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Country Report of Malaysia*

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DEPARTMENT OF SURVEY AND MAPPING MALAYSIA
(JABATAN UKUR DAN PEMETAAN MALAYSIA)

THE CURRENT STATUS OF GIS IMPLEMENTATION IN MALAYSIA

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1.0 INTRODUCTION

1.1 Country Geographical Context

Malaysia covers a land area of about 329,758 sq. km, consisting of 11 states in Peninsular Malaysia, 2 states in the island of Borneo (Sabah and Sarawak) and 3 Federal Territories. Peninsular Malaysia, covering 198,160 sq. km. has its frontier with Thailand and Singapore while the states in Borneo covering 198,160 sq. km borders the territory of Indonesia's Kalimantan to the South and Brunei to the North. Malaysia lies close to the equator between latitudes 1° and 7° North and longitudes 100° and 119° East. The population is approximately 28.2 million, with a growth rate of about 1.7%. Malaysia is a multi-racial country and the majority of the population resides along the west coast of Peninsular Malaysia.

Figure 1 – Map of Malaysia

1.2 GIS roles in Malaysia

Nowadays, GIS is fast emerging an effective tool to resolve issues faced by societies around the world. This technology has become an important tool in many sectors and industries including environment, oil and gas, utilities, disaster management, asset management as well as urban and regional mapping. It has assumed important role in addressing issues in land and natural resources management, infrastructure development, rural development and defence. GIS has also contributed significantly to overcome bigger challenges that the world is facing today such as environmental conservation, climate change and global warming.

In Malaysia, geospatial information is becoming part of our daily life and is growing remarkably. Each day when people travel, work, plan, strategise, watch television and use the Internet there are always elements of geospatial being employed. Major advances in Information and Communication Technologies (ICT) in the last decade combined with the rapid growth of global information networks such as the Internet, have transformed businesses and markets in Malaysia. These trends have revolutionized learning and knowledge sharing, generated global information flows, empowered citizens and communities in new ways that have redefined governance and created significant wealth and economic growth. The developments have exponentially expanded both the need for geospatial information and the access to this information.

Geospatial information is now recognised by the government of Malaysia as an essential resource that supports the economic, social and environmental interests of the nation. Demand for accurate, up-to-date, relevant and accessible geospatial information at the various levels of government in Malaysia is critical to the delivery of many government

services. The incorporation of accurate geospatial information and technologies in research activities and operations can empower seamless innovative spatial solutions.

2.0 DEPARTMENT OF SURVEY AND MAPPING MALAYSIA

Department of Survey and Mapping Malaysia also known as JUPEM (Jabatan Ukur dan Pemetaan Malaysia) is one of the oldest department in Malaysia. JUPEM was established during the occupation of the British Colonial in 1885. This organisation had undergone series of challenges and developments before the unprecedented World War II to the momentous Independence of Malaya in 1957. JUPEM has changed the culture of work from conventional analogue system to digital data utilising wireless technology. JUPEM is directly involved in investigating, determining, demarcating and maintaining national boundaries in order to uphold the national sovereignty as well as the role of assisting the government to provide necessary advice on resolving various international boundary issues with neighbouring countries.

JUPEM involves in two core activities namely cadastral survey and mapping activities.

2.1 Cadastral Survey

Malaysian cadastral survey has undergone dramatic changes technically, operationally, structurally and institutionally over the past decades. The reasons for these changes have been metrication, micro-economic reform, quality assurance demands, the requirement for increased service provision and increased efficiency, and the larger needs of clients and governments.

In some cases the changes have been IT driven, but in most cases IT has provided the tools to implement structural and policy changes both in the office and field processes. The introduction of a computerised system was not only for the purpose of increasing JUPEM's efficiency and productivity of computations and plan drawings, but also to introduce the concept of digital databases.

Being the sole official national organisation responsible for cadastral survey activities in the country, JUPEM has undertaken the initiative to create and maintain the National Digital Cadastral Database (NDCDB) which is survey-accurate and seamless; the base layer for enhanced GIS. NDCDB can overcome several issues such as incompatibility with the current technologies, accuracy inadequacy, and difficulties resulting from the use of different projection and geo-reference system. There are currently about 7.8 million cadastral lots in the NDCDB and the content is principally survey-accurate coordinates that have been populated, adjusted and undergone quality checks at every level of its formation. In contains administrative boundaries such as District, Mukim, Town / Pekan, lot boundary, lot number etc. In order to produce cadastral database (namely the NDCDB), a Cadastral Coordinated System (CCS) is implemented through the eKadaster project

eKadaster is a system that optimized current ICT, GIS and survey technologies, implicating modification in cadastral survey manner from the traditional Bowditch and Transit methods to a Survey Accurate Coordinate using Least Square Adjustment with the establishment of an NDCDB and Strata/Stratum/Marin Survey Database (SSMSD), aiming to expedite and strengthen the nations cadastral survey delivery system via an efficient integrated system. In other words, eKadaster is developed in order to transform current regiment cadastral system to a coordinated cadastral system. The main philosophy of applying CCS is to use a geocentric

datum to have a single projection system for the whole country and the application of least square adjustment procedure in the distribution of survey errors. With CCS, Global Navigation Satellite System (GNSS) will be the natural tool for cadastral surveys, hence enabling absolute and real time positioning, with coordinates being given legal significance. The prominence of measured bearing and distances are reduced whereby they are considered as only a means by which the final adjusted coordinates are derived.

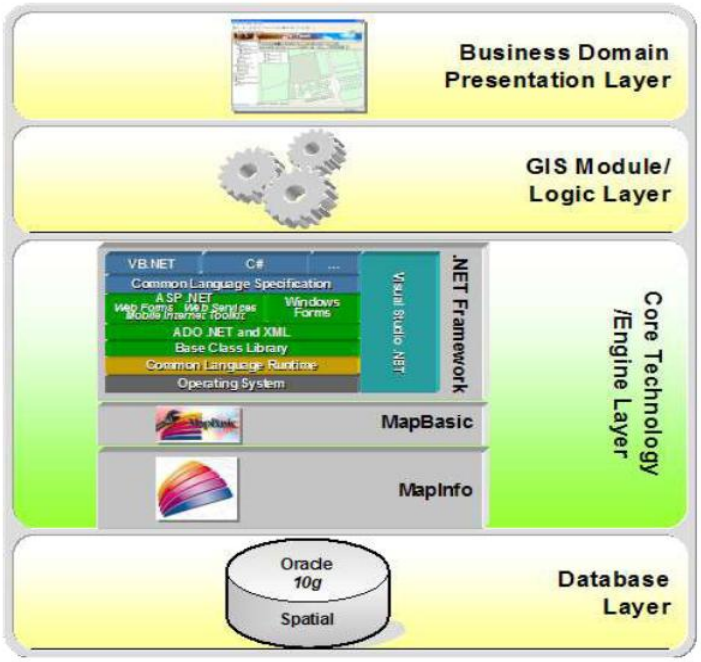

Fig.2 - Core Technology Engine Utilised in eKadaster

With the implementation of the project, various strategies and methodologies have been implemented to ensure improved delivery system, such as the change of the organizational structure and application modules which are now web-enabled to allow access from anywhere, anytime, 24 hours a day.

Besides that, eKadaster is integrated with other systems such as eTanah (e-system in Land Office), eLJT (e-system in Land Surveyors Board), JUPEM Geoportal and MaCGDI MyGDI (Malaysia Geospatial Data Infrastructure) which allow sharing of facilities and information for the benefit of the relevant government agencies with regards to land administration.

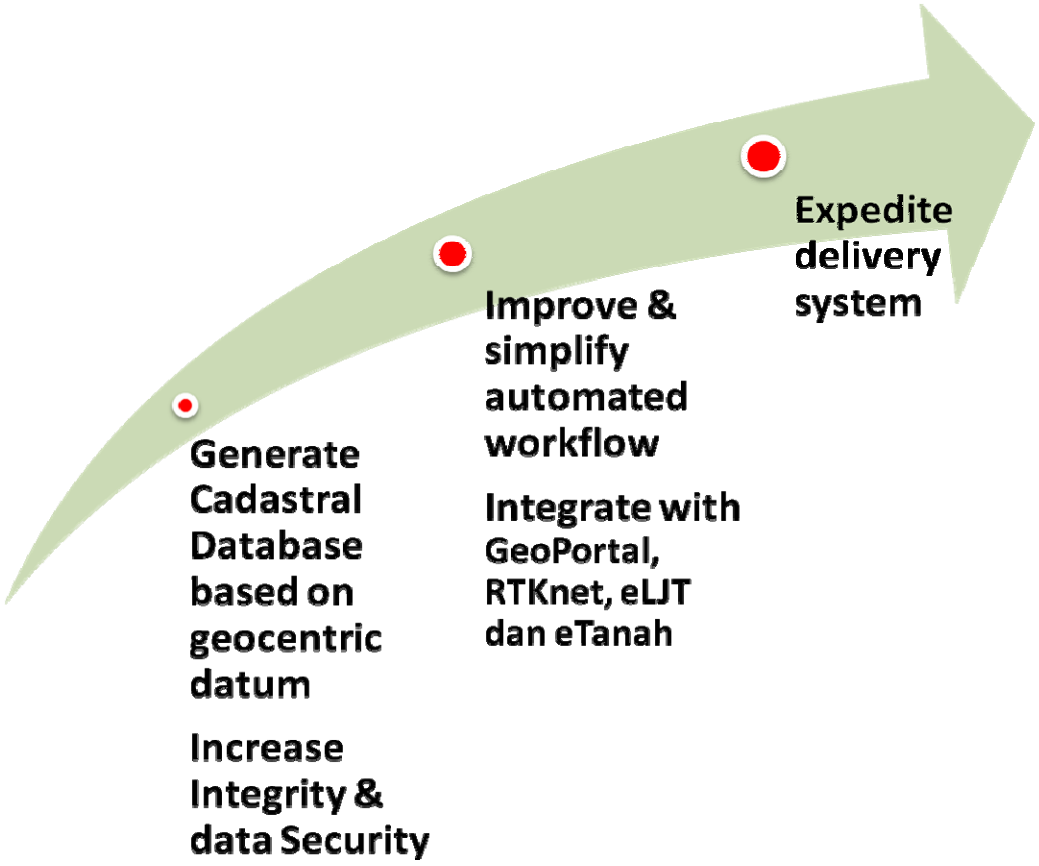

Fig.3 - JUPEM's new approach

Effective 1st May 2010, ekadaster has been implemented in all states in Peninsular Malaysia. This system has enabled us to reduce time taken to complete land survey operations by more than 80%. It has also accrued other benefits, including the replacement of the previous digital cadastral database with a seamless and homogeneous one and producing GIS ready cadastral survey information.

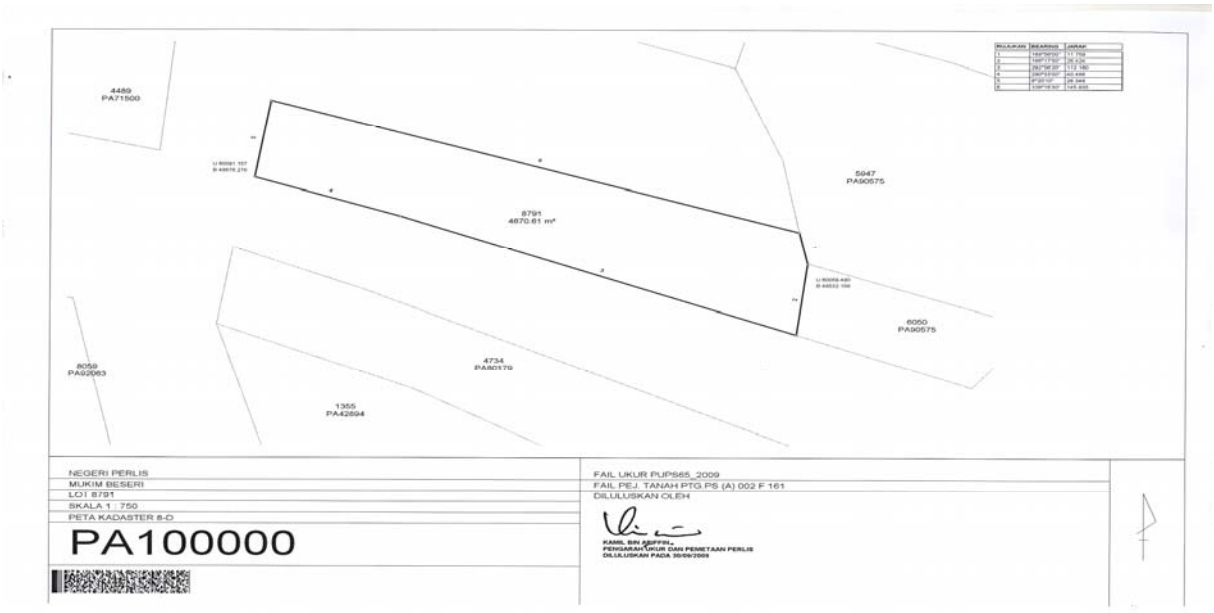

Fig.4 - A Certified Plan with 2D barcode generated using the Digital Raster Plan (DRP) Module under the eKadaster system

Under the 10th Malaysia Development Plan, we will further enhance the accuracy of the new digital cadastral database to meet the needs of our data users; the funds for this work have already been allocated and the concerned works has started in July 2011.

2.2 Mapping

JUPEM is keeping a close look at the future trends in geoinformation development with the objective of implementing new technologies with respect to optimising the provision (namely the collection, processing, storage, maintenance, visualisation, dissemination and use) of core geospatial data that serves as a spatial framework for organisations involved in monitoring, management and development in a Geoinformation Infrastructure (GI) context.

In 1988, Computer Assisted System Section (CAMS) was established. At the same time, the first phase of digital mapping was introduced to facilitate the establishment of the Topographic and Cartographic National Databases for production of topographical and thematic maps throughout the country with the scale 1:25,000 and 1:50,000 for the publics and military uses. In order to support the field work process in the digital environment, a new technique was developed since 2000 namely Computer Assisted Topographic Mapping System (CATMAPS) to replace the conventional method of data collection. Through this new system, productivity has increased by more than 150%.

The system which is fully integrated with GNSS technology and customized software has greatly expedited the fieldwork process. Various outputs were produced as the basic data source for others such as GIS applications. Those outputs are as follows:

i) Unrestricted Maps and Restricted Maps
ii) Digital Terrain Modelling
iii) Thematic Maps
iv) Miscellaneous Map such as Malaysia Report Map, Sabah Report Map, Malaysia Territorial Water and Continental Shelf Map 97 etc.
v) Aerial Photograph
vi) Orthophoto Maps

Under the 10th Malaysia Development Plan, JUPEM will continue to accelerate topographic data production and this will be undertaken under the recently approved e-Mapping project. This project aims, among other things, to further expedite mapping activities such as topographic data collection, production and data base updating by decentralising the said activities to the regional branches, and the outcome will certainly benefit the GIS community.

3.0 GEODETIC INFRASTRUCTURE

The Malaysian Revised Triangulation (MRT) has been used for geodetic, mapping, cadastral and several other activities since 1948 in Peninsular Malaysia. This network consists of 77 geodetic, 240 primary, 837 secondary and 51 tertiary stations. It is based on the conventional observations with many of the triangulation points dated as far back as 1885. The MRT has been adopted as a result of the re-computations of the earlier network together with the Primary (Repsold) Triangulation (Fig. 4) carried out between 1913 and 1916. The map projection used for mapping in Peninsular Malaysia is the Rectified Skew Orthomorphic (RSO) and the Cassini Soldner for cadastre.

Cadastral Survey has always been based on the local Cassini-Solder Coordinate Projection System which is a plane coordinate system for local cadastral system. Each state has its own origin and reference meridian resulting in a total of 9 different states' coordinate systems. Different origins in different states have resulted in incompatibility as far as digital database is concerned. It was impossible to retrieve a homogenous and unique cadastral data, which eventually led to confusion among users especially to those conducting cross-over-states cadastral survey works.

With the launching of Geocentric Datum of Malaysia 2000 (GDM2000) on 26th of August 2003, the single referenced geocentric datum is adopted to convert the state-based localise Cassini-Soldner system into the Geocentric Cassini Coordinate Projection System. The conversion allows efficient data exchange and sharing from various information systems compatible with global coordinates obtained from GNSS and other coordinate systems adopted in many parts of the world.; i.e satellite images, topographical maps and aerial photographs.

The GDM2000 supersedes the classical geodetic datums in Malaysia and has been established with respect to a geocentric reference frame defined in ITRF system at ITRF2000 epoch 2 January 2000 at an accuracy of 1 cm. On the other hand, the new GDM2000 (2009) coordinates have taken into account the displacement and movement due to the Sumatran earthquakes in 2004, 2005 and 2007. This new GDM2000 (2009) would be continuously maintained and managed through the use of My RTK Net permanent tracking stations to ensure the availability of highly accurate, homogeneous and up-to-date datum of Malaysia.

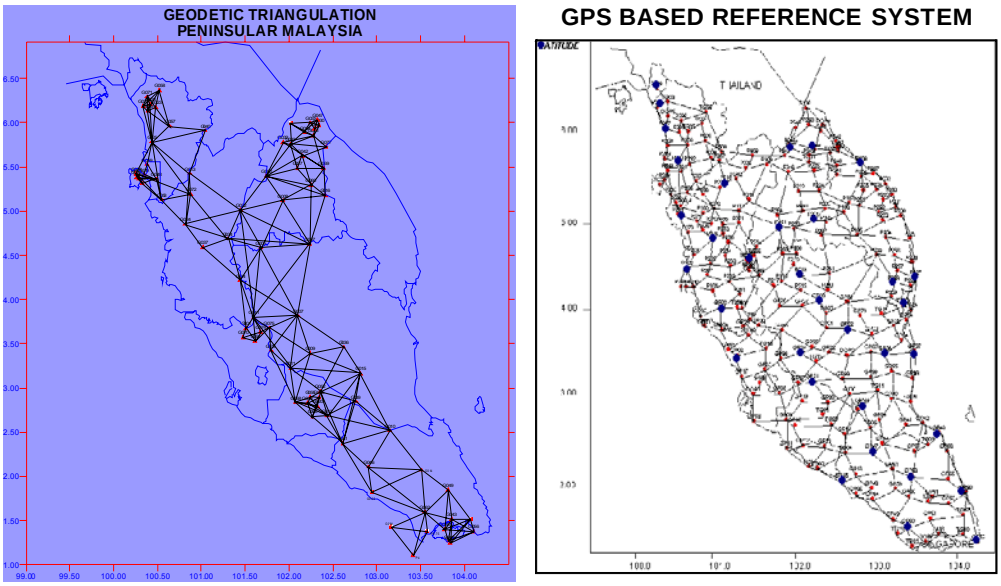

Fig. 5 - Old and new Geodetic Infrastructure established by JUPEM

The new generation of Real Time Kinematic (RTK) process known as “Virtual Reference Station” is based on having a network of GNSS reference stations continuously connected via tele-communication network to the control centre. A computer at the control centre continuously gathers the information from all receivers, and creates a living database of Regional Area Corrections. With VRS system, one can establish a virtual reference station at any point and broadcast the data from the reference station to roving receivers.

Currently, Malaysia has 78 RTK reference stations for the network covering the whole Peninsular Malaysia and two major cities in Sabah and Sarawak. Each reference station is equipped with a Trimble 5700 GNSS receiver, antenna, power supply and modem to communicate with the control centre via Internet Protocol Virtual Private Network (IPVPN) communication infrastructure. The system is designed for autonomous operation and is able to run 48 hours without intervention.

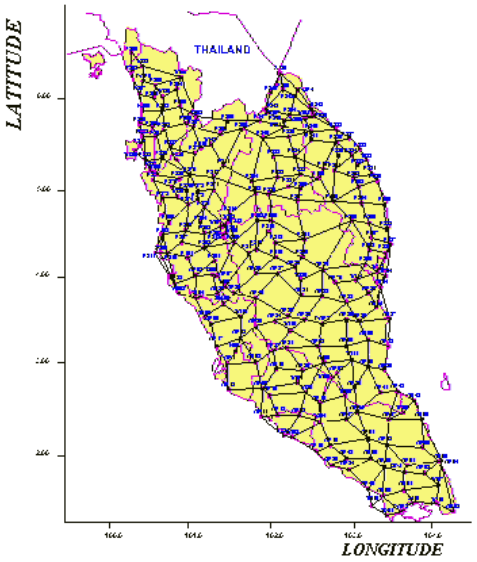

Fig.6a-Peninsular Malaysia GPS Scientific Network

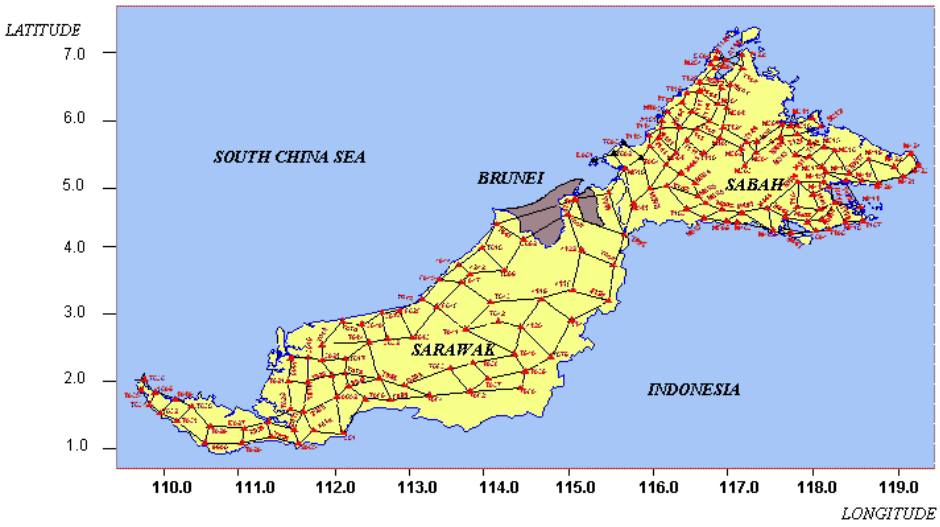

Fig.6b-Sabah And Sarawak GPS Scientific Network

4.0 GEOSPATIAL DATA STANDARDS

With the development of modern information technology, a great deal of geospatial data from different sources is produced almost continuously. With the development of computer networks and the growing popularity of the Internet, more and more information must be processed in different software packages to be distributed over the network. Thus, the issues of how to acquire data rapidly from different sources, integrate the data for analysis, and realize heterogeneous spatial data interoperability in a distributed environment becomes very important. As information sharing is an important requirement for the development of Information Age society, GIS interoperability is an essential technology for information sharing. The geographic information sharing and interoperability has been an important direction in GIS. A lot of research in geographic information sharing and interoperability has been carried out for decades. A number of standards have been constituted including those by OpenGIS Consortium and ISO/TC211. It is becoming clear that the major barriers and impediments to harnessing geographic information will not be technical ones but rather institutional and organizational ones like the ability to reorganize national mapping agencies such as JUPEM and other governmental organizations, in order to cooperate with one another, learn from each other and create data standards. In this regard, JUPEM will continue to play an active role in the development of local Malaysian Standards and at the ISO/TC211 level.

In Malaysia, various committees are collectively involved in designing, drafting, scrutinising and approving the Malaysian geographic information standards, namely: National Mapping and Spatial Data Committee, Malaysian Centre for Geospatial Data Infrastructure (MaCGDI), Malaysia Administrative Modernisation and Management Planning Unit (MAMPU), and National Committee on Geographical Names, TC2 / SIRIM and Department of Standards Malaysia. At the international level, ISO/TC211 coordinates and develops a family of

international standards that will support the understanding and usage of geographic information.

5.0 MALAYSIAN CENTRE FOR GEOSPATIAL DATA INFRASTRUCTURE

In January 1997, NaLIS (National Infrastructure for Land Information System) was developed, under the authority of a unit called NaLIS Secretariat. In 2002, against the wide scope and duty of the unit, the Malaysian Centre for Geospatial Data Infrastructure (MaCGDI) was established to replace NaLIS Secretariat. On 27th March 2004, MaCGDI was subsumed under the Ministry of Natural Resources and Environment (NRE) that supersedes the Ministry of Land and Cooperative Development.

MaCGDI is responsible for the development of the Malaysia Geospatial Data Infrastructure (MyGDI) as the National Spatial Data Infrastructure (NSDI). The underlying goal of the infrastructure was to improve access to geospatial information over the Internet. MyGDI enables people to discover, share and use geospatial information and services. The ability to share information is leading to innovations and unforeseen applications that increasingly add social and economic values.

5.1 Objectives

The main objectives of MaCGDI establishment are:

i) To provide mechanism/ infrastructure in supporting the usage and sharing of current, accurate and reliable geospatial information among agencies by employing the latest geospatial technologies; and

ii) To avoid redundancy of duplicating efforts in collecting, processing, maintaining, providing and dissemination of required geospatial

information.

5.2 Functions

The functions of MaCGDI are:

i) To act as an advisor to the Government of Malaysia in the formulation and implementation of policies concerning geospatial data;
ii) To coordinate activities pertaining to the development of geospatial data and standard for geographic information/ geomatics;
iii) To be a technical reference centre for advisory and consulting services with regard to the development and application of geospatial data;
iv) To develop and coordinate MyGDI Clearinghouse activities;
v) To plan and conduct human resource development program in GIS and the related fields;
vi) To organise various activities in promoting the use of MyGDI throughout the country;
vii) To become a centre for research and development (R & D) for GIS and the related fields; and
viii) To represent the public sector in international forum, conferences and meetings involving geospatial data

5.3 Malaysia Geospatial Data Infrastructure (MyGDI)

MyGDI is an initiative by the government to develop a geospatial data infrastructure to enhance the awareness about data availability and improve access to geospatial information. This can be fulfilled by facilitating

data sharing among participating agencies. MyGDI is a geospatial data infrastructure that comprises of policies, standards, technology research and development and skilled human resources. Through this infrastructure, smart partnership among agencies is continuously being developed to produce and share geospatial information thus providing customer-focused, cost effective and timely delivery of geospatial data. The goal of MyGDI is to enable members of the geospatial community to share and access data together seamlessly.
Furthermore, MyGDI facilitates online access to geospatial information, avoid duplication of effort in the collection of data and to ensure the accuracy, timeliness, correctness and consistency of data to be used in planning, development and management of land resources by:

- Providing a mechanism to facilitate the utilisation and sharing of geospatial data among the agencies that use and supply the data.
- Encouraging wider use of geospatial data at the state and national levels.
- Stimulating and enhancing the awareness about the value of geospatial data and the relevant technology.
- Contributing towards strengthening the development of national geospatial data through collaboration.

In order to manage the development and operation of MyGDI, a MyGDI National Coordinating Committee (MNCC) was formed with the role of a central policy and decision making body on matters pertaining to the implementation, development and operations of the MyGDI programmes and initiatives. Besides the coordinating committees, there are three Technical Committees – Framework Technical Committee, Standards Technical Committee and Clearinghouse Technical Committee. The MaCGDI activities are mainly driven by these three technical committees.

Complementing to these committees is the MyGDI State Coordinating Committee (MSCC) and the MyGDI State Technical Committee (MSTC).

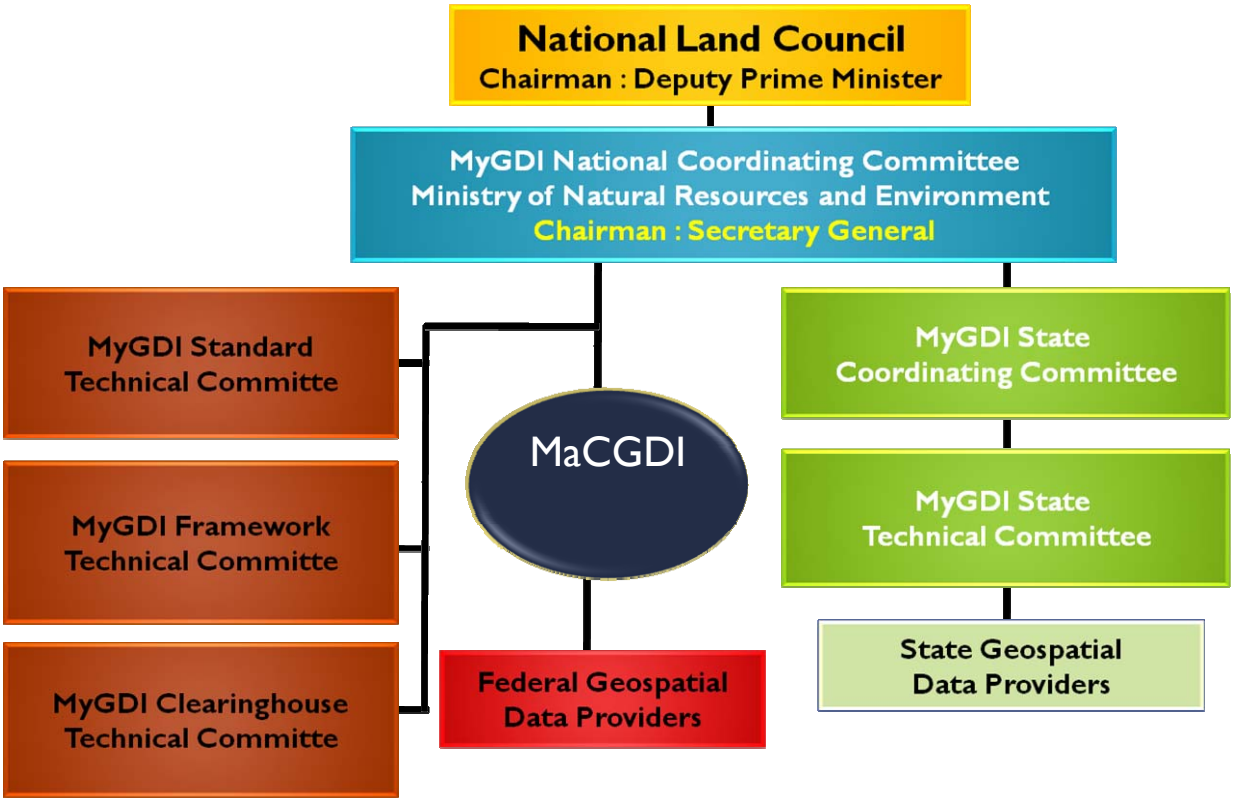

Fig 7.- MyGDI Governance Structure

5.0 CAPACITY BUILDING IN GEOSPATIAL SCIENCE

Malaysia is one of the countries who is currently and continuously working towards a full fledge digital community and government. Several systems were developed and implemented e.g. spatial based information system. These systems are being managed by agencies like JUPEM and MaCGDI.

Capacity building is evidently of major importance and currently is still an issue to be amicably addressed. A number of capacity building efforts are being undertaken by the relevant agencies including universities for example providing

formal education programs in GIS both at undergraduate and postgraduate levels, namely, BSc (Geoinformatics), MSc (Geoinformatics), and PhD (Geoinformatics). At the same time, a number of groups in Malaysia are currently working in research aspects of geospatial science (GIS) and the capacity building in the R&D focuses mainly on the following areas:

- Spatial Data Infrastructure (SDI) including standards
- National Geospatial Database
- 3D city modeling
- 3D cadaster (legal and technical)
- Multipurpose cadaster
- GIS for disaster management

The capacity building activities are being carried out by the groups via several ways e.g. conferences, workshops, seminars, short courses, and summer school programs. The groups could be categorized as professional bodies (e.g. Royal Institution of Surveyors Malaysia), universities, societies, and government agencies. NGOs like ISG (International Symposium and Exhibition on Geoinformation), National Conference on GIS, are those from Malaysia and international NGOs partners such as ISPRS (International Society for Photogrammetry and Remote Sensing), FIG (Federation of International Geomatics), PCGIAP (Permanent Committee on Geographic Information in Asia Pacific, OGC (Open GIS Consortium) contribute significantly to the Malaysian geospatial science capacity building efforts.

6.0 CONCLUSION

With its rapid rate of development, Malaysia faces an increasing complexity in land planning and management. These rapid development activities are fuelling high demand for geospatial information. A high quality geospatial information with an effective GIS system able to play strategic role for a country sustainable development and can contribute significantly to overcome bigger challenges that the world is facing today such as environmental conservation, climate change and global warming.

The GIS technology has become an important tool in many sectors and industries. In order to streamline and further enhance the development of GIS in this country, JUPEM and MaCGDI have formulated strategies to ensure better coordination and effective use of geospatial data. Towards this, we are working on a distinctive policy and legal framework to improve geospatial data management in the country. A separate Act is being formulated to improve governance and control of geospatial activities undertaken by government agencies and private sector in the country. The proposed Act will provide multiple benefits to the citizen and the country towards digital environment.