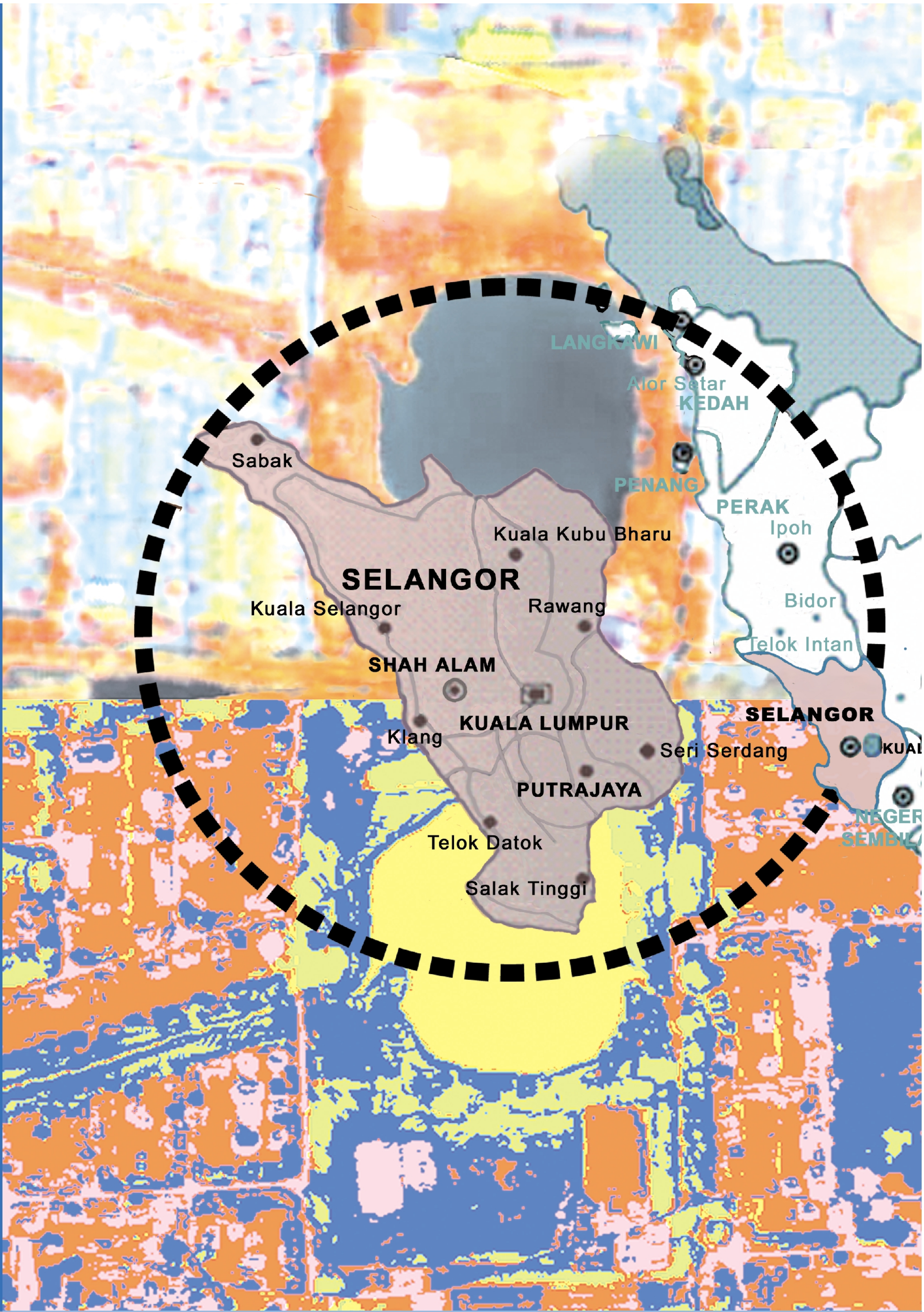
BULETIN GIS



JAWATANKUASA PEMETAAN DAN DATA SPATIAL NEGARA

BIL.1 /2008

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PENDAHULUAN

Jemaah Menteri berasaskan Kertas Kabinet No.243/385/65 bertajuk *National Mapping Malaysia* telah meluluskan jawatan dan terma-terma rujukan *"Surveyor-General Malaya and Singapore"* sebagai Pengarah Pemetaan Negara Malaysia dan mengesahkan keanggotaan serta terma-terma rujukan Jawatankuasa Pemetaan Negara pada 31 Mac 1965.

Cabutan para-para 2(b), 2(c) dan 2(d) daripada kertas kabinet tersebut mengenai keanggotaan dan terma-terma rujukannya adalah seperti berikut:

"2(b) National Mapping Committee

That a National Mapping Committee be appointed to comprise the following:

- *i. Director of National Mapping*
- *ii. Director of Lands & Surveys, Sabah;*
- *iii. Director of Lands & Surveys Sarawak;*
- *iv. Representative of the Ministry of Defence;*
- *v. Representative of the Ministry of Rural Development (now substituted by the Ministry of Natural Resources and Environment);*
- *vi. Assistant Director of Survey, FARELF*

2(c) The terms of reference of the National Mapping Committee to be as follows:

- *i. to advise the Director of National Mapping on matters relating to mapping policy;*
- *ii. to advise the Director of National Mapping on mapping priorities.*

2(d) That the Committee be empowered to appoint a Secretary and to co-opt persons who would be required to assist the Committee,"

Seterusnya pada 22 Januari 1997, Jemaah Menteri telah meluluskan pindaan terhadap nama, keanggotaan dan bidang-bidang rujukan Jawatankuasa Pemetaan Negara kepada Jawatankuasa Pemetaan dan Data Spatial Negara (JPDSN), bagi mencerminkan peranannya yang diperluaskan ke bidang data pemetaan berdigit. Keanggotaan JPDSN pada masa kini adalah terdiri daripada agensi-agensi seperti berikut:

1. Jabatan Ukur dan Pemetaan Malaysia
2. Jabatan Tanah dan Ukur Sabah
3. Jabatan Tanah dan Survei Sarawak
4. Wakil Kementerian Pertahanan
5. Jabatan Mineral dan Geosains Malaysia
6. Jabatan Perhutanan Semenanjung Malaysia
7. Jabatan Pertanian Semenanjung Malaysia
8. Jabatan Perhutanan Sabah
9. Pusat Infrastruktur Data Geospatial Negara (MaCGDI) *(co-opted)*
10. Jabatan Pertanian Sabah
11. Jabatan Pertanian Sarawak
12. Pusat Remote Sensing Negara (MACRES)
13. Universiti Teknologi Malaysia
14. Universiti Teknologi MARA *(co-opted)*
15. Universiti Sains Malaysia *(co-opted)*
16. Jabatan Laut Sarawak *(co-opted)*
17. Jabatan Perhutanan Sarawak
18. Jabatan Perancangan Bandar dan Desa Semenanjung Malaysia *(co-opted)*

Buletin GIS ini yang diterbitkan dua kali setahun adalah merupakan salah satu aktiviti oleh Jawatankuasa Pemetaan dan Data Spatial Negara, sebagai salah satu media pendidikan dan penyebaran maklumat dalam mendidik masyarakat memanfaatkan maklumat spatial dalam pembangunan negara. Walau bagaimanapun, sebarang kandungan artikel-artikel adalah tanggungjawab penulis sepenuhnya dan bukan melambangkan pandangan penerbit.

Kandungan

Dari Meja Ketua Editor

Di Negara Jepun, kejadian gempa bumi yang berukuran 7.2 skala Richter di Kobe pada tahun 1995, telah meragut 5,500 nyawa serta mengalami kerugian ekonomi sebanyak USD 200 bilion. Impak daripada kejadian tersebut, kerajaan Jepun telah mencontohi Kerajaan Amerika Syarikat yang pada ketika itu telah terlibat secara langsung dalam penggunaan Sistem Maklumat Geografi (GIS) bagi menguruskan kejadian bencana alam. Bermulalah daripada situ, Kerajaan Jepun telah menyegerakan pembangunan Infrastruktur Data Spatial Kebangsaan (NSDI) di semua peringkat masyarakat termasuk agensi kerajaan dan industri swasta. Untuk menuju ke arah itu, sumber kewangan yang mencukupi telah disediakan bagi mewujudkan data digital yang diperlukan bagi GIS.

Geographical Survey Institute (GSI) iaitu agensi ukur dan pemetaan Negara Jepun telah memainkan peranan yang penting dalam membekalkan data geografi di bawah undang-undang *The Survey Act of Japan.* Pada tahun 1997, GSI telah menubuhkan *GIS Promotion Office* yang berperanan secara langsung dalam aktiviti GIS di seluruh negara tersebut. Untuk itu, beberapa kumpulan kerja telah ditubuhkan bagi membangunkan data spatial dan kerangka data spatial. Di samping itu, Negara Jepun yang juga mempunyai lebih daripada 10 juta nama geografi telah menguruskan koleksi, susunan dan piawaian nama-nama geografi berpandukan kepada *Japan Industri Standard (JIS)* bagi mempromosikan kegunaan GIS.

Sementara di Malaysia pula, Jabatan Ukur dan Pemetaan Malaysia (JUPEM) memberi pelbagai perkhidmatan pemetaan dan kadaster kepada jabatan kerajaan, syarikat swasta dan orang ramai. Ini termasuklah pembekalan peta topografi terhad dan tidak terhad serta peta tematik dan pelan akui dalam bentuk digital dan *hardcopy*. Dalam hal ini, nilai pembekalan peta berdigit yang diuruskan oleh Seksyen Perkhidmatan Pemetaan, Ibu Pejabat JUPEM adalah melebihi sejuta ringgit setahun. Pembekalan data digital JUPEM adalah berkait terus dengan aktiviti GIS yang diuruskan oleh pihak swasta mahupun jabatan-jabatan kerajaan termasuklah pihak Suruhanjaya Pilihan Raya juga telah turut memperoleh data digital JUPEM sebagai sumber maklumat yang penting bagi menguruskan pilihan raya umum Malaysia 2008 baru-baru ini.

JUPEM juga memberi perkhidmatan konsultasi pemetaan kepada jabatan kerajaan yang ingin atau sedang membina GIS di jabatan masing-masing seperti di Jabatan Perancang Bandar dan Desa, Jabatan Perdana Menteri, Jabatan Penilaian dan Perkhidmatan Harta dan Jabatan Kerja Raya. Adalah diharapkan, dengan kemajuan teknologi GPS, *remote sensing, ICT* dan *internet,* pertumbuhan aplikasi GIS akan berkembang dengan lebih pesat lagi di pejabat-pejabat kerajaan dan industri swasta Malaysia.

Ng Eng Guan

DEVELOPMENT OF GEOGRAPHIC INFORMATION SYSTEM DATABASE FOR TOWN PLANNING OF SRI SERDANG, MALAYSIA USING UPM-APSB'S AISA AIRBORNE HYPERSPECTRAL IMAGING DATA

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Abstract

Sri Serdang is a rapidly developing small town located within the extension of the metropolitan area between Kuala Lumpur and Putrajaya, Malaysia. Any development in Sri Serdang will be very critical since Sri Serdang is now a land deficient town. Setting up a Geographic Information System (GIS) is very important for proper planning of the town for future metropolitan development. GIS database can be used in monitoring structures in a city or municipal area with the help from remotely sensed data. This study utilized UPM-APSB's AISA airborne hyperspectral sensing data in the development of GIS database for Sri Serdang's future planning and development. The data was then pre-processed and enhanced to improve the quality of the image. Minimum distance classifier was applied on the image to identify the features within the study area. The data was further post-processed and exported as five different thematic GIS layers (ArcView Shapefile) with individual attribute which consisted of buildings, trees, vacant lands and green lungs, water bodies and roads layers. The accuracy of the classification was 83.7% and this has shown that UPM-APSB's AISA sensor was capable of detecting urban features accurately and it is suitable to be used for development and updating of GIS database in future town planning.

1.0 INTRODUCTION

Malaysia is a country which is moving towards an industrial country to achieve our country's mission to become an advance country such as Japan, USA, etc. Malaysia's development planning process is well-defined and is based on two major planning instruments. This helps in concentrating our efforts in achieving well-defined long-term national objectives and promoting social and political stability as well as efficient management of the economy. This will provide a stronger foundation for the attainment of sustained growth and development, particularly in the process of transformation towards becoming a developed nation by the year 2020 (Cho, 1997). In order to become a developed nation by 2020, the population of Malaysia is predicted to break 23,953,136 in the year 2005 with population growth rate of 1.80% in 2005. The overall population density is 73 persons per km^2 but the population is unevenly distributed. There were about 64% of Malaysia's population is urban (Ulack, 2005). Malaysia's largest city is the country capital of Malaysia, Kuala Lumpur. In addition to Malaysia's largest city, large cities in the country include Ipoh, Johor Bharu, Petaling Jaya, Klang, Kuala Terengganu, and George Town. Malaysia's largest metropolitan area, the Klang valley, consists of Kuala Lumpur, Petaling Jaya, and Klang which is Malaysia's largest urban region. Most of the conurbation is located in the state of Selangor, which surrounds the Kuala Lumpur federal territory.

Selangor has an area of approximately 8,000 km^2 (Loh, *et al*, 1997). It is located at the west coast of Peninsular Malaysia. Its advantageous geographic position and rich natural resources have made Selangor the most prosperous state in Malaysia. Selangor is Malaysia's most populated state with an annual population growth rate of about 6% which is the highest of any Malaysian state (Ulack, 2005). The increment of employment opportunities in the Klang Valley conurbation and the sprawl of the Kuala Lumpur greater metropolitan area beyond the borders of the federal territory have brought to the high population growth rate. The development of the state continues with the extension of metropolitan area since the late 1990s by the construction of a new administrative centre of the federal government at Putrajaya, about 40 km to the south of Kuala Lumpur. The new Kuala Lumpur International Airport (KLIA) is also located at the south of Putrajaya.

Sri Serdang is a small town located within the extension of the metropolitan area between Kuala Lumpur and Putrajaya. It is now developing rapidly due to exponential development of the population due to immigration of students from the whole country to further their tertiary studies at Universiti Putra Malaysia. Any development in Sri Serdang will be very critical since Sri Serdang is now a land deficient town. Setting up a Geographic Information System (GIS) is very important for proper planning of the town for future metropolitan development.

GIS is frequently applied to geographically oriented technology, integrated systems used in substantive applications. GIS are integrating systems which bring along together with ideas developed in many areas including areas of agriculture, botany, computing, economics, mathematics, photogrammetry, surveying, zoology and finally geography (Maguire, 1992). Burrough (1986) has defined GIS as a powerful set of tools for collecting, storing, retrieving at will, transforming and displaying spatial data from the real world. Geographic Information System can be used in monitoring structures or spatial features in a city or municipal area with the help from remote sensed data (Anonymous, 2003). According to Jones (1997), GIS has become more widely used for decision support in application such as urban and regional planning, agriculture and the utilities.

The development of GIS is built upon a combination of database management system for storing information and computer graphics for digitizing and displaying spatially referenced information. Some GIS employ the techniques from the field of computational geometry to manipulate geometric data and image processing functions to interpret remote sensed data (Jones, 1997). GIS integrates data and present it in graphic format, this will allow town planners to plan a town properly with available related information on the database management system (DBMS). The database in the DBMS is mainly geo-referenced. Spatially referenced information is an essential requirement for a large proportion of the task expected of local, regional and national government. The example of these tasks are planning the location of new industrial sites, hospitals, new housing areas, trees and parks, roads and highways, building and maintenance and management and maintenance of properties owned by an authority.

Developments in a small town like Sri Serdang requires a detailed and precise planning before it can be implemented. Planning such as location of new industrial sites, hospitals, new housing areas, trees and parks, roads and highways, maintenance and management of building and properties owned by an authority needed to be considered before the implementation of any project to make the project a success (Jones, 1997).

In conventional town building where sporadic housing estates are allowed to come together as adjoining growth centres to form larger township is disastrous not only to the future traffic circulation but also to the social units and community well-being. With the current system of planning approval, the planners are more concerned with satisfying standards from within each housing estate rather than meeting the need of the whole conglomeration of housing estates whose threshold requirements in term of basic facilities and social amenities may differ quite drastically. These problems could have been avoided if proper study of the regional growth pattern is made and a forecast attempted on the direction and size of all future developments at the outset. Once the upper limit of all future housing density for the whole region is evolved then it is possible to calculate the ultimate traffic volume and flow in order to design the requisite arterial roads and superhighways to efficiently accommodate the anticipated growth in vehicular traffic.

Planning of a town can be separated into several departments in order make implementation more efficient. Planning distribution however, has caused a main problem where every department has their own system of managing their plans. Gathering information from every department are tedious, less productive and time consuming which directly leads to subjective decision-making. With GIS developed, improvement of the performance of these departments can be done by automation, enabling the prompt decision-making by analysis, easy information retrieval and timely, accurate, complete and updated information on town planning (Tripathy, 2002). Town planner will have a centralised database accessible to all the departments using maps and related information instantly. This will increase their productivity and result in the prompt decision-making (Tripathy, 2002).

Application of GIS technology in urban and regional planning can be very cost, time and effort efficient. The degree of accuracy is increased with the geo-reference data in GIS database system. GIS implementation can be separated into three levels which include visualization, planning and detailed planning/spatial analysis. Level of implementation can be chosen according to the community needs and financial resources. Urban and regional planning usually uses GIS in the planning and detailed planning depending on types of planning required by the town planner.

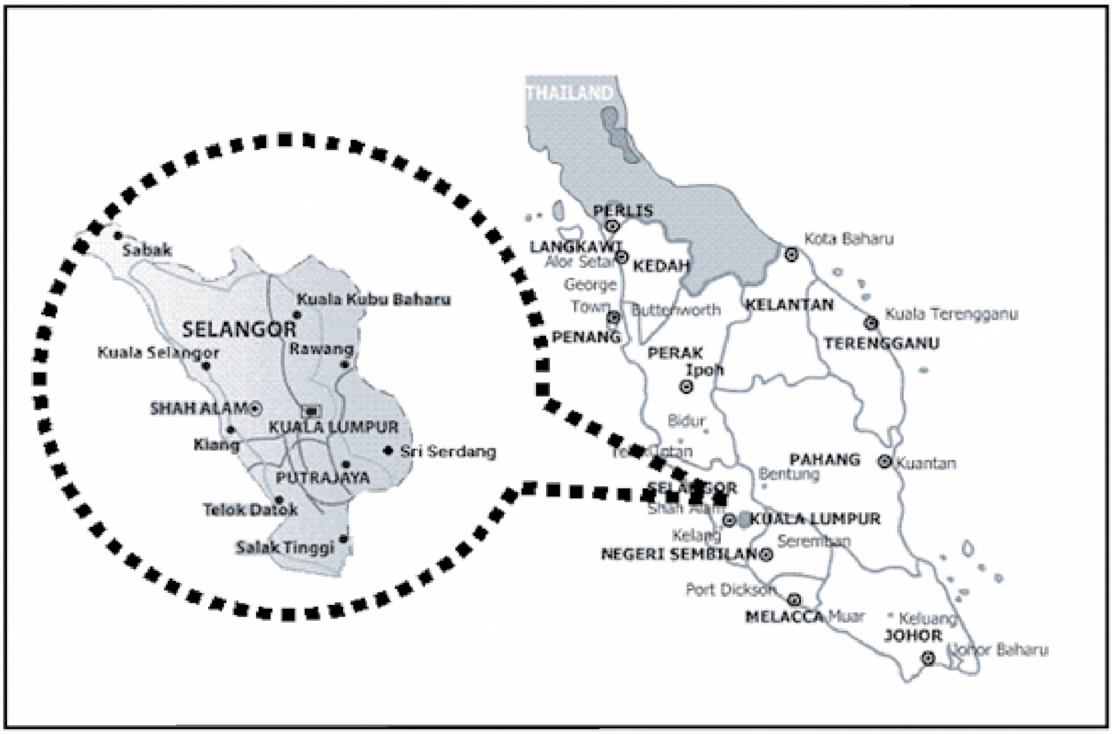
GIS is usually integrated with remote sensing where remote sensing is used to gather datasets for use in GIS. Both Peninsular and Sarawak and Sabah consist of more than 40% of cloud coverage at any time. This has made the image of high altitude remote sensing such as spaceborne remote sensing data cannot be obtained without any cloud interruption. This might cause some information in the acquired images to be biased or lost. The frequent cloud coverage also caused data acquisition cannot be preceded every time when the spaceborne sensor flight through the airspace of the desired area. The application of UPM-APSB's airborne hyperspectral AISA data in gathering datasets for GIS development has the potential to avoid cloud coverage during data acquisition due to the low altitude flight of the sensor bearing aircraft. The fine spatial resolution is of UPM-APSB's AISA airborne hyperspectral images also allow the features in urban area to be classified with higher accuracy. Previously, there were very few studies about the capability and compatibility of UPM-APSB's AISA sensor in mapping urban buildings and materials and GIS database development. The general objective of this study is to assess the usefulness of "ready-made" UPM-APSB's AISA data in urban GIS database development. The specific objective of this study is to develop five essential GIS layers with attribute tables (buildings, trees, water bodies, vacant lands and green lungs and roads) in Sri Serdang for future town planning and development using UPM-APSB's AISA data.

2.0 METHODOLOGY

2.1 Descriptions of Study Area

The study was conducted in Sri Serdang, a town located on latitude 3°0'12.08" N to 3°0'32.39" N and longitude 101°2'35.77" E to 101°3'6.73" E (Figure 1). It is a town in Serdang which is within the metropolitan area stretch of Kuala Lumpur and Putrajaya. Sri Serdang is an area heavily populated by the Malay community which has been transformed from a quiet, tranquil suburb to a bustling university township. The nearby town is made up of Serdang Jaya, Seri Kembangan, Serdang Raya, Serdang Perdana and Serdang Lama. This area has progressed tremendously over the years, creating a name among local and foreign students of Universiti Putra Malaysia (UPM) and other nearby education institutions including Universiti Tenaga Nasional (UNITEN), Technology Park Malaysia (TPM) and Kuala Lumpur Infrastructure University College (KLIUC). Pubs, karaokes and discotheques are rarely seen here. Instead, the Subang Jaya Municipal Council (MPSJ) projects a healthier lifestyle by providing a recreational park and football fields. Joggers do their rounds, old folks astound at the breathtaking scenery, and youngsters work at the exercise bars available at the park. Shopping facility and service shops bloom here because of the amounting needs of students of UPM and other primary, secondary and tertiary level students. The welfare and social securities are well taken care of as banks, clinics, pharmacies, schools and insurance agencies converge to provide the best services.

The climate of Sri Serdang is similar to the climate of Malaysia which is humid and hot in the whole year with mean daily temperature of 27 °C. The peak temperature could reach 32.3 °C and the lowest at 21 °C. The hot and humid climate of Sri Serdang is accompanied by an average rainfall of 2,500 mm per annum with the highest of 290 mm per month and the lowest at 130 mm per month. The sky of Sri Serdang is frequently covered by thick clouds especially during Northeast Monson Season (NMS) during the month of September to March every year which will bring together with heavy monsoon rain within the duration. Thunder and lightning often accompany the heavy downpour which normally lasts for about an hour or two. The humidity level is constant at 80% throughout the year.



2.2 Equipments and Software

A Garmin® GPS 12 Personal Navigator® was used to locate every feature on the land and non-spatial data can be obtained directly from the feature. GPS 12 offers the power and performance of a 12-channel receiver with fast satellite acquisition in the toughest conditions even in heavy tree cover in the study area. ENVI is the ideal software for the visualization, analysis, and presentation of all types of digital imagery. ENVI's complete image-processing package includes spectral tools, geometric correction, band combination, image classification, terrain analysis, radar analysis, raster and vector GIS capabilities. It supports images from a wide variety of sources including images from UPM-APSB's AISA hyperspectral images.

ArcView is a desktop Geographic Information System developed by Environment System Research Institute (ESRI), Redlands. Intelligent, dynamic maps can be created using data from virtually any source and across most popular computing platforms. Maps, database tables, charts, and graphics can be managed using the powerful tools in ArcView GIS. Data and other attributes obtained from ground verification can be added to the maps created easily. Those data also can be accessed from existing databases and display them on maps. The data can be integrated to perform spatial analysis and queries to achieve the objectives of the study.

2.3 Methodology

2.3.1 Data Acquisition

The primary data of this study was acquired using UPM-APSB's AISA hyperspectral sensor over the airspace of Sri Serdang on 18 February 2004 at the altitude of 1,000 m from the ground. The data was then subjected to image processing such as geometric and radiometric correction. Geometric correction was done to the image to correct the distortion and degradation of the image to improve geometric integration of the image. While radiometric correction was being done to the image to compensate the bias of radiance measurement from the ground features so that the image value represent as closely as the true reflectance of land features. Image enhancement was performed to enhance the clarity of the image to obtain a more accurate classification.

The ancillary data used in this study were the development map of Sri Serdang and the ground verification data collected during ground verification. The development map of Sri Serdang was obtained from the Department of Development and Planning, Subang Jaya Municipal Council (MPSJ). This map was used to allocate the location of the features in Sri Serdang during ground verification with the help of GPS. The ground verification data was used to construct attribute table of every feature layers. This data consisted of non-spatial data about the features in Sri Serdang. For instance, the attribute table of ornamental trees in Sri Serdang consisted of tree species and tree vigour. **Figure 2** showed the flowchart of methodology of GIS database development for Sri Serdang using UPM-APSB's AISA data.

2.3.2 Regions of Interest (ROIs) Establishment and Spectra Extraction

Before classification was done to the processed image data, spectra were collected using ROI methods where spectra for every selected GIS layers to be developed were collected and categorized into different classes. ROIs were selected on the image based on GIS layers to be created. Spectra within the ROIs were extracted and used in the classification process to classify the image into several classes according to the predetermined classes. These ROIs were also known as training data. GIS layers that needed to be created are buildings, roads, vacant lands and green lungs, ornamental urban trees and water bodies layer.

Table 1 shows some of the different types of spectral extracted from ROIs. This method was being used to extract spectra instead of using on-the-ground spectroradiometer because there was a time interval between the date of last data acquisition and spectra extraction. There might be a lot of changes happening on the study site such as repainting of buildings, renovations, oxidisation of materials, etc. These changes might cause bias between the image and the situation in the real world. Collecting spectra on the ground might cause some of the data in the image could not be classified and this could reduce the accuracy of the classification.

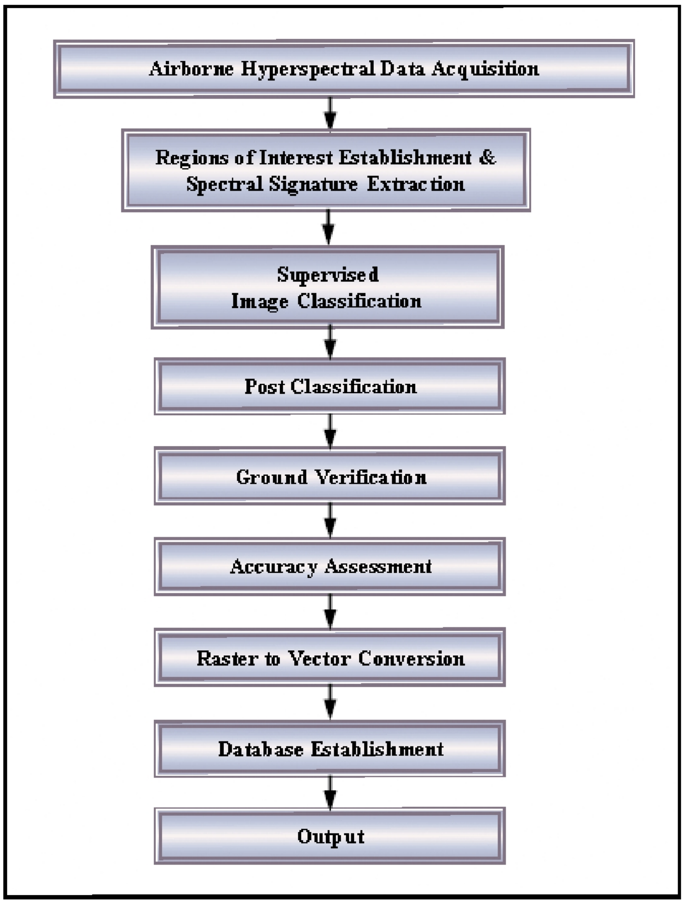


Table 1: Different Types of Spectra Extracted from ROIs

GIS Layers to be Developed	Spectra Extracted from ROIs
Buildings	Different Building Materials (Houses, Schools, Mosque, Pos Office, Shop Houses, etc.)
Roads	Different Types of Road Pavement
Vacant lands and Green lungs	Vacant Lands, Fields, etc.
Ornamental Urban Trees	Ornamental Trees
Water bodies	Ponds, Rivers, Streams, etc.

2.3.3 Supervised Image Classification

Supervised image classification was used to classify the image into predetermined classes using the spectra from the ROIs. Minimum distance algorithm was used to perform classification. The minimum distance technique uses the mean vectors of each end member (extracted spectra) and calculates the Euclidean distance from each unknown pixel to the mean vector for each class. All pixels are classified to the nearest class unless a standard deviation or distance threshold is specified, in which case some pixels may be unclassified if they do not meet the selected criteria.

This type of classification algorithm is not sensitive to different amounts of variance in the training data sets. Therefore, analysts tend to stay clear of this algorithm in application situations where spectral classes are close to each other and where the classes have high variance. However, this method was selected to perform classification on the image and it produced the most reasonable classification among other supervised classification algorithms. It is also mathematically simple and computation efficient where classification can be done to a large area within a short period of time.

2.3.4 Post Classification

Features in urban area are usually shown as polygons with distinct edges. The shape of the features in classified image were imperfect polygons with some of the pixels might be involved in omission errors. Post classification was done to the classified image to modify the classification results so that the features were in the proper shape of complete polygons. Post classification also removes additional commission errors pixels in every class so that every feature were represented by a polygon consists of identical pixels from the same class. This procedure is very important in order to produce a systematic and tidy urban structure GIS for town management and maintenance.

2.3.5 Ground Verification

Stratified random sampling by which a minimum number of samples were selected form each class (strata) as ground verification ROIs. This combination of stratified and simple random sampling provided the best balance between statistical validity and practical applications (Congalton, 1988). A total of 50 samples were collected from every class to assess the individual accuracy of individual classes in the remote sensing classification image. Congalton (1991) suggested that a good rule of thumb was to select 50 samples from each class in the confusion matrix. The sample size could be altered according to the size of the area. If the area of the class relatively small thus the sample size can be reduce to an appropriate sample which suit the area (Jensen, 1996). The same theory also applied to the class with large area. The samples selected were visited on the ground with the aid of GPS to verify the compatibility of the classification classes assigned to the sample point. The data were subjected to a confusion matrix and accuracy assessment analysis.

Ground verification was also done in the study to obtain non-spatial attribute data of the ground features. Every feature identified by supervised classification was visited to obtain non-spatial information. These non-spatial data were used to create attribute table for every feature layers created. The location of every feature was obtained from the GPS reading in the data acquired. Updated map of Sri Serdang was also used to ease ground verification job in identifying the location of the features identified. A normal saloon car was used to reach the location of the features as all of the features were located within the area of Sri Serdang town. The dataset collected were stored into Microsoft Excel spreadsheet to prevent the data from being ruined and enable it to be managed easily.

2.3.6 Accuracy Assessment

After the data was classified, an assessment was done to the result of classification in order to assess the accuracy of UPM-APSB's AISA hyperspectral sensing in detecting urban buildings and materials. ENVI's confusion matrix method was used in this purpose to show the accuracy of a classification result by comparing a classification result with ground verification information. The confusion matrix is calculated by comparing the location and class of each ground verification pixel with the corresponding location and class in the classification image. ENVI was used to calculate a confusion matrix using ground verification regions of interest (ROIs) (also known as reference test pixels). These ROIs were not used in classification therefore represented unbiased reference information since ROIs used in classification might biased by the analyst's *a priori* knowledge and caused the classification accuracy to become generally higher (Campbell, 1987). The report will show the overall accuracy, kappa coefficient, confusion matrix, errors of commission (percentage of extra pixels in class), errors of omission (percentage of pixels left out of class), producer accuracy, and user accuracy for each class.

2.3.7 Raster to Vector Conversion

The classified images produced by supervised classification were in raster image format. However, ArcView GIS 3.1 was unable to process raster files. These images were converted into ENVI Vector Files (.evf) to vectorise every raster pixel in the classified image into vectors. This vector file was later converted into ArcView GIS 3.1 readable shapefile (.shp). In shapefile format, every feature was separated accordingly with its respective attribute table. These attribute tables will be enriched later with non spatial data related to the features. This conversion was conducted on different classification classes in order to build different GIS layers. At the end of raster to vector conversion, a total of five shapefile will be created representing five predetermined GIS layers that needed to be created.

2.3.8 Attribute Database Establishment

The non-spatial data collected during ground verification were inputted into the attribute table of every feature using ArcView GIS 3.1. New columns were added instead of the initial columns and modified according to the dataset collected. Every column were proposed with an appropriate column width in order to suit the dataset enter. This step is very important to ensure the size of the attribute table is as small as possible in order to make the GIS to operate faster and more effective. An unsuitable column width may cause the dataset entered unreadable or space consuming.

2.3.9 Output

At the end of this study, a GIS map consist of five main overlaying layers (buildings layer, roads layer, urban trees layer, vacant lands and green lungs layer and water bodies layer) was created with respective attribute tables. This GIS map can be used by the town planner at the future for planning and development of Sri Serdang and also for routine municipal maintenance and services.

3.0 RESULTS AND DISCUSSIONS

3.1 Image Enhancement

Edge detection in digital images is an important low-level operation in image processing and computer vision (Mohan and Hogg, 2004). Image enhancement was performed to the image after pre-processing to enhance the clarity of the image. Convolution and morphology filtering were applied to enhance the image. Sobel edge detection filter showed the best effect on the image in detecting edges of buildings and other urban infrastructure compared to other convolution and morphology filters. No single standard method of enhancement can be said to be 'best' for all kind of images, the need of different user may differ (Mather, 1999). The images of Sri Serdang before and after 70% image add back (Sobel edge detection) were showed in **Figures 3** and **Figure 4**, respectively.

Comparison has been done to both images with and without the application of image enhancement technique. Sobel edge detection was proved to have enhanced the appearance of the image. Features in image without enhancement **(Figure 4)** did not have distinct edges which differentiate between adjacent features while image with image enhanced tended to show distinct edges with the adjacent features. Shaw *et al* (1982) concluded that Sobel edge detection technique produced very intense enhancement on local edges. This has eased the problems faced in extracting features from remotely sensed images.

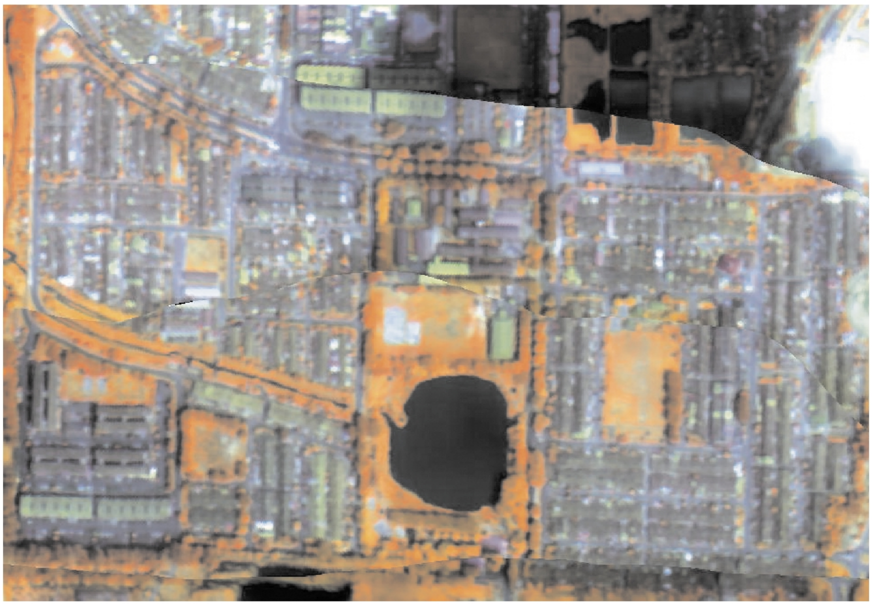


Figure 3: Image of Sri Serdang before Image Enhencement (R-G-B Band Combination: 19-11-12)

According to O'Leary *et al* (1976), Sobel edge detection was mainly used in the enhancement of images for identification and analysis of geological lineaments which can be easily mapped, simple or composite linear features whose parts are aligned in rectilinear or slightly curvilinear. These criteria matched with the features available in Sri Serdang making it the most suitable to be used in enhancing the images for the purpose of GIS layers development.

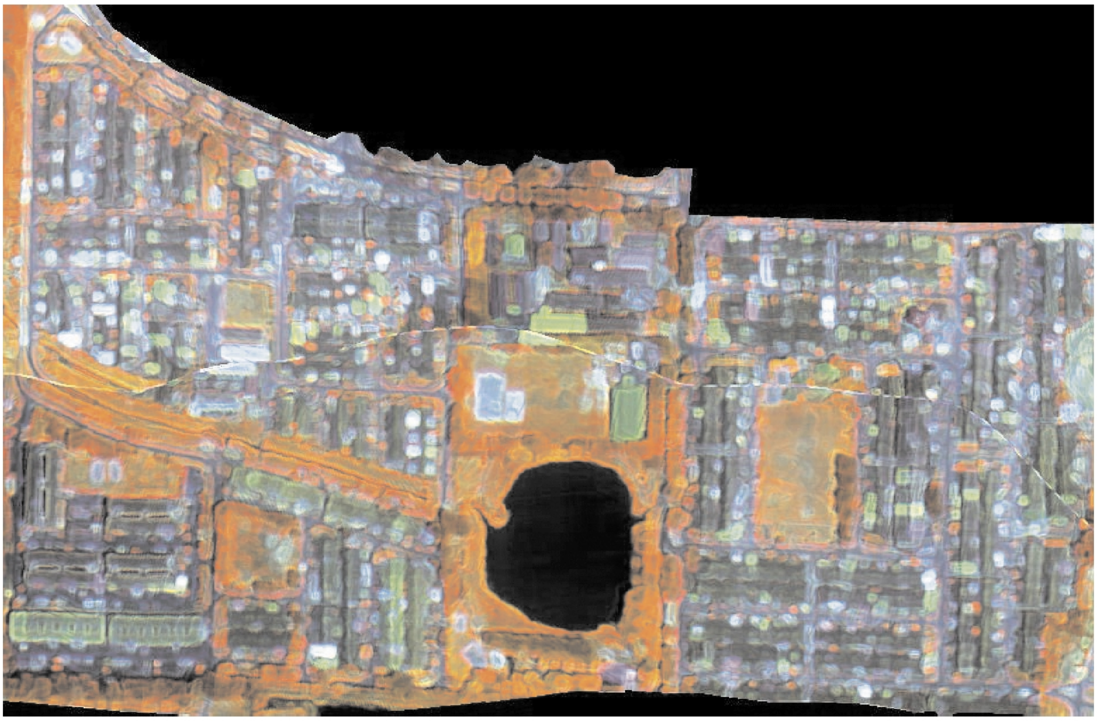


Figure 4: Image of Sri Serdang after 70% Image Add Back (Sobel Edge Detection)
(R-G-B Band Combination 19-11-2)

3.2 Image Classification

The enhanced image was classified with minimum distance classifier. Five main classes according to GIS layers that needed to be created were selected to classify the image. The colours of respective classes were showed in **Table 2**. **Figure 5** showed the result of classification using minimum distance technique. From the classified image, the seams between the stitches of image stripes were eliminated by minimum distance algorithm. The seams were classified to the nearest classes. The water bodies (yellow), urban trees (green) and vacant lands in the image were pertinently classified with minor misclassification.

Table 2: Colours Indicating Different Classification Classes

Colour	Class
Red	Buildings
Magenta	Roads
Blue	Vacant Lands and Green Lungs
Yellow	Water Bodies
Green	Urban Trees

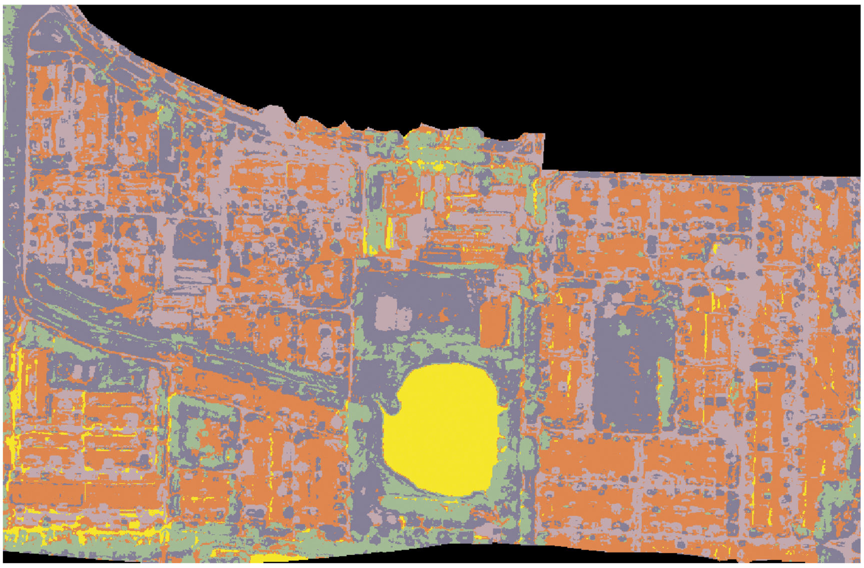


Figure 5: Minimum Distance Classification of Sri Serdang Image
(R-G-B Band Combination 19-11-2)

However, the some of the buildings (red) were poorly classified especially buildings located at the upper left of the image. The digital numbers at the described area were rather close between each other causing the classifier to misclassify between buildings and roads. Besides that, roads (magenta) were also poorly classified by the minimum distance algorithm. The objects on the road especially vehicles reflect radiation from different wavelength (different paintworks) causing some area of the road were misclassified as other classes. These errors in classification can be corrected by applying post classification process. However, this classification algorithm is the best among other classification algorithm such as the parallelepiped, mahalanobis distance, maximum likelihood and binary encode.

The classification results of those classification algorithms were compared with the results of minimum distance algorithm. The results showed that other classifications fail to classify the image area near to the stitches of image stripes accurately. The seams still existed and it influenced the result of the classification. Some of the algorithms such as maximum likelihood and mahalanobis distance classified the area beside the seams into two different classes. While parallelepiped algorithm failed to differentiate between buildings and roads which is the major classes in the classification.

There were several errors in the classification result of binary encode classification where the masked area of the image were misclassified as buildings (red) and vacant lands and green lungs class (blue) were absent in the classification result. No vacant land and green lung was detected in this classification.

3.3 Post Classification

Post classification was performed on the minimum distance classification result. Alterations were done to the classification result in order to make the result more presentable in the form of GIS layer. The partially classified features were re-edited manually into proper polygons. Some joined features such as the urban trees (green) were being separated manually according to the canopy boundaries observed on the original image. Some areas in the classified image were left unclassified to create a distinct margin between every feature so that the features can be interpreted easily when converted into GIS layers. The image after post classification process was shown in **Figure 6**.

From the above image, every single tree canopy was differentiated and separated from each other to enable individual attributes development for the GIS layer. The same steps also applied to the other classes. However, for the buildings class, no further separation was carry out since the boundary between every single unit within the building was absent from the image. Thus, the separation was being done to the entire building instead of individual unit within the building.

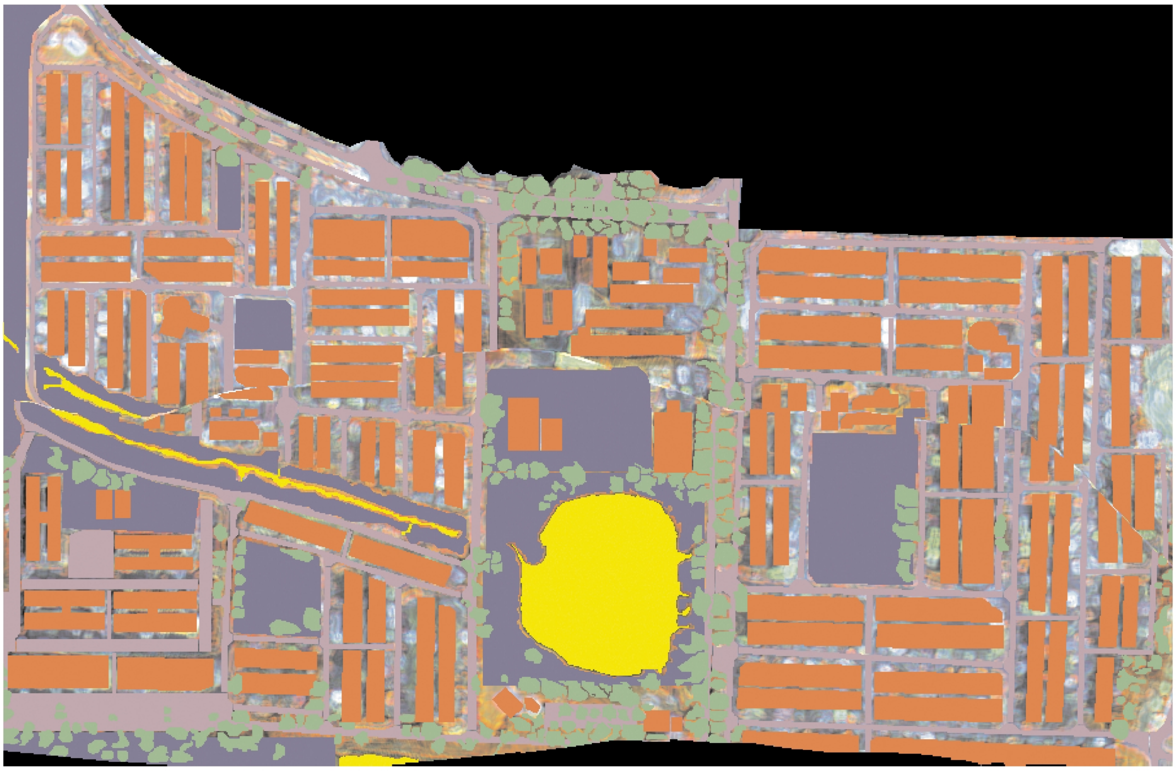


Figure 5: Image of Sri Serdang after Post Classification

3.4 Accuracy Assessment

In overall, from the confusion matrix obtained from ground verification, the accuracy of the classification is 83.6991%. This accuracy was greater than the prerequisite accuracy of 80% to be considered as an accurate classification. However, the kappa coefficient is lower than the overall accuracy. Congalton (1991) stated that these two measurements will not agree. The overall accuracy only incorporated the major diagonal and excluded the omission and commission errors. Conversely, the kappa coefficient incorporated the off-diagonal element in its computation. Usually, kappa coefficient is used to compare two identical matrices (consisting of identical categories) to determine if they are significantly different. **Tables 3**, **4** and **5** showed the confusion matrix, producer's accuracy and user's accuracy of the classification image of Sri Serdang, respectively.

Table 3: Confusion Matrix of the Classification Image of Sri Serdang

Overall Accuracy: (267/319) 83.6991%			**Kappa Coefficient: 0.7911**		
	Ground Verification Pixels				
Classes	Buildings	Trees	Vacant Lands and Green Lungs	Water Bodies	Roads
Unclassified	0	0	0	0	0
Buildings (Red)	64	4	0	0	14
Trees (Green)	0	62	13	0	0
Vacant Land and Green Lungs (Blue)	1	6	40	0	3
Water Bodies (Yellow)	0	1	0	27	5
Roads (Magenta)	5	0	0	0	74
Total	**70**	**73**	**53**	**27**	**96**

Table 4: Product of Accuracy of the Classification Image of Sri Serdang

Class	**Producer's Accuracy**		
	Pixel	**Percentage (%)**	**Omission Error (%)**
Buildings	64 / 70	91.43	8.57
Trees	62 / 73	84.93	15.07
Vacant Lands and Green Lungs	40 / 53	75.47	24.53
Water Bodies	27 / 27	100.00	0.00
Roads	74 / 96	77.08	22.92

Table 5: User's Accuracy of the Classification of Sri Serdang

Class	**User's Accuracy**		
	Pixel	**Percentage (%)**	**Commission Error (%)**
Buildings	64 / 82	78.05	21.95
Trees	62 / 75	82.67	17.33
Vacant Lands and Green Lungs	40 / 50	80.00	20.00
Water Bodies	27 / 33	81.82	18.18
Roads	74 / 79	93.67	6.33

Besides from overall accuracy, the producer's accuracy and user's accuracy of the classification is also very important because we never know hoe the classification may be used (Felix and Binney, 1989). For example, we are interested in the ability to classify buildings using AISA sensor. The overall accuracy was 83.6991% which included the accuracy of all other four classes. It could not express the accuracy of the classification for one class accurately. The producer's and user's accuracy can be used to determine the accuracy of the classification for the class. From **Tables 4** and **5**, the producer's accuracy and user's accuracy for the buildings class were 91.43% and 78.05%, respectively. From these accuracy measurements, a specific accuracy for building class was yielded. Although 91.43% of the buildings pixels were correctly identified as buildings, only 78.05% of the areas called buildings are buildings. Therefore, although the producer of the map can claim that 91.43% of the time an area that was buildings was identified as such; a user will find that only 78.05% of the time he or she visits in the field using the map actually be buildings. Hence, different accuracies can be derived from the confusion matrix depending on the user of the classification result.

3.5 GIS Layers Development

The classification results were converted into shapefiles (.shp) which originally in raster format to enable readability of GIS software such as ArcView GIS 3.1. These classification results were converted into shapefiles (.shp) in individual layer to produce thematic map presentation for file management and query in ArcView GIS 3.1. Together with these shapefiles, non spatial data collected during ground verification was inputted into the attribute table (refer to Appendix A) of every individual layer according to it respective class. Layers produced from these conversions were showed in **Figures 7**, **8**, **9**, **10** and **11** as buildings layer, trees layer, vacant lands and green lungs layer, water body layer and roads layer, respectively. These layers can be displayed simultaneously to form a complete GIS database of Sri Serdang **(Figure 12)**. These layers were ready to be used in any GIS to perform data query and analysis for future town planning and maintenance.

4.0 CONCLUSIONS

Several conclusions can be drawn from the study, namely (a) UPM-APSB's data is capable of differentiating urban features in Sri Serdang with an overall accuracy of 83.7%, and (b) a total of five different selected GIS layers were successfully developed namely buildings layer, trees layer, vacant land and green lungs layer, water bodies layer and roads layer has been developed with attribute tables equipped with non-spatial data regarding every feature in the layers for future planning and maintenance of Sri Serdang.

ACKNOWLEDGEMENTS

The authors would like to thank Aeroscan Precision (M) Sdn. Bhd. (APSB) for the airborne hyperspectral data and assistance in the data analysis.

Figure 7: Buildings Layer Derived from UPM-APSB's Classified Image

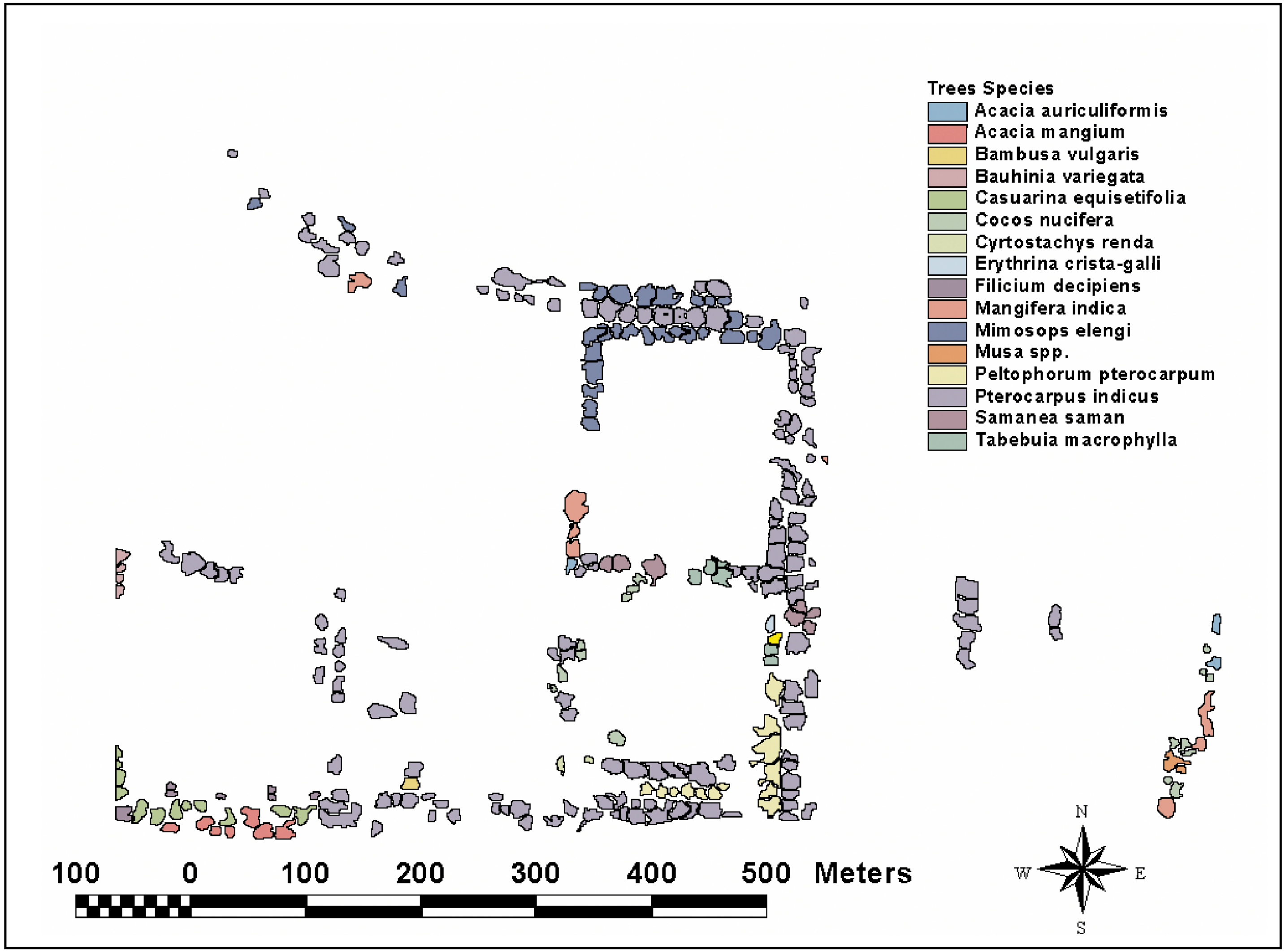


Figure 8: Trees Layer Derived from UPM-APSB's Calssified Image

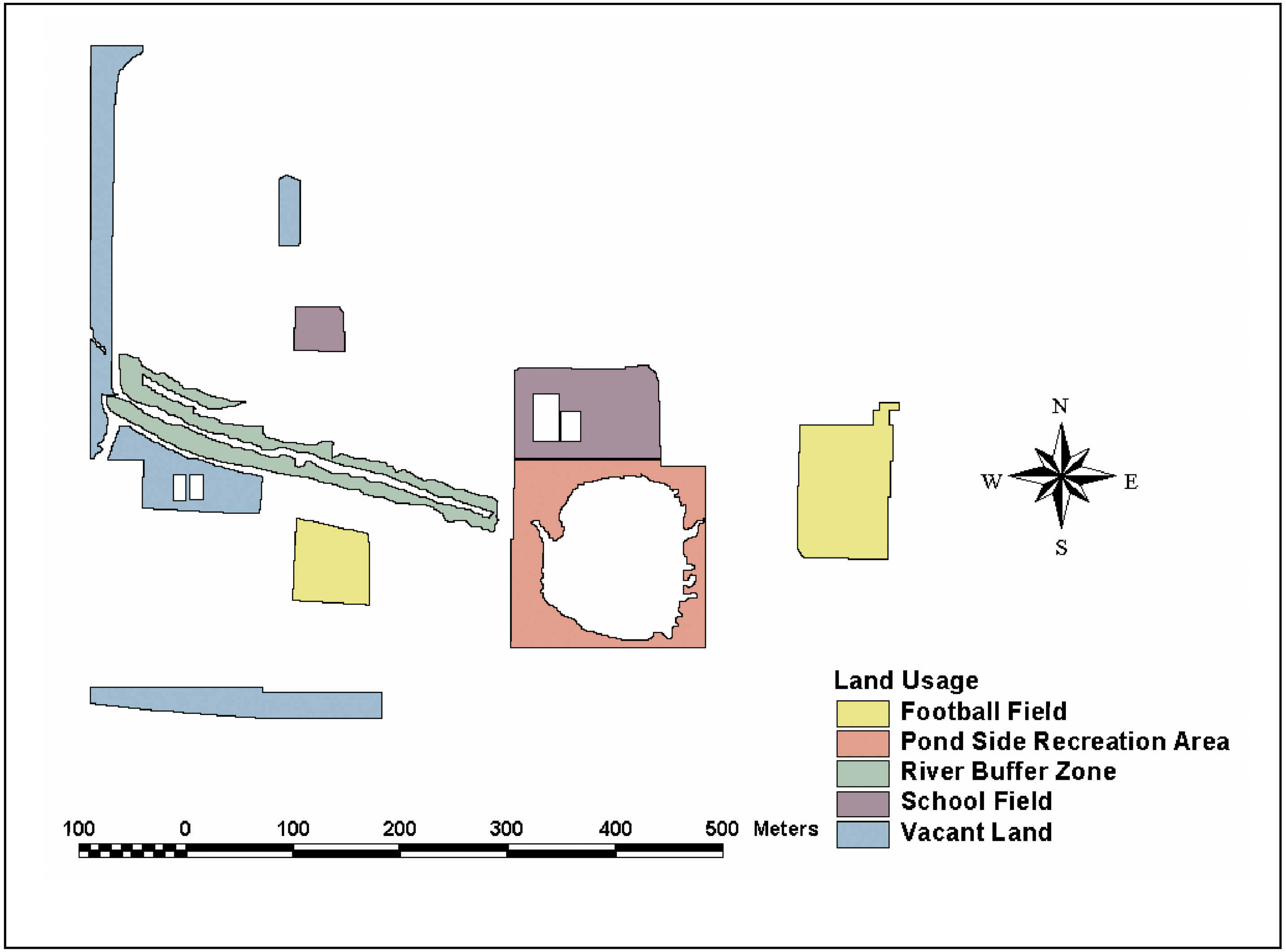


Figure 9: Vacant Lands & green Lungs Layer Derived from UPM-APSB's Classified Image

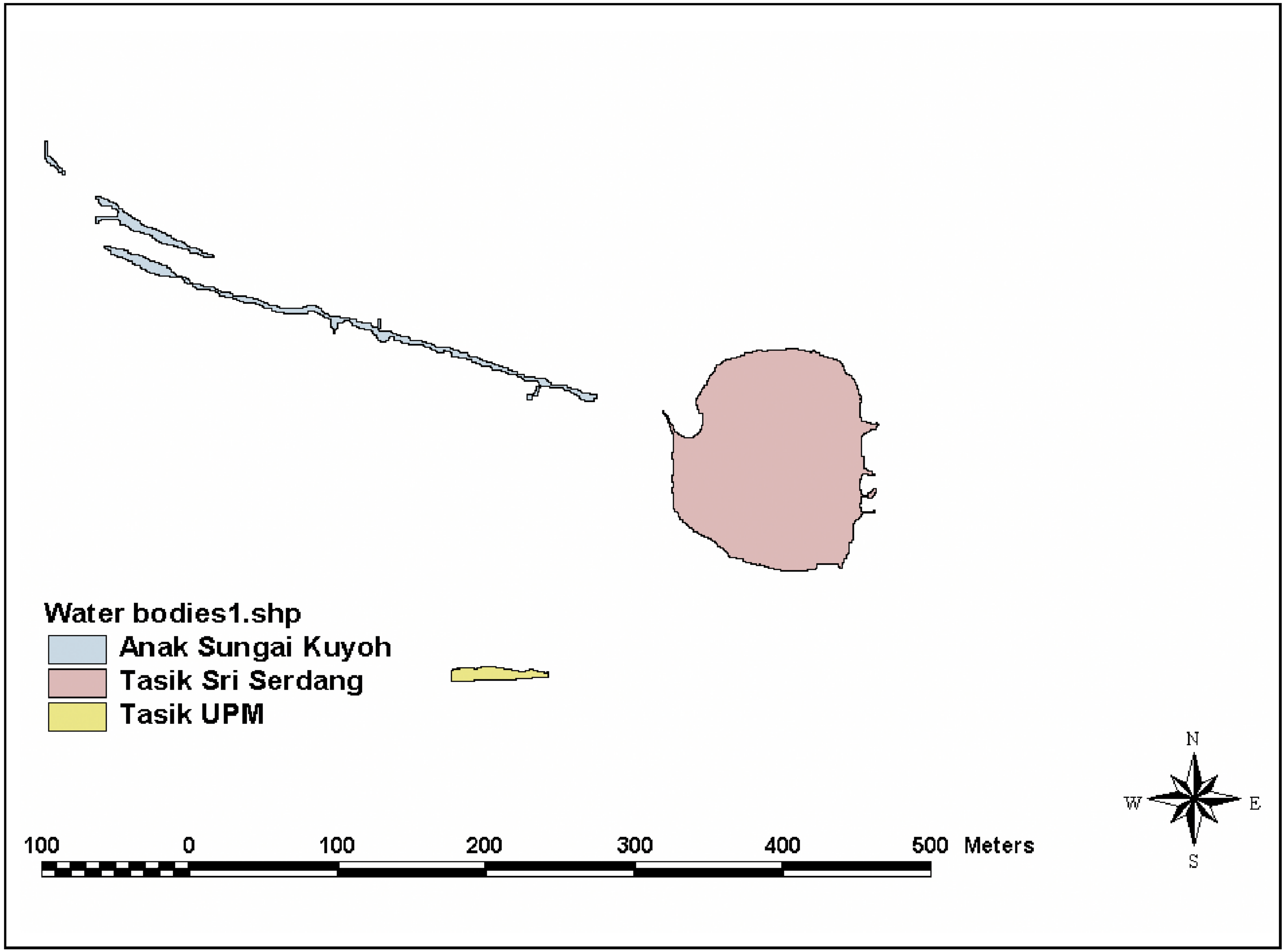


Figure 10: Water Bodies Layer Derived from UPM-APSB's Classified Imaged

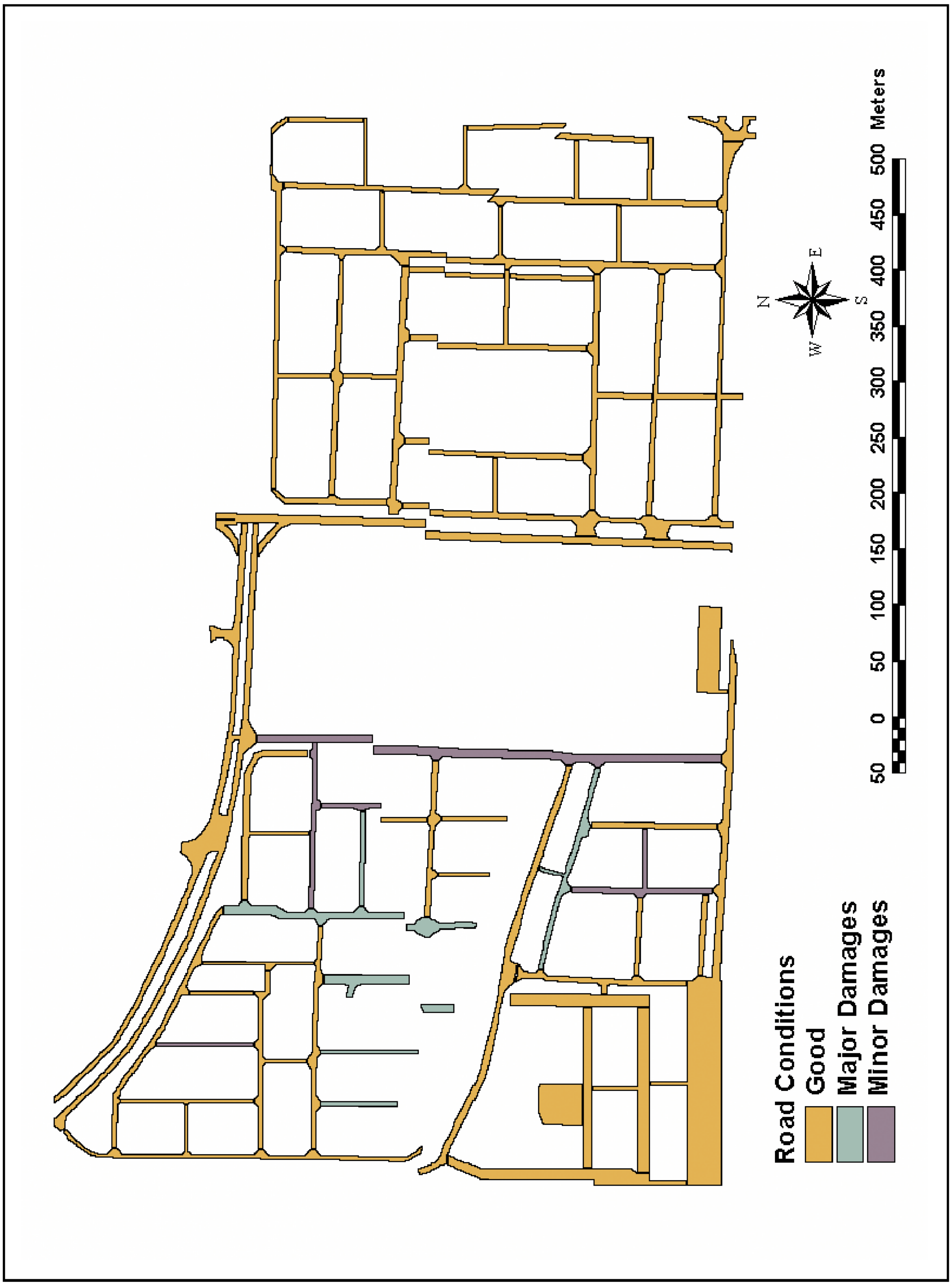


Figure11: Roads Layer Derived from UPM-APSB's Classified Image

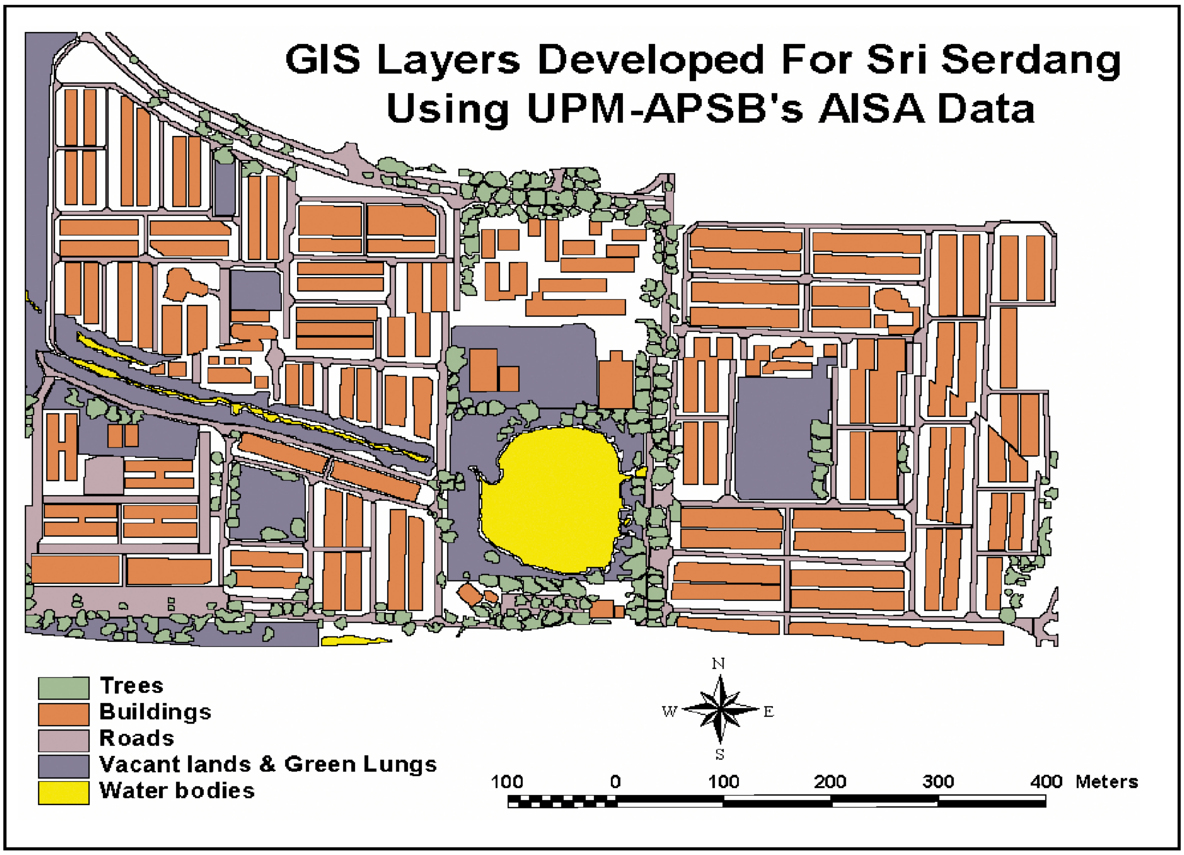


Figure 12: GIS Database of Sri Serdang Comprising of Trees.Buildings, Roads, Vacant Lands, and Green Lungs Water Bodies

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NATIONAL UTILITY MAPPING INITIATIVES AND ISSUES

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Background

The installation of underground utilities in Malaysia is not something new; water pipes had been laid down for decades, so were the laying of sewerage pipes, electric and telephone cables and so on. This is also the case in other countries; in Europe, for instance, the laying of underground utilities and their computerised mapping were discussed and carried out since the late seventies.

In Malaysia, topographic mapping work was actively pursued after the formation of the Directorate of National Mapping in 1965. However, the focus then was on executing the standard topographic mapping work - more to fulfil the needs of the military during that time as well as subsequent to those times. As a consequence of this arrangement, JUPEM has been intensely involved with the mapping of topographic features appearing on earth's surface only and those underneath were not rendered since it was considered beyond JUPEM's scope of responsibility to perform such works. Apart from that the need for doing so then was not that very evident. Subsequently, the mapping of public utilities was carried out individually by the utility agencies.

These utility owners carried on with their business of providing the aforesaid amenities to customers without much coordination and consequently matters became disorganised. Concisely, there is not a single agency that keeps and maintains utility information in an integrated manner; furthermore the exchange of data in between them was very minimal. As a result of this situation quite substantial damages occurred to existing underground utilities during digging when new utilities were installed in areas where old facilities exist. Worse still, it disrupts the provision of those services to customers. Various problems including water and electricity supply disruptions, road accidents as well as traffic jams due to this uncoordinated situation were brought to the fore in the form of public complaints.

From a different perspective, disruptions to electricity supply too had incurred significant losses to some, particularly to those in the manufacturing sector. Additionally, there were also cases of project delay caused by the need to wait for utilities to be relocated prior to highway construction (where highway design does not earlier take into consideration the existence of underground utilities in the area). Apart from that is the case of delay to projects caused by redesign when construction cannot follow the original design due to unexpected utility conflicts. Others include delays to contractors during highway construction caused by damaging or discovering utility lines that were not known to be there.

Problems arising out of the situation mentioned above had been raised and discussed in the Malaysian Cabinet Meeting on two occasions. Firstly, in 1994, whereby it was decided that underground utility map has to be prepared to map the utilities – and that this map be kept by JUPEM (apart from the concerned utility providers). Subsequently, four years later in 1998, it was again discussed, and the decision was for JUPEM to upkeep or maintain the utility map.

In line with the decision of the government, JUPEM had undertaken a number of initiatives, which include addressing basic issues such as policy matters on utility mapping that relates to its functions as assigned by the government.

Establishment of Technical Committee on AM/FM (Automated Mapping and Facilities Management)

The initial step taken by JUPEM to effectuate the Cabinet's decision is to establish the Technical Committee on Automated Mapping and Facilities Management under the National Mapping Committee, in 1994. Matters in regard to policies, programmes and activities on underground utility mapping were considered by this Technical Committee. They were formulated, discussed, and brought to the National Mapping Committee (now called the National Mapping and Spatial Data Committee) for endorsement before being implemented. Currently, there are 24 permanent as well as 7 associate members of this technical committee, as shown in Fig.1.

Fig.1: Composition of the AM/FM Technical Commitee

Development of Standards for Utility Mapping

JUPEM has been actively involved in the development of national mapping standards – that is termed as Feature and Attribute Codes or simply MS 1759. The formulation of this standard would enable the producer and user of geospatial information utilise a common system in designing their digital database, which would consequently facilitate the exchange and sharing of data, albeit from different systems and platforms. And in this development the part associated with utility mapping had also been undertaken and completed; in fact it had already been approved by SIRIM (the Malaysian authority on standards) in 2004.

Formulation of Utility Mapping Guideline

As aforementioned, there is little coordination, if any pertaining to the task of utility mapping in Malaysia, particularly in terms of data sharing. Apart from that there were varying practises adopted by the utility providers in regards to data capture, data processing, storage and maintenance.

The issue of data quality and availability too needs to be expeditiously addressed. In this case, utility owners collect data using different approaches and keep them in differing forms, including in the form of as-built plans as well as design maps. Consequently, resulting data were of varying accuracies with most of them being inferior.

The aforesaid practices which caused quite extensive problems had to be streamlined whereby standard practises had to be introduced to address the predicament. Among aspects that had to be streamlined include:

- Role of the various parties involved in the production as well as sharing of data on utility mapping
- The various quality levels that had to be assigned to utility data and their related production
- Format for Utility Maps
- Methods for acquisition of underground utility data

In an effort to deal with the aforementioned issues, above all to streamline the varying practices, JUPEM then initiated the formulation of the Utility Mapping Guideline. Generally, the guideline provides the policies and procedures on matters listed below:

- The role and responsibility of the stakeholders
- Quality Levels of underground utility data
- Format for Utility Map
- Design and Development of the Underground Utility Database (or PADU)

Role and Responsibility of the Stakeholders

The guideline provides for the roles that are to be played by JUPEM, utility owners as well as land surveyors in undertaking utility mapping for the whole country. Among others, JUPEM has to develop and build the utility database. In this regards, JUPEM will need to extract relevant information from data provided by the utility owners and store them in the database, apart from collecting those that could not be obtained from the data providers. The data stored will be in a form that will assist in identifying the location of the utilities and their alignment and that which would be relevant to the objective of avoiding mishaps during construction works involving excavations. Associated with this is the task of checking the quality of data submitted by the utility owners, assigning quality classifications and certainly the task of providing utility data to them as well.

On the other hand, utility owners will have to provide information to JUPEM to enable the latter build the underground utility database. In addition, they are also obliged to provide land surveyors (who would be performing the work of surveying and mapping the position of new facilities emplaced) access to their utility information. Unlike in certain countries where engineers undertake data capture, land surveyors were given the task of performing this function in Malaysia.

In concert with the roles to be played by other stakeholders, the land surveyors are expected to serve as consultants to utility owners. Among others they will need to advise their clients on the various data quality levels and the reliability of those data as well as the planning and design of alignments for new routes to install new utilities. Apart from that they are required to survey and map new facilities to the highest level of accuracy (categorised as Level A in the guideline), and to certify and be responsible for the Level A maps or plans that they produce.

Quality Levels of Underground Utility Data

There are many sources and forms of utility data kept by the utility owners. They include simple drawings showing the rough alignments, design plans, transmission maps or distribution maps and as-built survey plans of utilities that had been emplaced in the ground. Although arguably quite reliable information could be obtained from as-built plans, the other sources provide data that were discovered to be inaccurate in the majority of cases.

The dumping of all of these data into PADU without any segregation according to their quality would cause immense confusion. In this regards, it is common knowledge that databases which contain combined data without the distinct separation of the good and inferior ones will undoubtedly result in the deterioration of the quality and reliability of the database itself. Thus, the data will need to be categorised accordingly into the different quality levels. Due to significant accuracy variants of data expected to be supplied by utility owners, four levels of accuracy classifications were introduced in the guideline, i.e. Levels A to D.

Briefly, Quality Level D data is the lowest quality level with information being very approximate and coming in the form of description, for instance the utility line being a certain distance from the edge of a road. Although it could help the planner get an overall “feel” for the utility congestion, it had to be used with care. Quality Level C is relatively better and in the example given, it addresses the problem of determining where the road edge might actually be by using for example the water valve or other associated visible utility structures (that indicate the utility below the surface) surveyed to project control and placed on plans at the right spot. Quality Level B involves the use of surface geophysics to detect and field-mark underground utilities, combined with a survey of the field markings (certainly tied up to project control as well), and subsequent reduction onto plans or into the digital database. Approximate depth would also be determined from the surface geophysics. Quality Level A is the best level with accuracy to the nearest 10cm, both in their horizontal and vertical positioning. This data is gathered, surveyed and depicted through excavation and exposure of the utility or during its installation before being covered with earth.

The guideline also provides for the use of appropriate symbology as well as terminologies, whereby definitions were comprehensively provided. This is done with the intention of standardising the production of utility maps in terms of map specifications, the development of the utility database and also the means of data capturing. It is hoped that through this effort, there would be uniformity in the practice of map production, considering that the eventual products would later be utilised by the numerous utility owners. It is also designed to be easier understood, particularly in regards the quality levels and its associated levels of reliability.

It was the hope of JUPEM that concerned parties involved with utility mapping would use the guidelines as their standard reference document and this should in certain ways help to standardise related practices regarding utility surveys and their mapping in Malaysia.

Formulation of the Utility Surveying Guideline

This document provides guidelines which include aspects on geophysical detection and surveying of the utilities - equipments and techniques that could be used in detecting the underground utilities, required level of accuracy for data acquisition, approach to be utilised in surveying new facilities that are to be emplaced, prerequisites for achieving Quality Level A, etc. These were prescribed through the issuance of the Director General of Survey and Mapping's (DGSM) circular to all concerned, in particular the land surveyors.

Among others, provisions were made in regards to the following:

- The use of electromagnetic (pipe and cable locator (PCL), ground penetrating radar (GPR), metal detectors, etc.), magnetic (magnetometer) as well as elastic wave (seismic wave reflection, refraction and acoustic emission) technologies for geophysical detection of underground utilities. Although the aforesaid techniques were permissible, it has been noted that the most popular equipments currently being utilised were the pipe and cable locator (PCL) and ground penetrating radar (GPR). Even JUPEM itself has resorted to making use of these two for their practicality as well as cost effectiveness.

- At least 20m detection intervals and closer in areas with congested utilities underground were imposed (Fig.2). Additionally, similar requirement is made for instances where there is change in the alignment of the utilities as well as positions where there were utility connections (leading to those utilities surfacing out of the ground level).

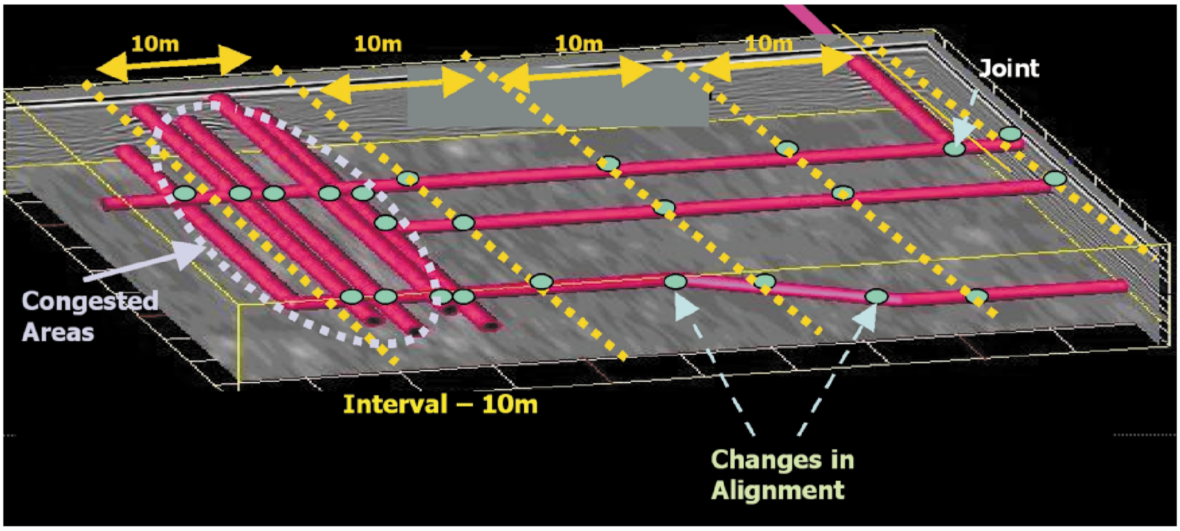

Fig. 2: Detection Intervals

- The requirement to perform verification of the utility's location in order to qualify for Quality Level A category. This would need to be conducted through the process of exposing the utilities via test holes and performing survey measurements to the position of the exposed parts. Test holes could be made using back hoe (albeit not being recommended), shovel or vacuum excavator. They could be circular or square shaped and with approximately 30cm diameter or of roughly 900sq cm respectively. Emphasis is given to the need to adhere to the requirements of safety as provided in the Occupational Safety and Health Act, 1994 in performing this task.

- The need to undertake control surveys to control positional accuracies and alignment of facilities, apart from the relevant details being surveyed as well as the required referencing system to be utilised for the planimetric and vertical or heighting surveys.

- The requirement to perform calibration of survey and detection equipments. In the case of the former, calibration procedures provided through existing DGSM circulars will have to be adhered to whereas in the latter case, calibration requirements as stipulated by the manufacturer will have to be abided.

- The methods of surveying in the case of using PCL and GPR (the most commonly used techniques of detection). In using PCL and GPR, survey measurements to detectionpoints(usually detected positions will be marked using paint on roads) would be made to determine the alignment of the detected utilities.

- Approach to conducting verification surveys as well as surveying in concurrence or simultaneously with the emplacement of the utilities.

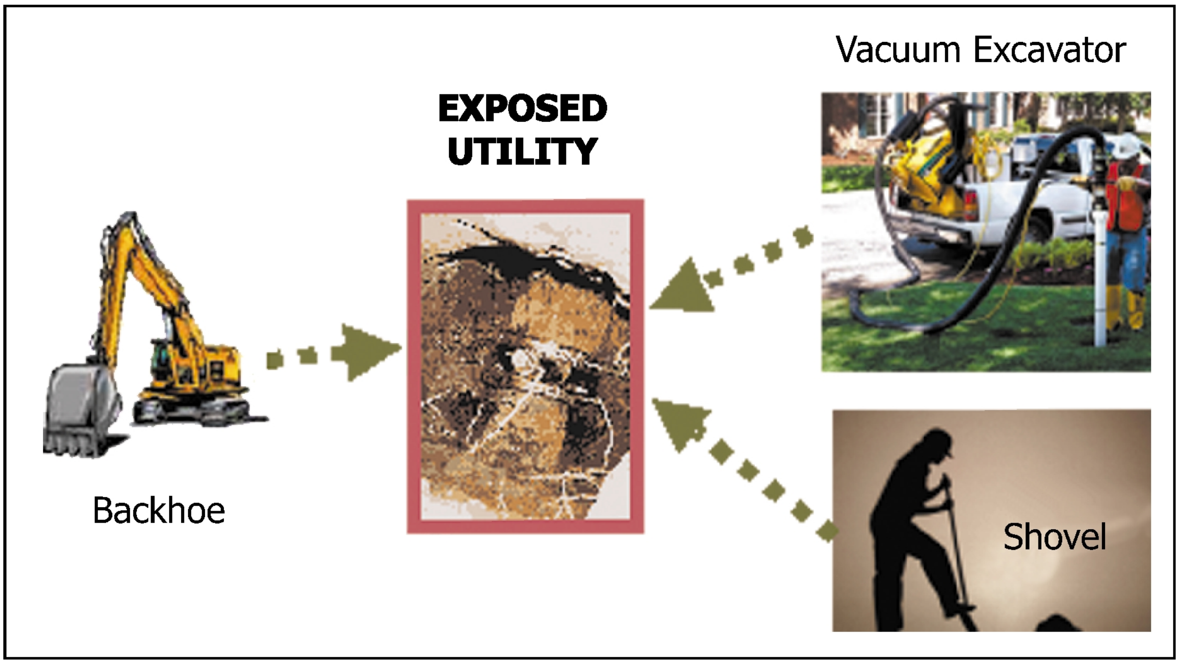

Fig.3: Exposing Utilities for Verification Purposes

Issues

In reality there are many issues in regards to the implementation of utility mapping - that which concerns organisational, legal, institutional framework etc. The following is limited to only those that concern technical issues related to the work of JUPEM and some organisational issues as well.

- **Data Availability**

  In this initial effort of building a utility database, those data will need to be contributed and submitted by the utility owners to JUPEM. In discussions made with them, there seems to be reluctance on the part of some of the utility providers to do so. In this regards, JUPEM does take cognizance of the fact that utility owners spend money to acquire those data and hence not favouring them being provided to others for free. Nevertheless, the eventual benefits and beneficiaries (who would be the utility owners themselves) would need to be taken into consideration. Thus, it would be for the good of the utility owners themselves to share data and towards that end, initially provide them to JUPEM to be integrated and disseminated to all concerned.

  Apart from that, there were also several occurrences of data being lost and thus no longer in their possession. This is due to the lack of emphasis given by some utility providers in maintaining good record keeping of their assets. Obviously, this would result in the difficulty of producing a comprehensive, complete and reliable utility database.

- **Data Quality**

  Data submitted to JUPEM by the utility owners were, in the majority of cases, in the form of design plans. Even though some (albeit very minimal in number) were in the form of as-built plans and surveyed, they were however of doubtful accuracies. Until now it was found that none of them falls in the Quality Level "A" category. Evidently, massive amount of work needs to be undertaken to upgrade those information, if the database is to provide data of highest reliability. On the other hand, classification of data into the various quality levels should be able to address this situation, whereby the user will be able to gauge the risks associated with the use of the concerned data.

- **Base Map**

  Base maps would be required to provide the basis for the preparation of the utility maps. The two main base maps that were utilised were the cadastral and topographic maps. Provision of cadastral maps at such large scales of 1: 500 or 1:1000 would not pose much problems since JUPEM readily possess survey accurate databases. However, topographic maps at those scales would need the commissioning of a special development programme, which is rather immense. As an example, the number of map sheets that will be needed to cover the whole of Klang Valley at those scales is estimated to be more than 72,000 sheets altogether. Compared to the 177 sheets at 1:50,000 scale required for the whole of Peninsular Malaysia, the task is clearly monumental. In addition, problems were faced in obtaining aerial photos that would suit data acquisition at 1:500 scale due to flying height limitations.

  In dealing with this issue only topographic features that are distinct and within a certain corridor as well as relevant to the portrayal of utility alignments were acquired. Apart from that ground surveying methods were utilised in cases warranting its use. All of these information would then be displayed on utility maps as guiding information in locating the positions of underground utilities.

- **Competency of Land Surveyors**

  Land surveyors are expected to be competent in conducting surveys to determine the location of objects on earth. In Malaysia, they were familiar with the work of surveying objects that are apparent or visible to them. On the other hand objects emplaced underground need to be detected using geophysical methods and this domain is relatively new to them. Clearly, the need to locate underground utilities requires land surveyors who are proficient as well in the field of geophysics and related technologies, in addition to their normal area of expertise. Thus, there is a need for their further training to enable them to competently perform the task.

- **Utility Mapping Guideline**

  The aforementioned document is meant to provide guiding principles to all stakeholders and is strictly not legal binding. It was the hope of JUPEM that those concerned will abide by it as the provisions were mutually agreed upon by the stakeholders. In this regards, the guideline had undergone the stages of intensive discussions at the AM/FM Technical Committee level and with the Association of Authorised Land Surveyors (body representing the licensed land surveyors) before eventually receiving the final endorsement of the National Committee on Mapping and Spatial Data, in May 2006. However, it was later realised that some of the essential provisions were not complied and thus need to be legislated so that they have legal force and be obligatory on all concerned.

All the aforesaid issues will have to be addressed by JUPEM in collaboration with those involved in this industry. With conviction and resoluteness in providing this important service to the country, it could be convincingly accomplished to fulfil the mandate given by the government.

Conclusion

Utility mapping is a relatively new endeavour by JUPEM, albeit the emplacement of underground utilities in Malaysia has already been made for many decades. Extensive damages due to lack of information that consequently incurred wide ranging losses had caused the government to call for a proper and organised mapping of the utilities. The success of this new undertaking would need the close cooperation of all stakeholders, both in government as well as the private sector. Not less in importance is the need to equip all involved with the required level of competency, both in skills as well as expertise to ensure that a reliable system would be put in place.

IMPLEMENTATION OF E-CADASTRE IN MALAYSIA

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ABSTRACT

The Malaysian government's vision of becoming a developed nation by 2020 encompasses the realization of an efficient public delivery system at various levels. Among the national emphasis are land related matters which include cadastral survey. Towards this end, in its push towards a fully digital Malaysia by the year 2015, the Government has approved what is now known as the eCadastre project, to be implemented by the Department of Survey and Mapping Malaysia (DSMM). This is by far the largest Information Technology project approved under the 9th Malaysian Development Plan, which span over a five year period from 2006 till 2010.

Since 1995 DSMM has embarked on a modernization program that saw the dramatic computerization of both its office and field processes of its cadastral survey division. The Digital Cadastral Database (DCDB), which is the crown jewel of the department, was created by capturing the survey accurate information of all land parcels. Under the eCadastre project, a comprehensive nationwide readjustment of the meshwork of parcels would be carried out based on a new geocentric datum. A dense network of global positioning system (GPS) RTK permanent stations has been established to provide on-the-fly precise geocentric positioning. Upon the successful implementation of eCadastre, DSMM has envisaged a significant reduction of time taken in any cadastral survey process from the existing average of 2 years to within 2 months.

The current system of cadastral survey is unable to capitalize on the advent of satellite based technology. A complete revamp of the system is required before any improvement to the delivery system could be achieved. The new environment will allow various cadastral survey processes such as planning, design layout submission, field data capturing, completed job submission, quality control, and approval to be carried out remotely via the mobile telecommunication network. Global positioning system will provide real time positioning at centimeter resolution homogenously to the entire country and coordinates will replace relative measurements as the ultimate prove of boundary mark multi-purpose cadastral. This new database will also be the launching pad to enable final title to be issued within a day.

Keywords: Virtual Survey; National Digital Cadastral Database; Coordinates.

1. INTRODUCTION

Since 1995 DSMM has embarked on a modernization program that saw the dramatic computerization of both the office and field processes. Initial changes occur in the office, where manual plan drafting was replaced with a computerized drafting system to enhance and expedite output of certified plans for the issuance of land title. Subsequently, the field equipments were upgraded from electronic distance measurement to total stations assisted by host of peripheral such as handheld GPS, and tablet PC. Hardcopy plans, field tracings and star almanac were converted to digital information stored in the tablet PC to ease information retrieval, assist computation and quality verification.

Currently, DSMM manages the cadastral workflow in a totally digital environment. Applications for surveys are lodged into the computerized system which will monitor files movement, assign jobs, verify jobs, and get the jobs approved by the state director of survey. Digital files are transferred through handshaking protocol between headquarters and district offices before the jobs are assigned to the field officers. However, the field procedures are still rigidly regulated to comply with accuracy set for older equipments which includes chains and theodolites. Translating such regulations into the computerized application modules limits the functionalities of computerized system. Current infrastructure requires the field officers to commute between field site and the district office when the need arises to extract addition information, download and upload jobs.

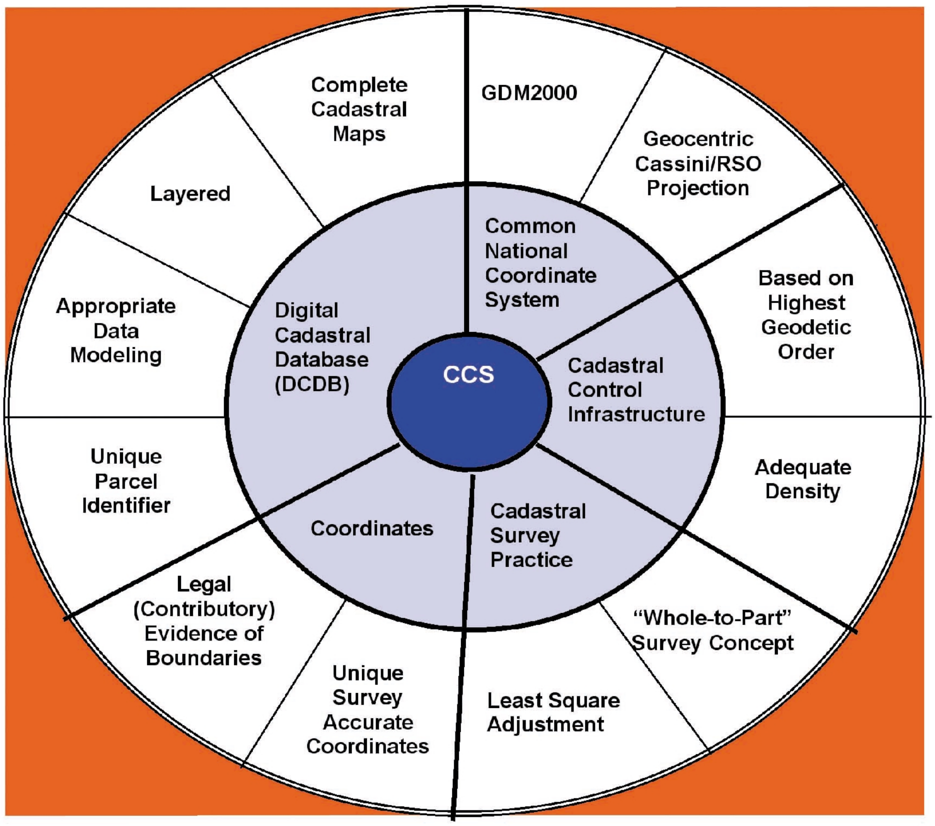
Early computerized office system was developed based on automating the manual procedures. The core module was developed to comply with the existing land law which requires hardcopy plans to be generated, approved and deposited with the state DSMM. Customized graphical editing tools were developed to assist the drawing of certified plans emphasizing aesthetic presentation. The approved plans are scanned and stored into an image database. Changes to the approved plan will require manual editing of the hardcopy plan and rescanned into the image database. As the demand for vector data increases, the department initiated the keyboard entry of bearings and distances portrayed in certified plans to form a complete cadastral network (known as DCDB). Discrepancies or gaps exist between the graphical display and the value of bearings and distances stored within the database as attributes. The gaps are snapped close to ensure topological integrity. Spatial analysis is limited due to the different that exit between the certified plans values and those extracted from the graphical display. Subsequently, pilot projects were conducted to correct this peculiar situation. The studies recommended that DSMM carry out a readjustment of the cadastral network based on a more accurate datum. The proposed model comprises of the introduction of a new datum, readjustment of the cadastral network, using coordinate based procedures and introduction of least square adjustment methodology for cadastral survey. The model is known as the Coordinated Cadastral Systems (CCS) and is to be implemented through the eCadastre project.

2. eCADASTRE

The primary objective of eCadastre is to expedite the delivery system for land title survey. This would entail the creation of a survey accurate database at the national level suitable for geographical information systems (GIS) users. Various issues related to the generation of a survey accurate database need to be addressed. Since 1996, those issues were addressed through pilot projects conducted to optimize the usage of coordinate based systems such as GIS and GPS. The CCS model outline in **figure1** was finally adopted by the Department.

The implementation of CCS is a major part of the eCadastre project which includes field and office reengineering to reduce processes and increase the use of digital technology. The three main components in eCadastre may be divided into three sub-systems namely CCS, virtual survey system, and cadastral data integrity system.

Figure 1: CCS model of Malaysia



2.1. Coordinated Cadastral Systems (CCS)

Since 1996, DSMM has work closely with the engineering and geo-information science faculty of University Technology Malaysia on the development of coordinated cadastral system for Peninsular Malaysia. Among the research conducted were the use of least square adjustment for cadastral survey, use of GPS for transfer of control for cadastral survey in isolated area, application of geocentric datum for cadastral and mapping to ease integration of both datasets, possible use of rectified skew orthomophic (RSO) in cadastral survey, issues related to legal traceability, standards and specification on use of GPS, the institutional and legal aspect of using coordinated system and the cost-benefit of CCS. Among the main products of the pilot projects is.infrastructure (CCI) to constraint the propagation of error in the cadastral network. Subsequently, the prototype modules were tested in a pilot project carried out in the state of Malacca. Improvements were made to the modules and workflow modified to suit production roll out.

The main objective of CCS, formulated from the pilot projects, is to develop a homogeneous cadastral database based 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 network. Subsequently, in the year 2003 the department decided to adopt the geocentric datum GDM2000 which is supported by permanent GPS tracking stations and real time kinematics stations. However, the Cassini projection is maintained but is now based on the new GDM2000 parameters. At the national level, the process requires the readjustment of the cadastral network based on coordinates obtained from GPS observation.

In order to achieve the above objective there is a need to establish a dense Cadastral Control Infrastructure (CCI) grid of 0.5km spacing in urban area and 2.5km spacing in semi-urban and rural areas. The underlying technologies needed for the establishment of CCI includes GPS positioning based on GDM2000 geodetic datum, and least squares adjustment. Once the dense CCI has been established the readjustment of the cadastral network will be carried out and this adjusted national digital cadastral database (NDCDB) will then form the base layer for all future title surveys. The readjustment uses least square methodology will distribute the residues homogeneously in the large cadastral network. Consequently, cadastral survey practices will be revamped to accommodate the use of least square adjustment.

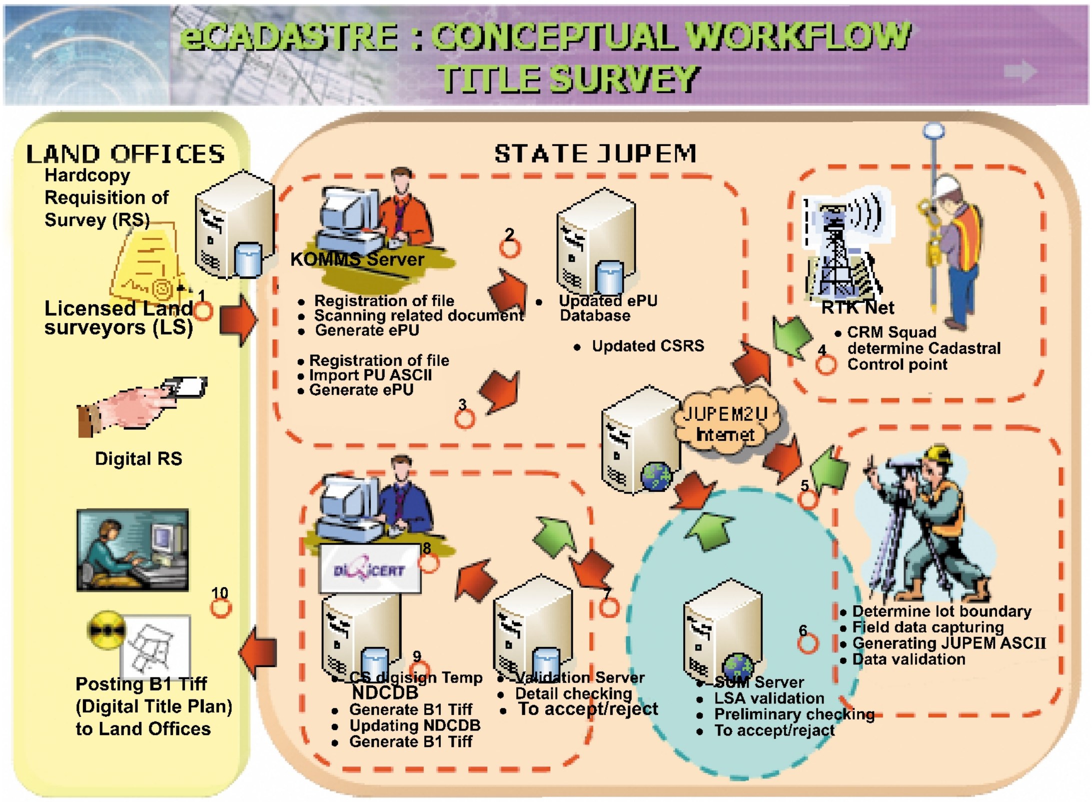
The study group had also drafted new survey procedures to serve as a guideline for all future surveys. The new procedures will inevitably be much simpler and quicker to reduce field cost and to further reduce mobility cost; field surveyors will be encouraged to submit their work online. Validation of work under CCS environment will be much faster and simpler. The control infrastructure is currently supported by an advance RTK-GPS network which can provide real time correction to field observations.

2.2. Virtual Survey System (VSS)

This sub-system will equip the field surveyor with state-of-the-art technology in ICT, total station, GIS and GPS. The surveyor will be able to interact with the system to extract information that will assist him in the field operation and most of the work will be automated to reduce tedious computation. The virtual survey system will re-engineer the field processes and permit real time digital submission of completed surveys to servers located at the state DSMM for verification. The most obvious change will be to replace the current field survey system with the use of coordinates based system such as GPS and GIS. **Figure 2** shows the various components in the eCadastre environment.

All requests for title survey either from the land office or the private licensed land surveyors will be lodged with the Department prior to field survey. The spatial location of the land parcels will be verified against the NDCDB to ensure that there is no encroachment. Initially the Department's cadastral control mark group (CRM) will facilitate the field survey teams by establishing GPS control marks surrounding the perimeter of the new request for survey. All information related to the GPS control

Figure 2: Cadastre Conceptual Workflow



can be accessed by the CRM group, the Department and private field surveyors via mobile internet. The field surveyor may start the survey based on controls obtained from existing marks stored in NDCDB, CRM layer or through GPS RTK-Network services provided by DSMM. Once the survey is completed, it may be submitted to the VSS servers located at the state DSMM for quality verification. The surveyor may choose to work in real time environment or online through the web depending on the communication bandwidth available. Rules will be coded to control workflow and decision making and subsequently minimize human intervention. The field surveyor will be informed on the acceptability of the job in near real time. This will allow the surveyor in the field to rectify the survey if required. The most significant change will be to allow surveyor the flexibility to use best practices in a totally digital environment. 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 main emphasis is the concept of coordinates which is the fundamental element employed in modern technology such as global positioning system (GPS) and geographical information systems (GIS).

2.3. Cadastral Data Integrity System (CDIS)

The cadastral data integrity system comprises of all the office applications which include pre-survey verification, field survey data computation and verification, digital title plans generation and approval. This sub-system will be developed to ensure high integrity of the data and to render them GIS-ready. Various checks will be put in place to assist users when making decision on the validity of data before posting it to the database. The raster title plans which are generated based on NDCDB will be delivered on-line to the Land Office.

Subsequently, datasets from other land-related agencies will be incorporated to complete the requirement of a complete cadastral database especially the qualified title (QT) layer. Graphical user interface will be provided to assist users in data capturing, editing, and manipulation. Additional servers will be added to increase processing speed and storage space. The present communication network will be upgraded to cater for the high volume of data throughput between servers and users, including the daily field operation. Much of the applications will be designed based on a fully integrated system and web-enabled.

Among the new requirements will be the need to capture 3D data to cater for strata, stratum,and the marine environment. These databases will be coordinates based which are tied to GDM2000 to better serve all future cadastral surveys. The system will be integrated with other land related systems such as the land office and the Licensed Land Surveyors Board through handshaking process.Ultimately, the various databases will support the implementation of utility mapping.

3. CONCLUSION

Once e-Cadastre is implemented the time required for cadastral survey will be significantly shorten, thus allowing qualified titles, which are issued in advance of survey to cope with the fast pace of development in the country, to be phased out. The current National Land Code already permits the issuance of final title without having to first issue qualified title. The image of DSMM will be greatly enhanced with the expedient issuance of titles and for being the sole custodian of the complete cadastral database for the country, which is much sought after by many government departments and agencies.

It is envisage that eCadastre will be fully integrated with eLand to form a complete Land Information System for Malaysia capable of completing all surveys and title delivery within a week. Land Information Malaysia will serve as the first fully digital system that will help thrust Malaysia into the digital era. This system will greatly benefits the citizen who will receive their final land title within a short span of time and also to generate greater confidence in the land market.

PEMANTAUAN SISTEM PENJEJAKAN KENDERAAN ERA TEKNOLOGI GIS

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Abstrak

Sejajar dengan perkembangan teknologi semasa, pembangunan sistem dalam penyelesaian masalah jalanraya perlu diatasi dengan perkembangan teknologi GPS dan GIS. Salah satu teknologi yang dipertengahkan adalah Vechicle Tracking System (VTS). VTS ini banyak memberi kelebihan serta fungsinya yang efisyen dan mantap dalam perkembangan semasa. Dalam artikel ini, dihuraikan mengenai implementasi sistem, komponen sistem, fungsi VTS, kelebihan VTS dan contoh pelaksanaannya di negara lain.

Keywords : Sistem Penjejakan Kenderaan,VTS, GPS, GIS, Navigasi

Pengenalan

Sistem penjejakan kenderaan *(Vechicle Tracking System)* direka bentuk menggunakan teknologi sistem GPS *(Global Positioning System)* dan GIS *(Geography Information System)* iaitu melalui padanan peta. Ini bermakna, sistem ini dibangunkan dalam bentuk perkakasan dan perisian. Dengan wujudnya sistem pengangkutan pintar, sedikit sebanyak memberi kesedaran dan mendorong perkembangan teknologi maklumat serta maklumat lalulintas jalan pada zaman ini. Tambahan lagi, kesesakan lalulintas menjadi masalah utama di negara kita khasnya di bandar utama seperti Kuala Lumpur, Pulau Pinang, Johor Bharu dan sebagainya. Ini disebabkan populasi penggunaan pengangkutan di jalanraya yang semakin hari semakin meningkat. **Jadual 1** di bawah menunjukkan populasi dan peratus penambahan pengangkutan di antara tahun 1992 hingga 1996 di sekitar negara Asia.

Jadual 1: Populasi dan penambahan pengangkutan bagi tahun 1992 – 1996 (Mario Battaglia, 1998)

Negara	Bilangan kenderaan pada tahun 1996	% penambahan kenderaan di antara 1992 hingga 1996
China	14,140,052	50
Hong Kong	526,015	12
India	7,723,528	25
Indonesia	4,804,329	34
Jepun	72,597,404	12
Malaysia	2,976,522	19
Pakistan	1,254,614	24
Filipina	1,052,273	35
Singapura	557,283	21
Taiwan	6,409,791	38
Thailand	5,686,084	100

Merujuk kepada **Jadual 1**, pertambahan bilangan kenderaan seperti di Thailand yang mengalami peningkatan iaitu sebanyak 100% adalah sangat membimbangkan pihak kerajaan negara tersebut. Sementara **Jadual 2** pula menunjukkan anggaran jumlah kadar kematian di beberapa buah negara Asia.

Jadual 2: Kadar anggaran kematian per 10,000 kenderaan (Mario Battaglia, 1998)

Negara	Kadar anggaran kematian per 10,000 kenderaan
China	24.3
Malaysia	8.4
Singapura	5.3
Thailand	36.3
Jepun	1.7

Jadual 2 di atas, jelas menunjukkan bahawa negara maju seperti Jepun mempunyai sistem pengangkutan pintar yang baik dan sistematik. Ini adalah kerana angka kematian yang dipaparkan adalah rendah jika dibandingkan dengan Thailand yang kurang berkemampuan dalam pembangunan pengangkutan.

Jadual 3: Pendaftaran Kenderaan Bermotor Sedunia (1994) (Mario Battaglia, 1998)

Zon Geografi	Populasi	Populasi per kereta	Populasi per kenderaan
Afrika	698,380,000	69	45
Asia	3,136,812,000	43	27
Amerika Utara & Tengah	436,149,000	3	2
Amerika Selatan	314,355,000	15	11
Eropah	850,471,000	4	4

Manakala Jadual 3 di atas pula menunjukkan pendaftaran kenderaan bermotor sedunia bagi tahun 1994. Merujuk kepada jadual tersebut, jelas menunjukan pertambahan bilangan pendaftaran kenderaan bermotor di Asia khasnya di negara China dan Thailand. Dengan jumlah kenderaan yang semakin membimbangkan, maka kerajaan perlu melaksanakan pelbagai polisi bagi menyelesaikan masalah khasnya kesesakan lalulintas. Permasalahan ini mendorong teknologi sistem pengangkutan pintar dilaksanakan. Justeru itu, pelaksanaan sistem penjejakan kenderaan merupakan salah satu teknologi untuk membantu meningkatkan pengurusan keselamatan jalanraya serta mampu memberi maklumat mengenai sesebuah kenderaan. Dengan adanya sistem pengangkutan pintar seperti sistem penjejakan kenderaan, kesesakan lalulintas dan keselamatan jalanraya dapat diatasi dan diperbaiki.

Menurut Edward J. Krakiwsky (1997), sistem pengangkutan pintar mampu menyelesaikan masalah terhadap setiap navigasi yang diimplementasikan. Implementasi ini meliputi kegunaan individu iaitu bagi urusan peribadi sehinggalah ke pengurusan perjalanan. Dalam implementasi sistem, teknologi yang digunakan adalah merangkumi teknologi GPS dan GIS. Dalam perkara ini, teknologi GPS akan memberikan situasi kedudukan sesebuah kenderaan manakala teknologi GIS pula akan memaparkan peta vektor berdigit. Peta vektor berdigit adalah bergantung kepada grafik peta yang dipersembahkan, manakala kedudukan pula adalah merangkumi penentududukan, permulaan kedudukan, penentuan arah perjalanan, pandu arah dan maklumat yang diperolehi. (Harris, et al, 1988). Gabungan teknologi GPS dan GIS ini mampu menyampaikan arahan dengan baik secara luaran atau dalaman ke sesuatu destinasi dengan lebih sistematik, tepat dan pantas.

Implementasi

Dalam implementasi jejakan navigasi kenderaan terdapat beberapa jenis jejakan untuk kegunaan pengguna seperti pemandu, pengurus, pemberita dan pelancong. Sistem navigasi jenis-jenis jejakan ini boleh dikelaskan kepada lima kategori sistem seperti berikut;

a) Sistem individu,
b) Sistem nasihat,
c) Sistem pengurusan,
d) Sistem senarai, dan
e) Sistem mudah alih.

Secara keseluruhan, 3 jenis sistem pertama di atas yang dikelaskan adalah berdasarkan kepada kebolehan berkomunikasi. Berdasarkan kepada 3 sistem tersebut, sistem individu tidak mempunyai komunikasi, manakala sistem nasihat mempunyai satu hala komunikasi dan sistem pengurusan pula mempunyai 2 hala komunikasi di antara stesen asas dan setiap kenderaan. Sistem senarai dan sistem mudah alih dikelaskan untuk kegunaan khas dan merupakan sistem yang penting dalam sistem navigasi. Kategori sistem senarai lebih berhubung kait dengan masa dan kedudukan maklumat jalan. Manakala sistem mudah alih yang dihasilkan adalah berdasarkan kepada data yang dihantar. Perbezaan di antara sistem mudah alih dan sistem senarai adalah berdasarkan kepada hasil keluaran *(output)*. (ITS World 101)

Dalam implementasi VTS, sistem navigasi yang digunakan adalah gabungan di antara GPS dan GIS. Oleh yang demikian, beberapa perkara asas berikut adalah diperlukan;

a) Peta asas yang diperolehi daripada mana-mana punca pengukuran seperti fotograf udara, *remote sensing* dan sebagainya.
b) Membolehkan pembetulan kedudukan dengan pembezaan GPS dilaksanakan.
c) Berupaya mengguna dan membangunkan pangkalan data bagi tujuan analisis dan mengenalpasti, membuat pertanyaan serta mengemaskinikan data.

Namun demikian, terdapat tiga komponen penting dalam *'package'* navigasi ini seperti berikut;

a) GPS sebagai alat untuk mengutip data.
b) GIS sebagai pengurusan sistem kenderaan.
c) GPS sebagai laluan merekabentuk bantuan traffik.

Sistem Individu

Sistem individu diaplikasikan dalam kenderan navigasi dan kebiasaannya dalam kenderaan individu bersama-sama dengan kemampuan menentudududukan. Kemampuan menentudududukan adalah seperti GPS, *'dead reckoning'* dan peta asas. Sistem ini tidak mempunyai hubungan dengan mana-mana komunikasi luar kecuali gelombang satelit dalam GPS.

Sistem ini sesuai digunakan bagi pemandu yang tidak biasa dengan kawasan berkenaan. Apa yang dapat dilihat hasil daripada menggunakan teknologi tersebut ialah seorang jurujual mampu meningkatkan hasil jualannya dalam satu hari. Walau bagaimanapun, sistem ini tidak banyak digunakan. Contohnya seperti di Amerika, hanya sebahagian agensi sahaja yang menggunakannya seperti penyewa kereta. Namun begitu, ia tetap merupakan permulaan bagi penggunaan sistem navigasi pada masa hadapan.

Sistem Nasihat

Sistem ini berupaya untuk berkomunikasi dan menerima maklumat daripada pusat kawalan yang berperanan untuk memberikan maklumat pengangkutan. Ia hanya disampaikan melalui komunikasi satu hala seperti maklumat pembetulan jarak untuk memperbaiki kejituan.

Sistem komunikasi yang digunakan adalah seperti sistem data radio, beacon dan *'pager'* satu hala. Sebahagian kegunaan sistem ini adalah untuk menerima maklumat trafik jalanraya.

Sistem Pengurusan

Sistem ini mempunyai komunikasi dua hala di antara kenderaan dengan pusat kawalan melalui perhubungan komunikasi. Sistem ini banyak diaplikasikan dalam sistem pengangkutan awam, sistem kawalan keselamatan, panggilan kecemasan, keselamatan diri dan mengesan kedudukan kenderaan yang hilang. Kebiasaannya, penerima penentudukan dipasang di atas kenderaan dan peta asas berada di pusat kawalan.

Di dalam sistem ini, pusat kawalan akan memberikan kedudukan semasa kenderaan tersebut. Selain itu, pandu arah serta maklumat lain juga mampu diterima oleh kenderaan berkenaan. Perbezaan aplikasi ini mungkin dibezakan melalui situasi penggunaannya seperti kesesuaian pelayaran di laut atau darat, keluasan zon jejakan dan sistem asas perbandaran. Sistem ini bukan sahaja digunakan bagi pengurusan pengangkutan malah boleh digunakan dalam hal-hal keselamatan dan mengesan kehilangan sesuatu objek. Bahkan untuk kegunaan pihak ambulan dan polis juga.

Sistem Senarai

Biasanya sistem senarai akan meliputi peralatan kenderaan individu bersama-sama dengan kamera berdigital yang berfungsi untuk mengambil maklumat masa dan koordinat jalanraya. Penerima yang lain akan digunakan untuk mengukur gelombang dari permukaan jalanraya. Maklumat kedudukan yang diperolehi akan ditempatkan dalam GIS.

Kenderaan akan dihubungkan melalui komunikasi dengan pusat kawalan bagi perpindahan maklumat dan koordinat dari padang. Salah satu *'link'* komunikasi yang digunakan adalah menghantar pembezaan pembetulan kedudukan. Jelasnya, sistem senarai yang diaplikasikan adalah digunakan khas dalam data asas GIS yang mana sesetengah kenderaan telah ditetapkan sistem dan ada juga yang mudah alih.

Sistem Mudah Alih

Sistem mudah alih merupakan satu-satunya sistem navigasi yang paling cepat. Ia digunakan untuk pengukuran, perancangan perjalanan, pendakian, navigasi ke sesuatu tempat dan perancangan perjalanan perniagaan. Semua ini tidak memerlukan rekod secara *'manual'*. Dengan ini, sesetengah orang menggunakan alat penerima masing-masing untuk membantu dalam pelbagai perjalanan dan urusan. Misalnya penjejakan kenderaan individu, pengurusan pengangkutan, penyediaan laporan dan maklumat trafik oleh pihak polis, bantuan perjalanan oleh jururawat daripada satu tempat ke tempat yang lain, analisa laporan perubatan yang lepas serta penyediaan laporan kepada pihak doktor dan sebagainya.

Komponen-komponen

Secara keseluruhan, VTS adalah terdiri daripada 3 komponen utama iaitu;

a) Alat penerima GPS bagi mengira kedudukan dengan menggunakan kaedah triangulasi. Satelit GPS akan menyampaikan maklumat mengenai kedudukan pada setiap masa. Apabila koordinat satelit diketahui melalui masa penghantaran isyarat radio, maka alat penerima GPS akan mengukur jarak kepada satelit dan seterusnya pengiraan kedudukan akan diperolehi.

b) Alat penerima GPS akan mengikut kedudukan, halaju dan masa akan disalurkan kepada unit pemprosesan dan *'modem celular'*. Koordinat kenderaan akan dihantar kepada pusat kawalan data tanpa sebarang jaringan.

c) Semua data akan dimasukkan ke dalam pangkalan data. Seterusnya, pengguna mampu mengetahui kedudukan mereka dalam satu peta dengan menggunakan perisian komersial pihak ketiga seperti perisian *'tracker'*, *'Neomatrix'* dan sebagainya.

Fungsi-fungsi

Sistem penjejakan kenderaan merupakan salah satu sub-sistem yang menjayakan sistem pengangkutan pintar. Di Malaysia, sistem ini masih di tahap permulaan dan belum digunakan secara meluas oleh mana-mana pihak. Antara fungsi-fungsi VTS yang mampu diberikan kepada pengguna adalah seperti;

a) **Urusan pengurusan**. Pengurus mampu menguruskan segala urusan dengan lebih baik khasnya bagi pergerakan kenderaan. Ia akan meningkatkan hasil keluaran dengan mengawal setiap aktiviti kenderaan dan setiap pergerakan perjalanan dengan lebih efisyen. Dengan ini, perancangan perjalanan oleh kenderaan mampu dikawal dan jadual permulaan perjalanan sehingga ke destinasti yang dituju dapat diatur dengan lebih baik.

b) **Hilang dan jumpa**. Dengan adanya sistem seperti VTS, pemilik mampu menjumpai harta benda yang hilang dengan kadar segera yang mana sistem VTS mampu mengesan kedudukan kenderaan itu berada. Ini akan membantu pihak polis khasnya dalam menyelesaikan kes kehilangan kenderaan. Hal ini secara langsung dapat mengurangkan kes jenayah.

c) **Urusan kereta sewa**. Pengusaha kereta sewa mampu mendapatkan banyak manfaat dengan kejayaan mengesan kereta sewa yang hilang serta mampu mengetahui kedudukan aset kenderaan tersebut. Di samping itu, pengusaha kereta juga mampu memberikan khimat langganan serta *'notis'* atau memaklumkan berita terkini kepada penyewa ketika menggunakannya. Selain daripada itu, ia juga boleh memberi khidmat nasihat mengenai arah tuju sekiranya penyewa tersebut hilang arah tuju ke tempat destinastinya.

d) **Perkhidmatan kecemasan**. Sistem VTS berupaya membantu sesetengah pihak untuk mendapatkan perkhidmatan kecemasan dengan kadar segera seperti ketika berlakunya kemalangan jalanraya. Pemandu hanya memberikan tanda isyarat kepada pusat kawalan yang seterusnya akan menghubungi kesemua pihak yang berkenaan agar bantuan dapat diberikan dengan kadar segera.

e) **Khidmat Langgan**. Syarikat pengangkutan seperti teksi dan bas yang menggunakan sistem VTS mampu memaklumkan kepada pelanggan dengan tepat mengenai bas atau teksi yang terdekat serta masa kenderaan tersebut dijangka tiba.

f) **Laporan**. Sistem VTS mampu memberikan laporan yang tepat mengenai setiap perjalanan atau jejakan kenderaan. Sehubungan dengan itu, tarikh, masa dan kedudukan sesebuah kenderaan memulakan dan memberhentikan perjalanannya mampu dilaporkan. Selain itu, ia juga dapat membantu dalam memberikan laporan dengan tepat mengenai alamat yang dituju.Lantaran itu, pihak pengurusan akan mampu menilai setiap tindakan pekerja dalam melaksanakan tugas harian sama ada mengikut perjalanan atau tidak mengikut perancangan yang ditetapkan. Justeru itu, pihak pengurusan boleh mengambil tindakan susulan terhadap pekerja tersebut berdasarkan laporan yang diperolehi.

g) **Keselamatan terjamin**. Sistem VTS mampu memberikan ketepatan halaju dan data kedudukan. Pemandu boleh memandu dengan selamat untuk sampai ke sesuatu destinasi.

h) **Hubungan Kecanggihan Perisian**. Pengguna boleh menggunakan sistem VTS untuk pelbagai tujuan iaitu dengan menghubungkan kepada pelbagai sistem teknologi bagi tujuan pengumpulan data. Ia boleh digunakan dalam pelbagai bidang seperti Bomba, Jabatan Pengangkutan Jalan, Polis, Maritim dan sebagainya.

Secara keseluruhan, teknologi sistem penjejakan pengangkutan dengan menggunakan sistem penentududukan sejagat mampu memberikan banyak manfaat kepada individu dan pihak pengurusan. Ia mampu mengawal setiap penjejakan kenderaan dalam urusan setiap hari. Secara langsung, pengawalan aktiviti seperti ini akan menjadikan pihak pengurusan serta individu tersebut lebih produktif, bertanggungjawab, efisyen dan mampu menguntungkan syarikat. Dengan ini, pihak pengurusan mampu mengawal perbelanjaan kewangan dengan lebih sistematik dan tepat.

Kelebihan

Dengan menggunakan sistem penjejakan kenderaan dalam urusan harian, pelbagai faedah dapat diperolehi oleh individu tersebut seperti berikut;

a) Menentukan kedudukan kenderaan pada bila-bila masa.
b) Mendapatkan laporan ringkas mengenai kedudukan kenderaan, waktu mula dan tamat kerja.
c) Mampu membuat analisis terhadap masa lalu sekiranya dikehendaki oleh mana-mana pihak seperti polis dan peguam.
d) Menjimatkan perbelanjaan kerana mempunyai perancangan perjalanan yang efektif.
e) Mengurangkan tekanan daripada pekerja dan pelbagai aduan daripada pelanggan.
f) Mampu menyelesaikan masalah yang dihadapi oleh pelanggan dengan pantas.

g) Meningkatkan kualiti perkhidmatan khasnya terhadap pekerja yang tidak jujur dan tidak berdisiplin, persekitaran pekerjaan tidak selesa dan mengelakkan daripada penipuan serta kecurian terhadap masa dan barangan kargo.
h) Penambahan perkhidmatan atau khidmat 24 jam dengan menggunakan sistem ini mampu memberikan keyakinan dan jaminan kepada pelanggan.
i) Mampu mengawal waktu rehat pekerja.
j) Mengurangkan kemalangan jalanraya.
k) Mengurangkan perbelanjaan lebihan seperti minyak.
l) Mampu mengawal waktu kerja lebih seseorang pekerja.
m) Mengurangkan jumlah pekerja dalam menguruskan kenderaan, penyediaan laporan bulanan, penyediaan jadual perjalanan dan sebagainya.
n) Mengurangkan pembayaran premium insurans seperti keselamatan, peralatan kenderaan dan barangan kargo yang dibawa.
o) Mengurangkan pembatalan balik perjalanan berulang kali.
p) Meningkatkan perniagaan dan pasaran baru dengan memberi keyakinan dan tanggungjawab kepada pelanggan.
q) Mengurangkan penipuan dan penyelewengan dalam mana-mana perjalanan.
r) Meminimakan atau mengelakkan daripada berlakunya kecurian dan kehilangan kenderaan.
s) Mengurangkan kes ketidakefisyen dalam menuntut kilometer perjalanan yang berlebihan dan melicinkan serta mempercepatkan perjalanan. Selain itu, ia dapat mengurangkan ketidakefisyen dalam memberikan khidmat langgan kepada pelanggan iaitu dengan menyelesaikan masalah dan sedia berkhidmat kepada pelanggan.
t) Membantu menjalankan penyiasatan dengan berpandukan laporan yang lepas dan secara automatik akan memberi jawapan kepada pelbagai soalan yang timbul dalam satu laporan ringkas. Selain itu, laporan itu juga mampu menyelesaikan masalah yang dihadapi seperti kehilangan kargo, kelewatan atau tidak membuat penghantaran dan sebagainya. Dalam erti kata lain, sistem ini mampu menyampaikan maklumat yang berkualiti.
u) Membantu menyediakan laporan atau analisis mengenai ketidaksahihan penggunaan kenderaan selepas waktu pejabat, perjalanan di luar perancangan, kemalangan dan sebagainya.
v) Mampu memberikan laporan ringkas mengenai pemandu yang memandu dengan merbahaya dan melebih halaju.

Secara keseluruhan, pemantauan dengan menggunakan sistem VTS adalah disifatkan sebagai sistem yang innovatif, mudah diguna, fleksibel, efisyen dan juga pantas.

Contoh Pelaksanaan

Berikut adalah satu contoh pelaksanaan perkhidmatan kereta sewa teksi yang menggunakan sistem VTS di Australia. Dalam pada itu, terdapat beberapa perkhidmatan yang ditawarkan untuk menggunakan sistem berkenaan iaitu:

a) **Penyampaian dan panggilan teksi kawalan berkomputer**. Ia dibangunkan berdasarkan kepada pengurusan teksi yang menggunakan satelit untuk mendapatkan kedudukan kenderaan. Sistem ini membolehkan pusat kawalan menerima panggilan daripada pelanggan dan mendapatkan maklumat bagi senarai teksi dan pemandu yang terdekat untuk dimaklumkan kepada pelanggan mengenai lokasi teksi tersebut serta waktu teksi tersebut dijangka tiba. Sementara itu, pemandu teksi akan menerima panggilan dengan menggunakan komunikasi 2 hala seperti radio dan modem terminal data bergerak yang akan menghantar frekuensi kepada pusat kawalan. Kelebihan sistem ini adalah ia lebih cepat dan efisyen.

b) **Sistem penyampaian teksi**. Sistem ini mempunyai komunikasi setempat. Komunikasi setempat akan dilengkapi dengan sistem komputer yang mampu menyampaikan maklumat kepada penerima kawalan. Penerima kawalan akan menerima tempahan daripada pelanggan dan seterusnya akan menyampaikan maklumat tersebut kepada semua stesen yang mempunyai pangkalan data fail (*file server*). Ini membolehkan maklumat tersebut dikongsi bersama. Perkongsian maklumat ini akan diterima oleh pemandu teksi yang mempunyai modem atau alat penerima untuk menyampaikan dan menerima maklumat daripada pusat kawalan.

c) **Penyampaian data bergerak.** Sistem ini menjalankan dua aspek data komunikasi iaitu menyampaikan maklumat kepada kenderaan dan menerima balik maklumat daripada kenderaan kepada pusat kawalan. Sehubungan dengan itu, penggunaan radio sebagai alat komunikasi telah dapat dikurangkan. Sistem yang digunakan adalah mudah dan lebih ekonomi serta dapat memberi faedah dalam meningkatkan perkhidmatan kepada pelanggan. Selain itu, sistem ini juga memberi peluang kepada pelanggan untuk membuat panggilan dari rumah dan meningkatkan penggunaan kenderaan daripada semasa ke semasa. Justeru itu, pelanggan juga boleh mengetahui kedudukan kenderaan atau teksi pada bila-bila masa melalui maklumat yang disampaikan. Akhirnya, sistemini berjaya mengurangkan kos tenaga pekerja untuk berkomunikasi.

d) **E-teksi**. Sistem ini digunakan khasnya oleh pengguna Internet. Apabila pusat kawalan menerima panggilan daripada pelanggan yang menggunakan Internet dari rumah, Pusat kawalan akan mencari senarai pemandu dan teksi yang berdekatan dengan lokasi pelanggan yang mana isyarat daripada teksi sentiasa diterima oleh pusat kawalan melalui satelit GPS. Maka pusat kawalan dan pemandu sentiasa mempunyai hubungan komunikasi dan mampu memberi maklum balas kepada pelanggan dengan sewajarnya. Perkhidmatan ini juga memberi kemudahan kepada pelanggan untuk membuat tempahan dengan cepat dan pada bila-bila masa.

e) **Sistem Panggil dan Jawab Automatik**. Merupakan sistem yang mudah dan berfungsi dengan cepat dalam membuat sebarang tempahan dan pertanyaan khasnya teksi dan syarikat pengurusan pengangkutan. Sehubungan dengan itu, pihak pemandu teksi atau kenderaan akan memasang alat '*Swift-cab*' yang bertindak sebagai masa hakiki. Alat '*Swift-cab*' boleh menggunakan komunikasi setempat atau satelit GPS sebagai alat komunikasi. Komunikasi dengan satelit GPS akan menjimatkan kos dan alat *'Swift-cab'* boleh berkomunikasi dengan satelit GPS untuk menerima dan menyampaikan maklumat. Oleh yang demikian, ketika pelanggan membuat panggilan kepada pemandu teksi yang dikehendaki, jawapan tempahan tersebut akan diuruskan dengan serta-merta.

Kelima-lima komponen contoh pelaksanaan VTS adalah menggunakan jejakan GPS dan data asas dalam GIS. Jejakan maklumat yang diperolehi adalah terdiri daripada alat penerima GPS, radio komunikasi 2 hala dan modem telefon, peta asas *'digital'* dan sebagainya.

Kesimpulan

Di Malaysia, pembangunan VTS boleh dibangunkan melalui reka bentuk teknologi yang ada iaitu GPS dan GIS. Daripada segi pelaksanaan, VTS ini akan memberi lebih banyak kebaikan seperti yang dinyatakan di atas. Sehubungan dengan itu, pembangunan teknologi sebegini adalah sangat diperlukan bagi membantu kerajaan mempercepatkan pembangunan negara daripada segi ekonomi dan memantau masalah sosial serta meningkatkan kesedaran kepentingan kecanggihan teknologi di kalangan masyarakat negara kita.

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LAPORAN BERGAMBAR

MESYUARAT KE-59 JAWATANKUASA PEMETAAN DATA SPATIAL NEGARA (JPDSN)

Nornisha binti Ishak
Seksyen Perkhidmatan Pemetaan
Jabatan Ukur dan Pemetaan Malaysia

YBhg. Datuk Hamid bin Ali selaku Pengerusi sedang mempengerusikan Mesyuarat Ke-59 JPDSN yang diadakan di Awana genting Highlands Golf & Country Resort, Pahang.

Jawatankuasa Pemetaan Data Spatial Negara (JPDSN) telah mengadakan mesyuarat tahunan kali ke-59 di Awana Genting Highlands Golf & Country Resort, Pahang Darul Makmur pada 24 hingga 25 Mac 2008. Mesyuarat yang dipengerusikan Ketua Pengarah Ukur dan Pemetaan Malaysia, YBhg. Datuk Hamid bin Ali yang juga selaku Pengerusi JPDSN, telah dihadiri oleh ahli-ahli JPDSN dari seluruh negara yang terdiri daripada 42 wakil dari pelbagai Jabatan/ Agensi Kerajaan serta Institusi Pengajian Tinggi Awam (IPTA). Mesyuarat pada kali ini juga turut dihadiri YBhg. Dato' Dr. Abdul Kadir bin Taib, Timbalan Ketua Pengarah Ukur dan Pemetaan Malaysia dengan mempengerusikan mesyuarat pada hari kedua bagi menggantikan YBhg. Datuk Hamid bin Ali.

Dalam ucapan pembukaan, YBhg. Datuk Hamid bin Ali menjelaskan antara tujuan mesyuarat ini diadakan adalah untuk menyelaraskan aktiviti-aktiviti pemetaan dan penyediaan data spatial seluruh negara. Melalui mesyuarat ini juga, semua ahli yang hadir berpeluang untuk berbincang, mengkaji, menyelesaikan isu-isu atau masalah yang berkaitan serta merangka aktiviti dan program bagi menjana ke arah pembangunan sosio-ekonomi dan pengurusan sumber negara dengan lebih terancang. Beliau juga turut melahirkan sukacita di atas kerjasama yang telah diberikan terutamanya peranan-peranan yang dimainkan oleh semua Jawatankuasa Kerja dan Kumpulan Kerja Teknikal dalam mencari resolusi untuk menangani masalah-masalah yang timbul akibat pelaksanaan projek dan program di bawah JPDSN.

Seterusnya, beliau juga sempat mengimbau kembali beberapa kejayaan serta program berkaitan pemetaan dan data spatial yang telah dilaksanakan oleh JUPEM dalam tahun 2007 termasuk pelaksanaan projek-projek di bawah Rancangan Malaysia Ke-9 (RMK9). Antaranya ialah Projek Pewujudan Sistem Pemetaan Utiliti, Projek CATMAPS (*Computer Assisted Topographic Mapping System*) Fasa II, Projek MyRTKNet Fasa II, Projek Sistem Pangkalan Data Geodetik (SPDG) serta

YBhg. Dato' Dr. Abdul Kadir bin Taib Mempengerusikan mesyuarat pada hari kedua di Awana Genting Highlands Golf & Country Resort, Pahang.

Projek Perolehan Sistem Kamera Udara Digital. Manakala Projek Pewujudan Sistem Generalisasi Pangkalan Data Pemetaan, Projek Perolehan Sistem Penyediaan Data Cetak serta Projek Penggantian Perisian dan Perkakasan Bagi Map Publishing akan dimulakan dalam tahun 2008.

Dalam ucapan beliau juga turut menyentuh beberapa perkara yang wajar diambil perhatian oleh semua ahli mesyuarat iaitu berkenaan dengan Kes Kedaulatan Pulau Batu Puteh, *Middle Rocks* dan *South Ledge*, *Malaysia Marine Research Survey* (MyMRS), Pekeliling Arahan Keselamatan Terhadap Dokumen Geospatial Terperingkat, Penyediaan Peta Wilayah Pembangunan Iskandar, ALSS/LiDAR (*Airborne Laser Scanning System/Light Detection and Ranging*) serta Penganjuran Mesyuarat Ke-14 Lembaga Eksekutif PCGIAP (*Permanent Committee on GIS Infrastructure for Asia Pasific*).

Selanjutnya, beliau menyarankan agar semua Jawatankuasa Kerja dan Kumpulan Kerja Teknikal memainkan peranan penting serta aktif dalam meneruskan dan memenuhi matlamat untuk menghasilkan produk data spatial yang boleh dimanfaatkan oleh pengguna. Di samping itu, beliau juga berharap agar forum ini akan memberi ruang kepada semua ahli mesyuarat berinteraksi serta memberi input untuk dikongsi dan dimanfaatkan bersama-sama demi menjayakan matlamat asal penubuhan JPDSN.

Ahli-ahli mesyuarat yang terdiri daripada Jabatan/Agensi Kerajaan serta Institusi Pengajian Tinggi awam(IPTA).

Antara agenda mesyuarat ini diadakan adalah untuk membentangkan laporan daripada Jawatankuasa-jawatankuasa Teknikal dan Kumpulan Kerja Geodetik, membentangkan laporan aktiviti jabatan-jabatan/agensi-agensi dan juga membentangkan kertas kerja. Pada mesyuarat kali ini, dua kertas kerja telah dibentangkan antaranya bertajuk "Pelan Tindakan Ke Arah Pewujudan Datum Tegak Geodetik Malaysia Timur" yang telah disampaikan oleh Dr. Azhari bin Mohamed daripada JUPEM.

Kertas kerja ini menunjukkan pelan tindakan yang akan dilaksanakan bagi mewujudkan Datum Tegak Geodetik Malaysia Timur daripada tahun 2008 sehingga 2017. Sementara itu, kertas kerja kedua yang bertajuk "*GPS Measurement on Earthquake Included Vertical Deformation in Malaysia*" telah disampaikan oleh Prof. Madya Kamaludin bin Hj. Mohd. Omar daripada Universiti Teknologi Malaysia (UTM). Kertas kerja ini bertujuan untuk mengkaji kesan daripada gempa bumi yang berlaku di pantai barat Sumatera pada 26 Disember 2004 di Aceh dan pada 28 Mac 2005 di Nias ke atas anjakan tegak pada koordinat stesen-stesen GPS di Malaysia dengan menggunakan kaedah pengukuran GPS.

Hasil daripada mesyuarat JPDSN Ke-59 ini, dapatlah dirumuskan bahawa JPDSN berfungsi sebagai satu platform yang efektif dalam merancang dan menjalankan aktiviti pemetaan dan data spatial negara. Ahli-ahli JPDSN berpeluang untuk berkongsi pendapat, pengalaman serta pengetahuan di antara satu sama lain dengan kerjasama yang erat dan komited bagi menjayakan aktiviti-aktiviti yang akan menjadi pemangkin kepada perancangan, pembangunan dan pengurusan sumber negara.

CONFERENCE AND EXHIBITION WORLD TOWN PLANNING DAY 2007
THE THEME : TOWN AND COUNTRY PLANNING – 50 YEARS
21st – 22nd NOVEMBER 2007, PWTC KUALA LUMPUR, MALAYSIA

Aziz Bin Hassan
Outreach & Customer Service Section,
MaCGDI

The World Town Planning Day (WTPD) is a special day celebrated annually on the 8th of November to commemorate the role and contribution of town and country planning towards sustainable development and the creation of quality living environments. Since 1988, this special day has become an event celebrated annually by the Federal Department of Town and Country Planning, Peninsular Malaysia.

The theme for World Town Planning Day 2007, Town and Country Planning – 50 Years, is to commemorate 50 years of independence. The development started from a small agricultural-based backwater to what it is today. The growth in Malaysia are base from physical transformation, has indeed benefited from a systematic town planning services since 1921. Since 1988, the world Town Planning Day has been organize for 20 times with the first theme as "Ke Arah Kecemerlangan Perancangan".

Globalization, urbanization an ICT revolution have brought about many different lifestyles, some of which unfortunately cannot be considered as an improvement to the quality of life but the most important issues is to create a livable, safe and progressive living environment. The objective of the 2007 World Town Planning Day Convention is:

a) To educate all level communities about planning and its contribution in the development of the country especially in the building of cities and settlements.
b) To provide a beneficial platform for planners to gain experience and to promote better planning quality in the country; and
c) To honor and recognize the efforts of significant people involved in the planning process and their contribution towards creating quality neighborhoods and settlements.

At the same time, The World Town Planning Day also issue special Anniversaries stamp for the occasion of Town and Country Planning – 50 Years. The stamp was decorated with Hibiscus Flower where by signify the symbol of the national flower which symbolizes the spirit, teamwork, values, unity and the togetherness of Malaysian which will equip the strength and independence.

Special Anniversaries stamp for the occasion of Town and Country Planning 50 years.

Opening ceremonial was officially done by **YBhg. Dato' Mohd. Fadzil b. Hj. Mohd. Khir**, **Director General of Federal Department of Town and Country Planning** with his Keynote Address on the first day of the seminar. 10 seminar papers has been discuss toward a higher aspiration of society for better quality of living.

Participant for the exhibition consist of 20 booths locally and internationally, which MaCGDI occupied booth number 18. Our MaCGDI (Malaysia Centre of Geospatial Data Infrastructure) officer from Customer Service & Outreach section, which has been at the booth, are divided into two groups to occupy the time frame of the exhibition given.

i. Encik Norazmel bin Abd Karim
ii. Encik Ahmad Nazlie bin Muhammad @ Abdullah
iii. Encik Tang Kieh Ming
iv. Encik Aziz Bin Hassan

Souvenir from MaCGDI was presented to YBhg. Dato' Mohd. Fadzil b. Hj. Mohd Khir, Director General of Federal Department of Town and Country Planning on his visit to the MaCDGI's booth

The Convention and Exhibition started from 8.00am and ended at 5.00 pm. Exhibition of each participant comes from various agencies and government department are well display and regards as well organize and good respond from the visitors.

Visitors has been given explanation regarding the function of MaCGDI as the custodian of geospatial data and overview of GIS (Geographical Information System) as a tool that helps these geospatial data to be display and maintain from time to time. Not forgotten, that its also provide the simplicities and coordination for the management of geospatial data to the excellent in the afford towards the economic development, quality and stability of environment in Malaysia.

The booth competition that was also held with conjunction The World Town Planning Day has place MaCGDI the third placing and won five hundred Malaysian ringgit. The replica cheque was presented by YB Dato' Seri Ong Ka Ting to the winner on the opening ceremony at the Gala Dinner of Town and Country Planning – 50 Years at the Grand Ballroom, Hilton Hotel, Kuala Lumpur. It was an amazing night that gathers all the Director General, participant for notable speaker and the committee members for this occasion.

Conclusion

Replica Cheque was presented by YB Dato' Seri Ong Ka Ting and received by Me Tang Kieh Ming

WORLD TOWN PLANNING DAY 2007 was visited by almost all the participant concerning Planning and Surveying, which are most dealing with the development of the country. They are government officers, developers, student from local university and Local authorities.

Roll-Up banner has been set up at two Conner of the booth. More attractive showcase that was shown such as video display about the roll of MaCGDI has been shown. Information regarding Geospatial data that can be access through Malaysian Geoportal and NGDC (National Geospatial Database Centre) was not left behind for the visitor to browse through.

Explanation regarding GIS as part of the important tools were explain in the sense that to gives the awareness in communication between geospatial data in the development of DBMS (Database Management System). Personal from Customer Service & Outreach section are working hard in maintaining and updating the information of the system as well as the knowledge in GIS management particularly.

It is our hope that, in the future Outreach & Customer Service section under MaCGDI will work harder in monitoring the concept of booth participant and also to improve their commitment in conveying knowlage in hope that Malaysia realise Spatial Data and GIS will contribute in the development of the country.

BERITA GIS

Leica goes shopping

Hexagon acquired outstanding shares of Elcome Technologies Pvt. Ltd., who is a distributor and system integrators of products and solutions for customers using various technologies. Elcome will be fully consolidated on 1st January 2008 and contributed to Hexagon's earnings. Following this, Leica Geosystem Geospatial Imaging (LGGI) acquired all outstanding shares of IONIC software. LGGI also obtained technology assets of Acquis, a provider of web based data, and use the technology to provide enterprise functionality on the Oracle Spatial Database. Leica also obtained assets of ER Mapper.

ESRI Holdings acquired Helyx SIS Ltd.

ESRI acquired Helyx who provided highly focused consultancy, research and infrastructure services. Non-executive director of ESRI (UK) stated that this acquisition will enable ESRI (UK) to extend into related specialist sectors.

Autodesk takes over Hanna Strategies

In 2006, Autodesk purchased an ownership interest in Hanna and now had acquired the remaining shares in Hanna, an engineering services firm. These two companies have worked together for five years on development of a design software product of Autodesk.

MapInfo merges with Pitney Bowes

Pitney Bowes MapInfo is a result of merging between MapInfo and Pitney Bowes and is now called Pitney Bowes Software due to its combination with Group 1 Software. Biggest shareholders in MapInfo had always wanted sell shares in MapInfo because it is the nature business to go public and sell out.

Google Mistakenly Names Korean Places

Google Earth, a virtual program showing maps and the geography of the earth with satellite images, is facing criticism from Korean netizens for what they claim is the "wrong" use of Korea's geographical names. Furthermore, Google Earth lists Dokdo, Korea's eastern-most islets, which Japan claims as its territory, as the Liancourt Rocks to the ire of Koreans. Dokdo is a sensitive issue for Korean people because it symbolizes the nation's liberation from 35 years of Japanese colonial rule in 1945. The geographical sites are not the only misnomers at Google Earth where approximately 200 million people from across the world visit everyday.

KALENDAR GIS 2008

TARIKH	TAJUK	LOKASI	PENGANJUR	TALIAN PERTANYAAN
14 Januari 2008	Mesyuarat Penyelaras MyGDI Kebangsaan	Kota Kinabalu, Sabah	MaCGDI	Encik Yaacub bin Yusoff Tel : +603 88861254 Fax : + 603 88894851 E-mail : yaacub@macgdi.gov.my
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24 – 25 Mac 2008	Mesyuarat Jawatankuasa Pemetaan dan Data Spatial Negara (JPDSN) ke 59	Genting, Pahang	JUPEM	Encik Ng Eng Guan Tel : +603 26170831 Fax : + 603 26970140 E-mail : ng@jupem.gov.my
24 Jun 2008	Jawatankuasa Kebangsaan Nama Geografi (JKNG)	Kuala Terengganu	JUPEM	Encik Ng Eng Guan Tel : +603 26170831 Fax : + 603 26970140 E-mail : ng@jupem.gov.my
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4 – 5 November 2008	MRSS 5th Malaysian Remote Sensing and GIS Conference and Exhibition	Kuala Lumpur	UTM	Prof. Dr. Mazlan bin Hashim Tel : +607 5502873 Fax : + 607 5566163 E-mail : mazlan@fksg.utm.my

SUMBANGAN ARTIKEL/ CALL FOR PAPER

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