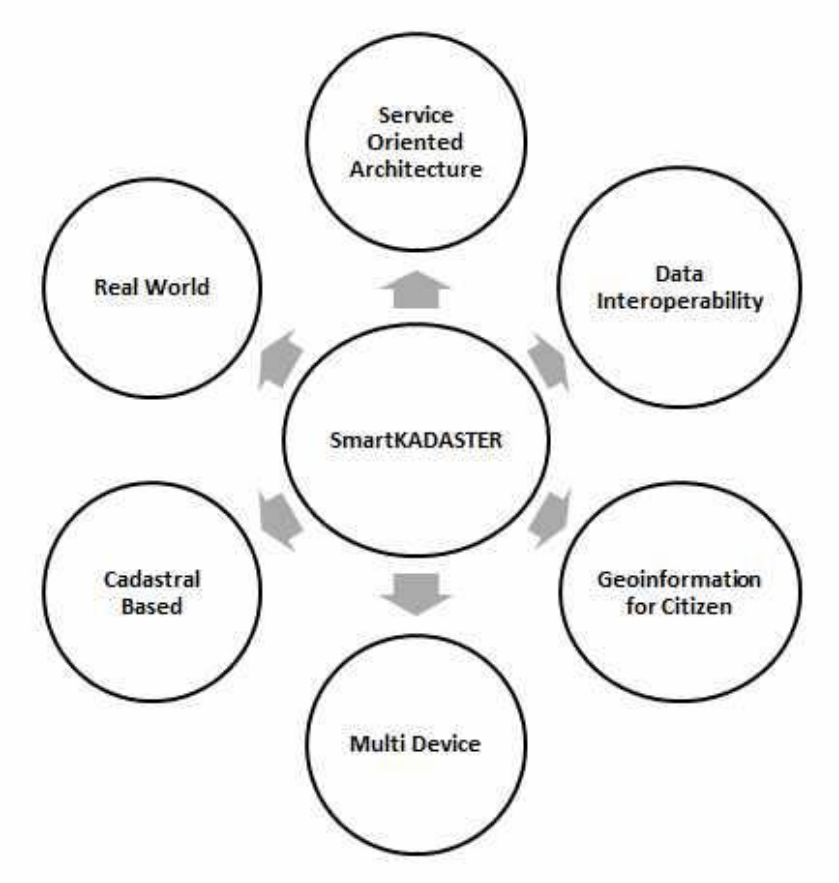

Figure 2: The fundamentals of SmartKADASTER

Meanwhile, as spatial users in the world are moving away from traditional 2D GIS, the emergence of cloud computing and the availability of highspeed broadband are enabling rich 3D GIS visualization solutions in many countries including Malaysia. For that, JUPEM intends to showcase its products in a 3D visualization environment by producing a 3D Digital City Model for FT of Kuala Lumpur and Putrajaya. To actualize this vision, a comprehensive set of data and information is required. Using cutting edge survey technology namely Light Detection and Ranging (LiDAR), Multiview Oblique Imagery, Mobile Laser Scanner, Terrestrial Laser Scanner and 360-Degree Panoramic Street View, JUPEM successfully established and fused all these data using a high-end software and create a web-portal that contains visualization and information in 2D and 3D environment. Despite the fact that all this information come from multiple sources and devices, the fusion was successfully done and the full set of geospatial data was published in a portal for public access.

3.2 SmartKADASTER Interactive Portal (SKiP)

SKiP was design to enable spatial analysis to be carried out to help user to make smart decision in line with its intention to provide a solid cadastral-based spatial analysis platform and concurrently supporting smart cities enablement in Malaysia. In fact, the ground-breaking innovation of SKiP

that it has the capacity to view 3D City Model for the whole FT of Kuala Lumpur and Putrajaya. The 3D City Model was built based on several workflow processing as portrayed in Figure 3.

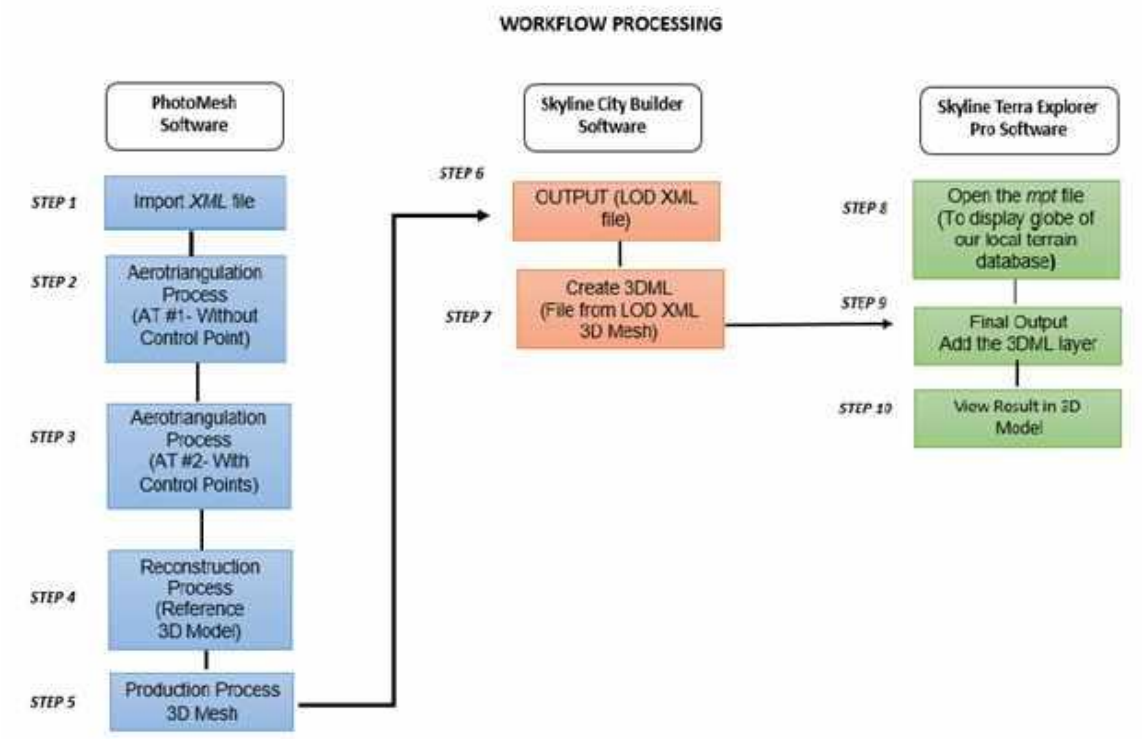

Figure 3: Workflow Process of 3D City Model establishment in SKiP

In brief, the captured images using Multi View Oblique Imagery were converted into XML and to determine the relative and absolute position of the datasets, an aero triangulation process was involved and finally the entire process was automated to create textured 3D mesh model and later was used to create 3DML. User can view the final output of 3D city Model using plug-in software; Skyline Terra Explorer.

Not only the that, this portal offers an application known as SKiP Walkthrough that enables the user to interact with the point cloud in real-time, for example visualising the point cloud from eye-level as if they were on site, freely navigating around the data. Walkthrough application also let user to experience and view desired building or site in 3D Model and 2D Schematic View. A screenshot of point cloud, 3D Model and 2D Schematic View as in Figure 4.

Figure 4: Clockwise – Point Cloud, 2D Schematic and 3D Model of JUPEM's Building

Apart from basic 2D and advanced 3D application, SKiP upholds the spirit of Geoinformation for Citizen and allow user to participate in contributing geospatial information by exercising crowd sourcing concept in MySKiP. To accommodate data dissemination and data sharing, user can opt to access the Catalogue which offers complete metadata of the data acquired in this project and it is accessible via Service Oriented Architecture (SOA). Therefore, data interoperability issue is not an issue in SKiP.

For the aforementioned details, SKiP can act as a decision-making tool in aiding user to make smart decision via multiple analysis and simulation such as slope analysis, flood analysis, contour map, terrain profile and many more according to user necessity.

4. ROAD TO SMART CITIES

City is known as a melting pot for all people from all walks of life. According to the United Nations Human Settlements Programme (UN-HABITAT) Global Activity Report 2015, in the last century, the world has been rapidly urbanizing. In 2008, for the first time in history, urban population outnumbered rural population. This milestone marked the emergence of a new 'urban millennium' and, by 2050, it is expected that two-thirds of the world population will be living in urban areas. In

Malaysia, an increasing population of city dwellers is illustrated in Figure 5.

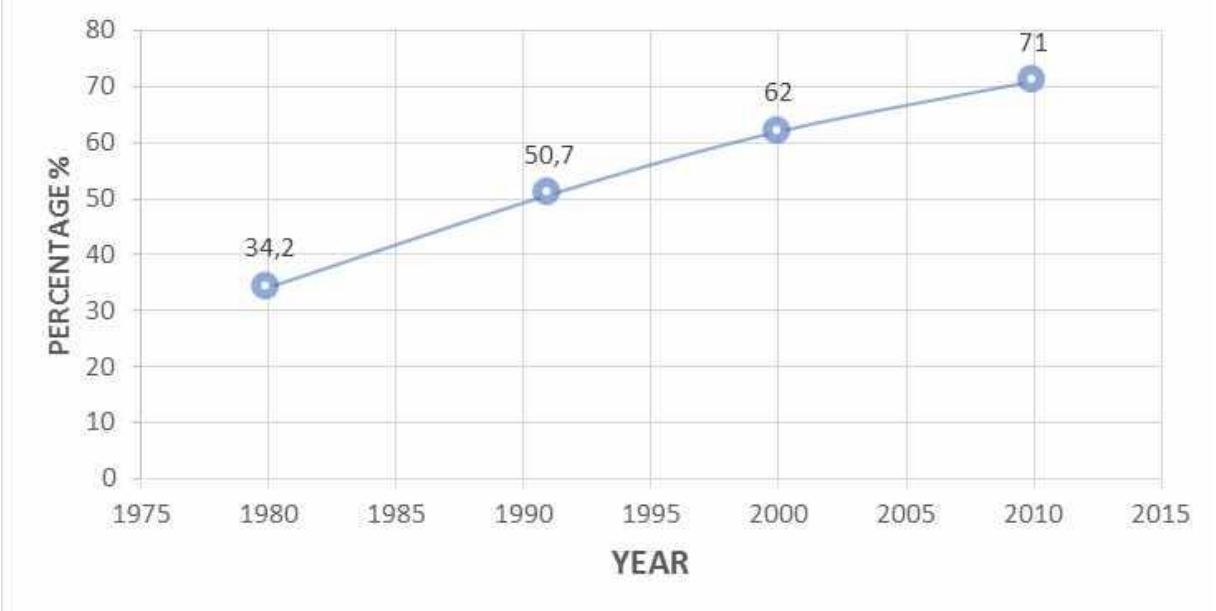

Figure 5: Percentage of Malaysian Living in Urban Areas from 1980 to 2010
Source: Department of Statistics Malaysia

This numbers keep on increasing as the Government introduced the 12 National Key Economic Areas (NKEAs) comprise selected sectors of economic opportunity which will drive Malaysia towards high-income status and global competitiveness. One of the NKEA is the introduction of Greater Kuala Lumpur/Klang Valley. The goal is to transform the region into a world-class metropolis that will boast top standards in every area starting from business infrastructure to liveability. The Government also planned to focus towards enhancing mass movement of people through public transport, providing high quality services in the areas of sewerage and solid waste management, developing green initiatives and leveraging on the river and heritage assets. These are few components that can promote to the preparedness towards Smart City in Malaysia. Therefore, to achieve these goals, Government is playing its duty by continuing to support the initiative lead by various Government Department including JUPEM. The SmartKADASTER initiative is one of the many tools that can support towards Smart City establishment in Malaysia.

Basically, there are multiple points of view in defining smart cities; varies from different stakeholders, academia, governmental institutions and private companies. However, it all comes to one unanimous definition; Smart City is a system that enhances human and social capital wisely using and interacting with natural and economic resources via technology-based solutions and innovation to address public issue and efficiently achieve sustainable development and a high quality of life on the basis of a multi-stakeholders, municipally based partnership (Fernandez-Anez, 2016).

The usage of 3D analysis in SmartKADASTER by local authorities or developer can help cities become smarter, improve environmental performance, transportation and utility networks, and

minimise the impact of construction and maintenance by practising sustainable development. Apart from new development, SmartKADASTER can also be used in maintaining existing development by continuous monitoring of related asset and one of the services which is SKiP Walkthrough allow users to explore inside the building and navigate as is the user is in the building. This provide smart solution for the building owner for maintenance and should there be any changes; such as building refurbishment in future, the owner can leverage the information for easy reference.

5. FURTHERANCE

SmartKADASTER was successfully launched in 2016 after two years of development. At present, it is fully operative and used by various category of users. As envisaged, SmartKADASTER is being advantageous to not only to government officials but also to private player, public, academician and student. The implementation of National Blue Ocean Strategy (NBOS) by the Government is fully observed by JUPEM as other/various Government Department are sharing data and services of SmartKADASTER via SOA. Consequently, Government resources is being minimise.

JUPEM has also take few measures to strengthen and widen the use of SmartKADASTER by initiating a Memorandum of Understanding (MOU) with selected local authorities. One MoU signing ceremony was held in July 2016 and another MOU is currently at discussion phase and expected to tie the agreement by end of 2017.

For this reason, under Malaysia's 11th Development Plan (RMKe-11) JUPEM is planning to prolong the value of SmartKADASTER to new and bigger AOI which has extensive scope involved. To date, the second phase of SmartKADASTER is still on initial stage and expected to kick off by July this year.

6. CONCLUSION

JUPEM has tremendously played its part by modernising cadastral based system and taking it to greater heights with the introduction of SmartKADASTER. Presently, cadastral system in Malaysia not only known to produce final title plan for land administration but also supporting and aiding user for various purposes especially in infrastructure project implementation and monitoring by providing accurate cadastral based analysis platform in 3D environment. The present cadastral system need to conform to the needs for flexibility and effectivity as stated in Bogor Declaration by UN. To go beyond cadastre, JUPEM needs to take necessary means to prepare towards the smart city enablement in Malaysia. As the city dwellers population is increasing, more integrated knowledge system and smarter solutions is in need to fulfil and accommodate Government's NKEA aspiration. As cities all over the world is heading to smart cities, Malaysia is following their wake. It is sufficed to say that SmartKADASTER is the steppingstone to the establishment of Smart City in Malaysia. Smart cities will be more than just a trend in the future; it can become an indispensable system to drive economic growth by harnessing the 3D information that will eventually lead to a better tomorrow.

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BIOGRAPHICAL NOTES

Mohd Noor bin Isa is currently holding the position of Deputy Director General of Survey and Mapping I since February 2017. He is also a Fellow of the Royal Institution of Surveyors Malaysia (RISM), Chairman of Geomatics and Land Surveying Division (GLS), RISM for the 2015/2016 session, Deputy Chairman of Land Surveyors Board Malaysia (LSB) and a Registered Land Surveyor.

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