Towards holistic and sustainable Geo-spatial Data Infrastructure for Sabah

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Abstract

Sabah aspires to develop a geo-information infrastructure that is holistic and sustainable through adapting spatial technologies that play a pivotal role in rendering capacity in managing our assets and infrastructure to support the socio-economic and environment well being of the State. This vision requires close rapport among all agencies within Sabah as well as partnership with federal ministries, primarily via the Malaysian Centre for Geospatial Data Infrastructure (MaCGDI). The Sabah Geographic Data Coordination Committee (SGDC) has outlined the fundamental Geospatial Data Infrastructure (GDI) components and functional models for Sabah in which, the Sabah State Clearinghouse (for Geographic Data) champion and proliferate GDI developments amongst stakeholders in the State. This paper hence discusses the strategy and development of product-based GDI model to realise the State's vision. Further, it highlights the distinctive working models between Sabah state and national level and impending issues including funding, continuous research and data development for nurturing product-based GDI development in Sabah.

1. BACKGROUND OF SABAH GEOSPATIAL DATA INFRASTRUCTURE (GDI) INITIATIVES

1.1 Natural Resources Hub

The diverse natural resources of the state of Sabah has to be managed in a sustainable manner that calls for a balance between developing and protecting the fragile and exotic bio-diversity environment. In the state IT Master Plan[1] (ITMP)

[1] Information Technology Master Plan (ITMP) formulated and adopted by the state government of Sabah in 1997.

(SGOS, 1997), Natural Resources Hub is one of the four hubs[2] aspired to be developed for the better and efficient management of state resources and to enhance the government delivery systems-channels in order to serve the public better.

Prudent management of natural resources calls for formulation of frameworks, policies, enforcements and mapping resources. Within the 8th Malaysian Plan, the state has worked with several foreign-aided projects to draw up strategies for the various specified bio-diversity environment projects. Some of these projects are :-

No	Project Name	Sponsor
1	Borneo Biodiversity and Ecosystems Conservation (BBEC)	JICA[3]
2	Corridor for Wildlife Reserves	JICA
3	Environmental Local Planning	DANIDA[4]
4	Capacity Building for Environmental Protection Department	DANIDA
5	Integrated Coastal Zone Management	DANCED[5]

All these projects have a Geographical Information System (GIS) component and the international consultants together with the local partners have developed and enhanced the existing systems within those agencies in order to capitalise on the GIS and Remote Sensing technologies development. Having natural resources and environmental issues charted on the maps is recognised as an effective to solicit political support and engage public participation. It is proven to be a powerful tool to deliver the government aspirations in conservation and development projects to the public.

1.2 SABAH GEOGRAPHIC DATA COORDINATION (SGDC)

Such realisation by the state government reflects the spirit of the Agenda 21 Declaration at Rio De Janeiro UNCED[6] Conference in 1992 where it was acknowledged that :

- *Availability of geographic information is critical for environmental decision making and*
- *Spatial data is important for sustainable global development.*

[2] The four hubs are : Natural Resources, People, Finance and Enterprise
[3] Japanese International Cooperation Agency - JICA
[4] Danish Ministry of Foreign Affairs - DANIDA
[5] Danish Cooperation for Environment and Development - DANCED
[6] United Nations Conference on Environment and Development - UNCED

In line with global and national development on geospatial data infrastructure (GDI), Sabah has begun the initiative for GDI through the Sabah Geographic Data Coordination Working Committee (SGDC) formed in 1998 under the Sabah IT Council (SITC). The SGDC has its root in State Remote Sensing Committee[7] has been serving as a platform since 1990 to report and share projects experiences in remote sensing technology for mutual benefits of government agencies. With the setting up of SGDC, Sabah aspires to develop a geo-information infrastructure that is holistic and sustainable through adapting spatial technologies that play a pivotal role in rendering capacity in managing our assets and infrastructure to support the socio-economic and environment well being of the State.

1.3 REINVENTING GOVERNEMNT WITHIN SGDC

In 1997, the state government has initiated the Reinventing Government (RG) movement across the public services. Within two years, trainings and workshops were held and the State Assembly endorsed the RG activities in April seating of 1999. This was followed by the training of all top civil servants by the renowned author and speaker on RG, David Osborne who gave the premier lecture on RG concepts. Subsequently, two hundreds over RG facilitators across the agencies were trained so that they can be the champions of RG within their own organisation.

In a way, SGDC was the 'product' of this state RG initiatives, whereby the entire state GDI development through SGDC anchors on the **people** that has made it work. It began with the realisation of GIS technical managers on the needs for collaboration to minimise duplication works of data capture and to maximise investment by building infrastructure for sharing. The idea was forwarded to the top management of state public services, in particular, the Yang Berhormat State Secretary (of Sabah) and other top government officials, who supported this far-sighted concept and idea of GDI. This in essence, was a bottom-up approach, conceived by professional group of managers, presented the opportunity to innovate the manner our State public service should be networked, and being **in-house** effort is what marks the difference, without the input of consultants.

[7] In 1998, State Remote Sensing Committee was revamped to become the SGDC.

The State Government continues to grant supports to this initiatives through the various means, including the followings:

i. Financial support for State agencies to develop corporate level of GIS databases as this will form the framework data of geospatial data infrastructure;
ii. Setting up GIS units for those data custodians within the NaLIS Sabah Pilot project whose agencies did not have dedicated GIS / mapping unit prior to NaLIS Sabah;
iii. Continuous human resources development by granting scholarship for MSc courses for nine GIS managers involved as NaLIS Sabah Coordinators within the pilot project; and
iv. Support the activities of SGDC in workshops and seminars where ministry permanent secretaries and head of departments have served as session chairmen and participated in the drafting of workshop resolutions.

2. VISION, MISSION, GDI COMPONENTS AND FUTURE DIRECTIONS OF SGDC

2.1 NaLIS SABAH – MyGDI SABAH

In 1998, SGDC Working Committee proposed to the federal government to implement a state-level NaLIS infrastructure that is, within its first year of mobilisation. This pilot project was named **NaLIS Sabah** with its Clearinghouse Website www.sgdc.sabah.gov.my successfully developed and launched in November 2001 by the Right Honourable Chief Minister of Sabah. As part of the NaLIS traditions to derive consensus on the GDI issues, numerous workshops were held over the years and resolutions are made to enhance the objectives of SGDC and NaLIS. These workshop resolutions significantly formed the milestones of Sabah GDI development. In 2002, NaLIS Sabah was selected and won a few competitions at the state, national and international arena :-

No	Competition	Placing
1	International Poster Competition organised by Intergraph Corporation, USA – Concept of NaLIS Sabah	Third Place (out of 143 entries throughout the world)
2	National IT Premier Award ("Anugerah Perdana Teknologi Maklumat") organised by MAMPU Malaysia – Concept and Mobilisation of NaLIS Sabah	Top Three finalists
3	State IT Quality Management Award ("Anugerah Pengurusan Kualiti Teknologi Maklumat") organised by MAMPU Sabah and State Quality Committee	Winner

These recognitions gave confidence and set the momentum for development of GDI development and in October 2002, the Kundasang Resolutions (SGDC, 2002) passed at the NaLIS Sabah Workshop 2002 features out the vision and mission statement of SGDC.

Appropriate with its objective, the NaLIS setup at Federal level was "upgraded" to a Centre in 2003 and called Malaysian Centre for Geospatial Data Infrastructure with acronym **MaCGDI** whereas the NaLIS project name was changed to Malaysian Geospatial Data Infrastructure or MyGDI. Hence, the NaLIS Sabah project is now known as MyGDI Sabah.

2.2 VISION AND MISSION OF SGDC

The vision of SGDC is "t**owards a holistic and sustainable geo-information infrastructure as the catalyst to elevate the quality of life"**. This vision requires close rapport among all agencies within Sabah as well as partnership with federal ministries, primarily via MaCGDI.

The missions of SGDC is to develop a sustainable geo-spatial infostructure to facilitate GDI implementation for the State of Sabah via continuous collaborative activities, as follows:

i. in developing the Framework Data Sets, Metadata, Data Standards, Clearinghouse operations as well as the Institutional Framework (to achieve the vision of MyGDI Sabah) by adopting a product-based approach;

iii. to intensify data development to build-up comprehensive geospatial data sets as well as capacity building to maintain currency of the same;

iv. to promote and expedite the sharing, exchange, dissemination and use of geo-spatial information, enabling geo-information for making informed decisions;

v. for homogeneous development of Spatial Data Infrastructure (GDI) for Sabah through instilling and educate the significance of GDI for sustainable natural resource and environment management.

2.3 GDI COMNPONENTS OF SGDC

The SGDC has outlined the fundamental GDI components and functional models for Sabah in which, the Sabah State Clearinghouse (for Geographic Data) champion and proliferate GDI developments amongst stakeholders in the State. It is imperative for SGDC to develop all the six components in cohesive manner in order to envisage a successful GDI implementation (Tai, 2002).

The components that make up the GDI for SGDC are **Framework Data, Metadata, Clearinghouse, Standards, Institutional Framework and People & Culture** as shown in Figure 1.

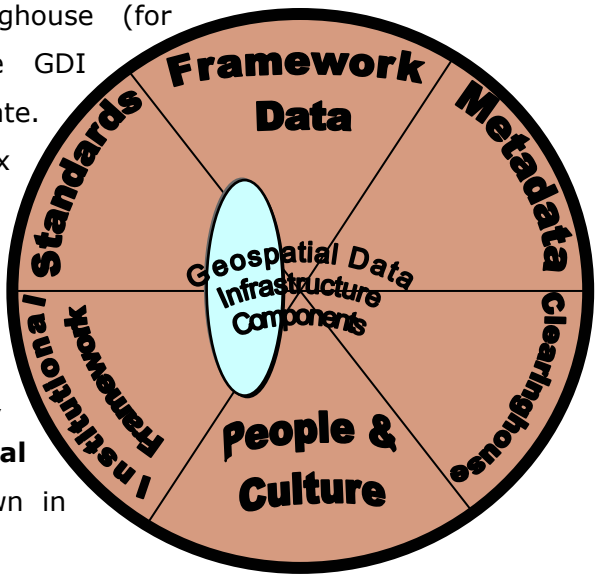

Figure 1: Geospatial Data Infrastructure Components of Sabah

2.3.1 Framework Data

Data is the most important component of a GDI. Framework Data is the identified fundamental datasets required for the successful implementation of GDI initiatives. From the fundamental framework datasets, other data may be overlaid for analysis or information deduced to aid decision-making. These framework data is identified using format, metadata content, standards, extent, accessibility, custodianship and quality assurance. Since the

fundamental datasets are essential for the other data to be built upon, it is necessary to give priority to the data conversion of these framework data.

2.3.2 Standards

Standards ensure the uniformity of the data capture and to allow easy data transfer. Standards solve particular problems as to how to represent data efficiently or manage a communications system, and they create benefits – interoperability, portability, ease of use, expanded choice, and economics of scale. A common standard allows data integration with ease. Common standards and procedures facilitates the sharing of data across the GDI.

2.3.3 Metadata

Metadata simply means data about data, which defines the details of a spatial information. This forms the directory service for all spatial data through the Spatial data directory/dictionary. Metadata summarises the characteristics of a set of data, it details the answers to the who, what, why, when and how questions of spatial data. Metadata is very important for spatial data as it allow the potential user to determine whether the dataset is useful or not before acquiring them. Through clearinghouse, the metadata will serve as an advertisement for the data providers regarding the usage and sale of their geospatial data, to the potential customers on the Internet.

2.3.4 Clearinghouse

Clearinghouse is the single portal to allow single point entry to access to multiple datasets maintained by multiple agencies. It normally uses a distributed network of geospatial data producers, managers and users linked electronically. Although it is possible that is a singular centralised portal. The clearinghouse commonly houses a metadata search and spatial data search system. The fundamental goal of the clearinghouse activity is to provide access to digital spatial data through the use of metadata.

2.3.5 Institutional Framework

Institutional framework comprises of data policies concerning sharing, pricing, transferring and usage of spatial data. Among other policies, are protection and security of data, copyrights and liability of data usage, access of data over

internet. This is where the collaboration communication efforts must be invested through discussions, forums, workshops among data providers and data users. A good communication channel is instrumental towards the successful GDI implementation.

2.3.6 People and Culture

People and culture constitutes a major deciding factor on the successful implementation of GDI. It is related to social make-up of a community and this includes: the extent of political support, the clarity of the business objective in GDI development, the continuous funding support, the degree of sharing within the community culture, the knowledge level of the community and the ability to enlist all stakeholders to utilise the infrastructure.

2.4 FUTURE DIRECTIONS OF GDI

In the opening address of the SGDC chairman, Yang Berhormat State Secretary, Datuk KY Mustafa, who chaired the SGDC meeting[8] (Mustafa, 2004), he outlined four pointers for the future directions of state GDI development, as follows:-

i. **GIS-Centric thinking** – it is important that all agencies adopt and adhere to the policies and guidelines related to GDI data developments for example, the Data Custodian Policy advocate that there should be no duplication effort on data capture.
ii. **Geospatial Data Development** at each agency level should be given emphasis and high priority and data sets need to be as comprehensive as possible to increase its potentials and analytical capacity.
iii. The **real benefits** of Geospatial Technology need to be demonstrated. For this, **Product-based approach** should be adopted to derive geospatial products that can promote and diversify its usage.
iv. **Community-based products** should be the main focus of development, such as MyGDI Sabah and G4E because it is important that **we deliver** what the community and users want and would use.

3. HIERARCHICAL MODELS AND ROLES OF GDI AT DIFFERENT LEVELS

[8] SGDC 1/2004 Meeting on 28 October 2004

3.1 HIERARCHY MODELS FOR GDI

The Centre for Spatial Data Infrastructure and Land Administration under the Department of Geomatics, The University of Melbourne, Australia has conducted numerous research into the hierarchical relationships of SDI models and has published many papers in http://www.sli.unimelb.edu.au website as their research outcome regarding the implementation issues affecting the success of GDI. One commendable contribution from the research efforts is the result of applying hierarchical spatial reasoning to SDI and this allows the hierarchical structure of GDI levels to be accurately outlined in the form of pyramid (Figure 2) published by Chan and Williamson (1999), showing the six levels of GDIs commonly implemented, in ascending order: corporate or GIS core dataset, local government, state, national, regional and lastly global level.

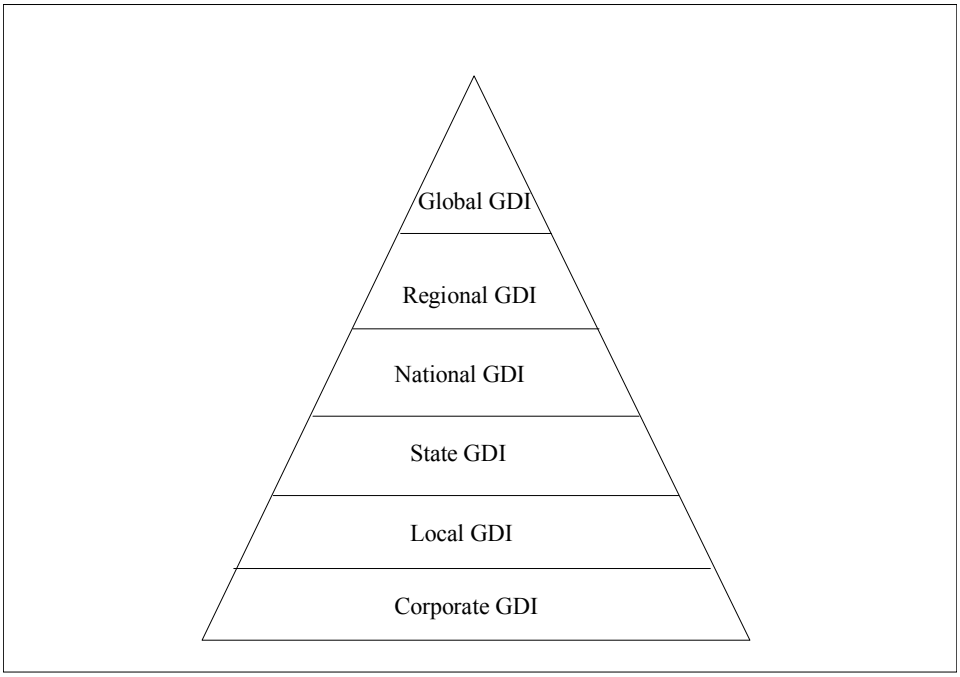

Figure 2 Pyramid Hierarchy of GDI level

3.2 STATE GDI AS BUILDING BLOCKS FOR NATIONAL GDI

As a "whole to part" concept, State GDIs form the pieces of building blocks that make up a national GDI. In the same manner, local and corporate level SDIs are building blocks that make up a state GDI. On this matter, SGDC recognises the significance and advocates that Sabah stakeholders at every level subscribe to the State GDI

principles. This shall ensure that State SDI development caters for all sectors and industries, which consequently converge every state GDI to the national GDI (GSDI, 2001). This is fundamental as manifested in the quote as follows:

> *"if the NSDI is to be fully successful for the nation, it must be embraced by state and local government and the populace as a whole." – Wally Bowen of the Mountain Area Information Network.*

3.3 DISTINCTIVE ROLES BETWEEN NATIONAL GDI AND STATE GDI

With the distinction of jurisdictions respectively, there should be distinctive role between National GDI and State GDI. For example, it is most appropriate for the planning, development and implementation of guidelines, major legislations and policies on Clearinghouse, Data Standards, Framework data, intellectual property rights, liabilities and privacy and so forth at National GDI level. Equally relevant is adequate monitoring not so much on enforcement but to identify, plug and enhance the National GDI. Distinctly for State GDI level, apart from participating the NGDI activities described above, the key role should be collaborating with all stakeholders, among State government agencies to start with, to nurture "partnerships" in developing State level, local and corporate level geospatial databases or GDI products that fundamentally conforming to the National Standards, framework and guidelines (Mohamad et al., 2002). In this manner, given time, the entire GDI development can be properly planned and balanced growth that befits the Users community.

At the national level, the main focus of MaCGDI should be to establish communication channel of knowledge infrastructure through promotional and capacity building programmes. MaCGDI can develop products for the national level but this should not form the main thrust of its mission. In the establishment of knowledge infrastructure for the entire nation, one important aspect of the work is to seek convergence and collaboration of similar national ICT programmes which are related to building spatial data community specifically and information rich society in general. In the pursuit of a singular mission to enlarge the GDI, MaCGDI need to create linkages and rapport with national ICT initiatives such as National Information Technology Council (NITC), National Mapping and Spatial Data Committee, Natural Resources and Environment Monitoring System (NAREM) and other activities related to spatial data.

At the state level, the main thrust of SGDC should be to develop products that meet the needs and requirement of the user community. Through the clearinghouse, it should be responsive and creative to develop dynamic products that will enhance the GDI acceptance and usage at the state level. In this matter, the State needs to operationalise the GIS data through strategic planning of the Sabah GDI components (*Figure 1*) at appropriate levels within its hierarchy.

4. TOWARDS PRODUCT-BASED GDI MODEL FOR SABAH

The Kundasang Resolutions 2004 strategic identifies a product-based GDI model for Sabah. In the discussion of product-based GDI, it is important to explore the latest geospatial technologies to enable the Clearinghouse to be responsive to the needs of the spatial data user communities. Even though the current MyGDI Sabah Clearinghouse application has somewhat realised the ITMP97 Natural Resource and Environmental Hub, the impact from merely integrating geospatial data sets across agencies still need to be further improved and explored in terms of GDI products.

SGDC has outlined **enhancements** for the State Clearinghouse that shall develop a product-based GDI and realize the full potential of SGDC/MyGDI Sabah through development of tools for data development, data integration, extraction, value-adding and compilation of thematic maps, Queries and reports for producing GDI products within the following applications:

4.1 SECTORAL-COMMUNITY APPLICATIONS

This encompasses development of multi-discipline **Sector-based pre-defined GDI products** and Queries for the State's community to support sustainable socio-economic development, the optimum usage and conservation of natural resource and environment. The followings are components of the Sectoral-Community Applications:

1) **Community products** on sustainable socio-economic development program, the optimum usage and conservation of natural resource and environment and so forth.

2) **Sectoral products** as follows:

a) **Public Safety and Emergency Response** encompassing security & uniform Units including police, fire department, demography profile, medical facilities, location of hospitals and clinics, number of beds, number of doctors & nurses, and so forth, transportation networks, environmental issues, commercial and residential areas, flood data and flood prone zone maps and Satellite images.

b) **Educational** products on location of educational facilities including kindergarten, schools, colleges, universities, attributes on number of students, teachers, capacity of schools and so forth.

c) **Tourism** products on hotels and resorts, rates, capacity and facilities, Flights & other tourism related information and links to Sabah Tourism Promotion Corporation (STPC) website.

d) **Socio-economic** products on landuse, forestry, agriculture, industrial development, water catchments areas, government facilities, wildlife habitat and Electoral profiles.

3) **Government And Public Geoinformation Channel** to provide facility for the government to disseminate public information via map products.

4) **Sectoral-Community Browser** secured with Systems Security and Login Authentication to publish GDI products in **interactive maps** format.

4.2 CUSTODIANS APPLICATION

Conceptualised on "**a tool for you to do your work**", this implements on-line facilities for government officials to effectively access to geospatial datasets mostly within their own agency as well as datasets of other agencies. The objective is for enabling government officials to access datasets, integrates on-line, execute queries and analysis to perform their daily tasks. The tools to be developed shall include as follows:

1) **Custodian 'Applications Channel'** for agencies having regional or district offices Users requiring access to data/information at their headquarters.

2) **Inter-government 'Applications Channel'** catering for inter-department business needs. This provides for customised GDI products and Queries for specific department(s) including for example land development planning taking considerations of all environmental concerns such as water catchment versus infrastructure development or resolving the conflict of plantations versus environment protection.

Hence, these tools shall provide convergence of geospatial data sets through the State Clearinghouse and data sets may be downloadable. These enhancements will at the same time, establishes new roles of State Clearinghouse to provide for intermediate solution to geospatial data needs of specific user groups in cases where data is not available.

4.3 E-COMMERCE

The implementation of e-commerce within MyGDI Sabah will enables Users to purchase data sets or Services via Prepaid and Postpaid accounts while credit cards payment will be included when the State Treasury implements it.

5. IMPENDING ISSUES FOR SGDC

The strategy and development of GDI model in order to realise the state's vision for SGDC is enveloped by two major impending issues as follows:

5.1 ADEQUATE FUNDING

Adequate budget is crucial to fund the implementation of the various program including procurement of technologies, upgrades and maintenance of computer systems, workshops, seminars and so forth.

Through first hand experience, shortage of fund is the main stumbling block hindering the development of State SDI, which in turn "prevented" the full realisation of National SDI. As long as the situation where most state agencies do not have sufficient funding for geospatial information systems implementation persists, this will continue to stunt the growth of State GDI components and diversity of GDI products.

Therefore, the Federal Government may need to shoulder major implementation cost in laying the foundations until the stage when State SDI is self-sustaining.

5.2 CONTINUOUS RESEARCH AND DATA DEVELOPMENT

To keep abreast with the dynamics of a State GDI to maintain healthy growth, there is a need for continuous human resource development for various level of GIS Users and managers as well as intensification of data development. Data availability and its manipulation have profound influence on the success rate of a GDI implementation. This necessitates long term planning on professional trainings on GIS technologies and applications, exposures and interactions through formal courses, workshops, national and international seminars and conferences, technical study tours and so forth. Hence, it is essential for adequate training budgets to be provided by both Federal and State Governments for these programs.

Apart from external trainings which may benefit only the elite, the Sabah GDI implementation aspires for such opportunities to reach all sectors as an attempt to nurture expertise including:

i) to integrate MyGDI Sabah into the State Electronic Government (EG) applications will cause mindset shift to recognise that deploying geospatial technologies is part of the ICT tools that drive public services evolution, where it shall become routine for government officers to logon in order to carry out their daily works. This will bring about changes in mental mindshift, one that always embraces and incorporate new technologies to improve their services.
ii) Promotional activities on research, to identify and inculcate knowledge on GDI technologies. SGDC even proposes to reach out to primary schools for exposure from young.
iii) SGDC has endorsed Adopt-An-Agency method to link up GIS newcomer for attachments and transfer of technology trainings at operation level.
iv) The fundamental datasets for a state has to have complete coverage before product-based GDI can be fully achieved as highlighted by the GSDI Cookbook (GSDI, 2001). In Sabah, many agencies have expressed their need for topographic data of 1:50,000 scale, it is required for terrain analysis, slope analysis, wildlife corridor mapping, riparian conservation,

and any spatial analysis requiring modeling of the area. Another core datasets required is the cadastral layer. All fundamental datasets need to be given top priority in data conversion and ensure of its available.

Albeit the above, SGDC recognised that private sectors and research institutions must be involved in order to continuously develop and strengthen the GDI initiatives.

6. CONCLUSION

In this era of globalisation and exponential growth of technology and information, every government entity in the world should aim to synchronise its development in the flow of the general trend. In the development of GDI, with the global organisation such as Global Spatial Data Infrastructure (GSDI), every nation is to develop its own National Geospatial Data Infrastructure (NGDI) and state level State Geospatial Data Infrastructures (SGDI).

The state government of Sabah has learnt numerous lessons through the implementation of GDI activities under the perview of SGDC. In view of the large amount of investment in financial and high commitment, highest level support for GDI development is essential, this has been proven as the crucial factor of success in SGDC. The state aspires to further support work of GDI in order to realise vision of SGDC and to ensure that GDI proliferation is compatible with global trends while maintaining Open GIS for the state.

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