

A Whole-of-Government Approach to Bruneian Geospatial Data Management

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Key words: Geospatial data management strategy, e-government, Australia, Singapore, Brunei

SUMMARY

Management of geospatial data from multiple sources can be challenging, especially with the rapid development of the spatial industry with more geospatial data being acquired and shared among organisations. In many countries, geospatial data are frequently distributed based on specific themes or interests for better analysis and decision making. Despite the ability to improve internal processes within organisations or disciplines, the management of the overall geospatial data at the national level can become more complex as more isolated data are created within a government as a whole. Thus this study aims to investigate a strategy for geospatial data management at the national level.

This paper presents challenges and concerns on geospatial data management with regard to implementation of e-government and national spatial data infrastructure by considering the cases thereof in Australia and Singapore. Australia is one good example with their experience and maturity in spatially enabling government and spatial data infrastructure. On the other hand, Singapore as a one level government has been observed to be successful in managing its land resources with a high population in limited space. The outcome of this study is able to provide prioritization between different factors in formulating the best approach in a geospatial data management strategy, specifically for Brunei Darussalam, a country that has implemented spatial data infrastructure for about five years. However, some important necessities for effectively managing geospatial data are still lacking such as spatial data policy, clearinghouse and metadata. Thus these current challenges directly relate to the findings from this study, thereby providing a recommendation for a Brunei-targeted geospatial data management strategy.

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1. INTRODUCTION

Some e-government initiatives support the spatial industry by supplying the national infrastructure with suitable technologies. There are many definitions of e-government or electronic government offered by researchers such as in (Fang, 2002; Basu, 2004). In this paper, *e-government* is defined as the use of technology or electronic means by the government in delivering its services and products to the citizens and businesses, as well as among government agencies. Government agencies have now better ways of communicating with one another via e-government infrastructure, and the distributed government information can be linked and overlaid under one platform using an integrated approach that enables the improved decision making. Many geoportals were developed under e-government projects to provide users with access to geospatial data that were not freely accessible previously. This effort successfully promoted benefits of geospatial data to all sectors, especially those supporting government services internally and externally. However, the formation of islands of information based on interests or agencies has inadvertently resulted, thus generating new complexities in management of geospatial data especially at the national level. A number of challenges and issues in both technical and non-technical aspects has been discussed by many researchers, such as in geospatial data sharing (Salleh and Khosrowshahi, 2010). In addition, institutional arrangement and policy preparation are two examples of common non-technical challenges and issues. Studies on geospatial data management have focused mainly on specific themes or interests such as electricity usage (Rasam et al., 2013) and water management (Cope and Pincetl, 2014), but it has been examined holistically, that is a whole-of-government approach which aims at avoiding duplication and harmonizing national efforts (Baker, 2007). This level of organization requires better coordination, compromise, and understanding between stakeholders. Thus, this paper aims to formulate strategies for national geospatial data management by investigating trends and impacts of e-government implementation within the development of spatial industry. Both e-government and the spatial industry require technology as one of their driving forces.

2. OVERVIEW OF GEOSPATIAL DATA MANAGEMENT

In the last few decades, the development of geospatial data increases with greater awareness of its benefits towards the management of specific domains such as land activities, utilities, climate and others. Initially, geospatial data were associated with the land data when the geographical information system tools were first introduced. The spatially referenced information has added even more opportunities including more innovations to the spatial industry. However, many islands of siloed information have been created and distributed based on different disciplines or controlling agencies. In some cases, they can be quite similar but presented for different purposes. In view of the whole-of-government, the need to share and integrate geospatial data has improved government processes and services, but at the same time, it has increased complexities in the context of management which has proven to be a continuous challenge.

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Traditional data management in the last few decades was less complex as it was done by the individual data custodian, with less or no requirement of data sharing or integration. Yet for modern governments, a common goal is to fully utilise the acquired data by government agencies. Nevertheless, sharing, integrating, and value-adding data can complicate data custodianship, which include chaotic roles and responsibilities. Moreover, challenges in data management will be greater with multi-level government compared to one-level government. From a management perspective, the consistency and harmonisation of primary key attributes between datasets are very important. Any updates in the primary key attribute of one dataset can affect other datasets that refer to the same attribute. Without any automatic update process, there should be notification to respective agencies on any changes occurring to both attribute names and/or values. Hence, there should be agreement among agencies on the centralisation or decentralisation of information management. The inter-agency agreement is highly important to ensure smooth management of information in government processes. The national spatial data infrastructure (NSDI) can be the best platform for geospatial data management, as its focus is on accessing, sharing and integrating of geospatial data. At a later stage, spatially referenced location and other types of data may also be pulled within the NSDI.

3. ROLE OF E-GOVERNMENT IMPLEMENTATION IN SPATIAL INDUSTRY

The concept of e-government has been discussed for a few decades with an aim in creating a modern or "smart government" using technology. The status of e-government varies between places. Developed countries may have better e-government implementation compared to developing countries, where knowledge, resources and money are significantly important. The ongoing trend for the e-government initiatives is the establishment of national portals or open data websites. Both can promote participation from other sectors, besides providing a platform for online government services. In the government sector, the spatial industry is often led by national land and mapping agencies as primary spatial data producers. The invention of spatial referencing tools that can link any information with geospatial data has broadened the geospatial data community. However, in some countries, these tools are not yet available, thus limiting the participation to some extent. Furthermore, geospatial projects in some places only involve a certain group of agencies with similar interests, a factor which may also restrict potential benefits to others. Both geoportal and open data websites in some countries have included spatial data. However, technical issues can constrain its inclusion and successful implementation. The emergence of geoportals in spatial data infrastructure (SDI) has illustrated the foundation of linking geospatial data with the e-government (Maguire and Longley, 2005). The authors highlighted that from the policy maker perspective, legal, economic and social issues pose greater concerns than technology. Open data, on the other hand, aims for transparency, participation and efficiency of government (Huijboom and Van den Broek, 2011), which reflects the need for good governance and better institutional arrangement.

While the e-government strategy normally considers the whole government, the geospatial data strategy normally focuses on existing spatial data providers and data users. As geospatial data may contribute to the modern government using technology, there should be connections between the two strategies. However, a gap is clearly apparent when looking at certain representative e-government strategies. For example, it was observed that not many countries highlight geospatial data in their e-government strategies. The Department of Finance in the Australian government has

included ‘spatial and location information’ as one of the emerging opportunities in its public service ICT strategy 2012-2015 (Australia, 2013). The government acknowledged the spatial and location information as part of the government data, potentially to be used to improve services to the public and product development. Based on the above, this paper will further investigate the relationship between e-government implementation and the management of geospatial data. Hence a hypothesis is formulated as: *“Implementation of e-government will aid in better development of national geospatial data management”*.

4. APPROACH

A logical first step is to investigate both e-Government implementation and geospatial data development in Australia, Singapore and Brunei through publications, country reports, government websites and other online information. The first two countries have been chosen because of their advancements in both areas. They were ranked as second and fourth, respectively, in implementation of e-Government with reference to United Nations e-Government Survey 2016 (UN, 2016). Furthermore, Australia is known for pioneering the spatial data infrastructure (SDI), spatially enabling government (SEG) and its land administration system (LAS). Similarly, despite Singapore’s small land size and large population, it has successfully managed their lands with vision ‘Limited Land Unlimited Space’. Yet one major difference between the two is their government structure: Australia with its multi-level government and Singapore with only one level of government. After establishing key principles required in geospatial data management, the next step is to use the findings to create a strategy for Bruneian geospatial data management. Brunei is as a small country as Singapore, with a much smaller population of 420,000 people. Brunei has implemented its SDI geoportal known as Survey Department Geoportal since 2010. However, it was observed that progress in some elements is very slow, even after more than five years of implementation. This lag includes development of metadata, policy and clearinghouse, e-payment gateway and participation from data providers, users, and value-adders. The current participation is mainly from agencies under the same ministry, yet government agencies have been connected via government network under e-government projects. However, the government of Brunei still encounters islands of silo information. Finally, the above-mentioned hypothesis will be discussed based on the experiences from Australia and Singapore, and mirrored with the issues faced in Brunei.

5. AUSTRALIA’S E-GOVERNMENT AND GEOSPATIAL DATA FRAMEWORK

The e-government implementation in Australia was reported to be stable since 2008 based on the report by the Ministry of Finance (Australian, 2012). In addition, Gauld et al. (2010) stated that ‘digital divide’ was the main factor that affects the e-government in Australia and New Zealand. In 2010, the same ministry has made the declaration of open government in order to encourage involvement from various sectors and utilisation of government information (Australian, 2010). It can be safely concluded that the Australian government is very supportive of e-government implementation and its promotion of several initiatives optimising government assets including information as formulated in the Australia public service ICT strategy 2012 -2015. However, legislative barriers and large allocations are reported to have caused delays in the execution of e-government strategy in Australia in the year 2013 (Australian, 2013).

The Australia New Zealand Land Information Council (ANZLIC) is the top government body in developing policies and strategies for geospatial data in Australia and New Zealand. Its initial focus was on national land information management, but with increased spatial capabilities, the focus has been broadened. One of the initiatives in organising large geospatial data is to improve the efficiency and effectiveness of the management processes (ANZLIC, 2016a), and to document all necessary information on the management of foundation spatial data framework (FSDF) (ANZLIC, 2016b). To support the declaration of open government, the Australian government made an agreement with Public Service Mapping Services (PSMA) to share two valuable national datasets; geocoded national address file (G-NAF) and administrative boundary (Wallace, 2015). The opening of G-NAF can further promote more opportunities and businesses.

Besides ANZLIC, there are a number of bodies and institutions that play important roles in geospatial data management in Australia, which include several levels of government, companies partially controlled by the government, bodies or institutions as part of government's initiatives, and others, such as research-based institutions with involvement from academia. The national Australian government needs to collaborate with several government levels that own geospatial data (Wallace et al., 2006). Harmonising these geospatial data and incorporating them as national datasets is one major challenge. In our view, the distribution of geospatial data in Australia is both centralised and decentralised. In one sense, it is centralised when harmonising similar datasets from various government levels and compiling them as national datasets such as G-NAF; yet in another sense, it is decentralised when individual bodies and institutions are considered. The preparation of policies and standards is not an easy task in the existing environment of Australia as it is a multi-level government. However, ANZLIC as the top government body has continuously compiled, documented, and harmonised elements related to geospatial data in Australia such as foundation spatial data framework (FSDF) and policies.

6. SINGAPORE'S E-GOVERNMENT AND GEOSPATIAL DATA FRAMEWORK

Through Infocomm Development Authority (IDA), a statutory board under the Ministry of Communication and Information, Singapore aims to be not only a Smart Government but also the "World's First Smart Nation" as quoted in the IDA's website (Singapore, 2016b). IDA is the leading agency in strategizing, planning, and monitoring entities related to e-government initiatives and implementation. Further, this "smart" goal is not only aimed at the government but also the whole of Singapore's society. The Singapore e-Government Masterplan of 2011-2015 (eGov2015) aimed for a collaborative government that would connect the government, the people and the private sector (Singapore, 2016a). The goal for the previous masterplan (iGov 2010) was to achieve an integrated government which covered integration of data, processes and systems within government agencies. For example, the data.gov.sg initiative, has provided a platform to access government datasets to develop more products and services. Currently it has nearly 12 thousand datasets, including geospatial datasets.

The Singapore Land Authority (SLA), a statutory board under the Ministry of Law, plays an important role in Singapore's spatial industry. The vision "Limited Land Unlimited Space" and the mission "to optimise land resources for the economic and social development of Singapore" reflect their continuous efforts in developing the country including a better use of resources especially the

geospatial data. There are more than 100 datasets in spatial format found in open.data.gov.sg. SLA has stated five data sharing principles, one of which states that the sharing is only via data.gov.sg and OneMap (an integrated map system for government agencies). Moreover, the Singapore Geospatial Collaborative Environment or SG-SPACE, the Singapore national spatial data infrastructure led by both SLA and IDA, facilitates the use of geospatial data. The components of the framework include the institutional framework, policy, clearinghouse, applications and services, and an intelligent OneMap. The cooperation between the two statutory bodies has strengthened the development of spatial industry in Singapore.

7. BRUNEI'S CURRENT SITUATION

The Bruneian digital government strategy of 2015-2020 was created as an effort to support the progress towards the Brunei national vision ('Wawasan 2035') via the use of technologies (Brunei, 2015). The vision aims for Brunei in year 2035 to be widely recognised for its well-educated and highly skilled people, high quality of life, and dynamic and sustainable economy (Department of Economic Planning and Development, 2007). Similar to Australia and Singapore, the collaboration and integration between government agencies represent focus areas as stated in the strategy; however, not much detail was provided in the document except for the requirement of the whole-of-government approach. The E-Government National Centre (EGNC) under the Prime Minister's Office, is the leading government agency in the implementation of e-government initiatives and has successfully connected all government agencies through the government network. However, it was observed that implementation of some government projects was still focused on individual interests.

Another lacking resource in the Brunei government is a lack of expertise, a deficit results in agencies depending heavily on private companies that may not reflect the holistic, whole-of-government approach. This particular condition was observed from a number of government projects applied for budget allocation that involved maintenance and improvement of existing systems. Options for involving the private sector is valuable as the government can learn from their skills and know-how; however, it should not be handed completely to them and the decision on the approach proposed by them should be reserved for the government. There have been some cases in which a project coordinated by one government department to improve an existing system has broken the existing connectivity to other departments due to a limitation of the software proposed by selected vendor, and this has rendered a great negative impact on those other departments. Thus the whole-of-government approach seems not to be enforced completely, communication and synchronisation are still lacking within the government. Another initiative for using technology promoted by the Brunei Government is the open data website; however, the current datasets are quite limited, open to textual and statistical data only.

The spatial industry in Brunei sprang from efforts in modernising land information using GIS. The survey department, lands department and Town and Country Planning (TCP) department initiated the land information system in mid 1990s and in 2010, survey department led the development of Brunei spatial data infrastructure by developing the geoportal (Survey, 2010). However, after five years of implementation, there is still lacking participation of geospatial data to the geoportal which may be caused by an absence of metadata, or unclear clearinghouse and data policies that have obfuscated the purpose of the dataset, consequently lowering the people's confidence level.

Currently, there are only two departments sharing their geospatial data in the geoportal, and registered users are mainly from government agencies under the Ministry of Development. Based on the country report 2006 by Brunei Darussalam during PCGIAP workshop in 2006 on data integration (Survey, 2006) and looking at the current status reported by the same source/person, almost all issues with regards to institution and technology are still at the same level of importance after 10 years with the addition of data format and expertise as indicated in Table 1. 'Items' in the table are selected items highlighted in the data integration template prepared in 2006. This indicates the need to improve the situation. Issues on data format and expertise were only reported during the implementation phase as in Table 1 for institutional and technical principles.

Table 1 – Comparison on status of Brunei geospatial data integration in 2006 and 2016

Items	Reported in 2006 by Survey Department to PCGIAP)	Reported in 2016 by Survey Department to author
National SDI Context	<ul style="list-style-type: none"> - National SDI in planning stage - No metadata in place 	<ul style="list-style-type: none"> - In 2012, Geoportal to access geospatial data was launched and now developed in phases. - Available data mainly from survey department and one received from TCP in 2015 - No metadata in place
Institutional Framework for Integration – Data provider	<ul style="list-style-type: none"> - ArcSDE is used as a tool in managing geospatial data 	<ul style="list-style-type: none"> - ArcSDE is used as a tool in managing geospatial data
Institutional Framework for Integration – Data user	<ul style="list-style-type: none"> - Data purchase physically in survey department 	<ul style="list-style-type: none"> - Data purchase either using geoportal or physically in survey department
Issues in integration of Built & Natural Environmental datasets	<ul style="list-style-type: none"> - Need of integration to share and fully utilise data - major issues – technical capability, data standard, custodianship, data policy, confidentiality, security and copyright law 	<ul style="list-style-type: none"> - Need of integration to avoid duplication and access to one common data - major issues – technical capability, data standard, custodianship, data policy, confidentiality, security and copyright law
Policy principles	<ul style="list-style-type: none"> - Issues mainly on data security, directive from higher authority, data custodianship and pricing 	<ul style="list-style-type: none"> - Policy needs to address data security and custodianship
Institutional principles	<ul style="list-style-type: none"> - Five issue ticked with importance level- 'Important(4): Funding, collaboration, data awareness, licensing and data access - Spatial information managed centralised 	<ul style="list-style-type: none"> - Seven issue ticked with importance level- 'Important(4): Funding, collaboration, data awareness, licensing, data access, data format and expertise - Spatial information managed

		decentralised
Technical principles	- Five technical issues hindering data integration ticked with importance level – ‘important(4): computational heterogeneity, vertical topology, reference system, data quality, metadata	- Seven technical issues hindering data integration ticked with importance level – ‘important(4): computational heterogeneity, vertical topology, reference system, data quality, metadata, data format, expertise
Cost of data in SDI	From cost of transferring data and full cost recovery	From free open access (viewing), cost of transferring data and full cost recovery

One illustrative example of geospatial data management in Brunei can be seen by looking at the data flow within the Brunei SDI as illustrated in Figure 1. All geospatial data published in the geoportal of Brunei SDI are stored in a server located in EGNC and are made available to the users via Internet. To publish geospatial data, the data custodian need to pass the data to the Department of Surveying as a coordinator to publish the data, where it requires to be stored in ArcSDE format in SVY local database before transferred to EGNC server via the Ministry of Development’s gateway. Ensuring data quality is under the jurisdiction of data custodians. In this paper, data custodian means the owner of the data and one that holds full responsibility to the data. Currently EGNC only allowed connection from any departments through the ministries, and the Department of Surveying is under the Ministry of Development. The ArcSDE is part of ArcGIS software, a proprietary software commonly used by the Department of Surveying in managing its geospatial data. The pros and cons of having this arrangement is presented in Table 2.

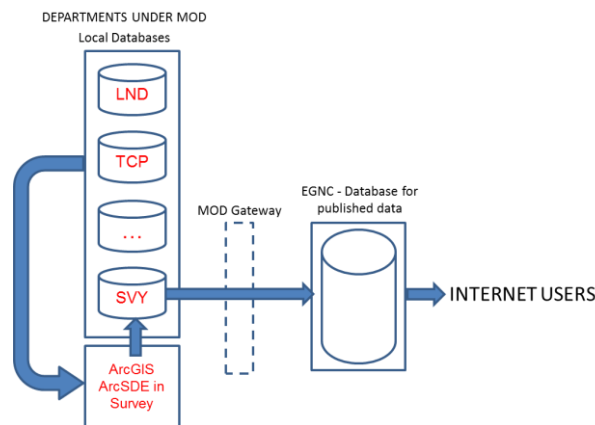


Figure 1 : Brunei Current SDI Data flow (source : Survey Department)

Obviously, as reflected by the current situation shown in Figure 1, more workload will be given to the Department of Surveying with more incoming datasets published in the geoportal, and ongoing issues concerning the duplication of data and resources will not be resolved. The presence of a clear data policy is direly required before more complication occurs. Both technical and institutional issues need to be reviewed constantly.

Table 2: Pros and cons of Brunei SDI geoportal data flow

Items	Pros	Cons
Store	Centralise	Data stored in Survey and EGNC servers
Update	Up to date data share with others	Not real time & through Survey department
Download	Information available to users	Only in PDF or image
Metadata	Not yet available	Not yet available
Consistency	Data policy not yet available	Data policy not yet available

8. DISCUSSION

During this study, information was gathered mainly from the governments or the respective bodies' websites, and little was gleaned from publications. Utilizing these primary sources gives a clear view of their operational status, functions, goals, initiatives, and other information. Further, it is important to note that the involvement of the academic sector in Singapore and Brunei are far less than in Australia.

Australia and Singapore are quite advanced in e-government implementation and spatial industry development. Their respective journeys to their e-government strategies bear similarities, which include an integrated approach, open data, transparency, collaboration, improvement of government services, and the utilisation of government information. In Australia, the use of geospatial data has been recognised as one dominant way to improve government services. Yet the institutional arrangement in Australia is quite complex involving several levels of government that gather geospatial data, and there are also initiatives put forth by entities with specific interests. ANZLIC plays the most important role in compiling and harmonising the state-based spatial policies into the national level which will support the FSDF for the whole Australian government. Additionally, the academic sector in Australia is pro-active in supporting any potential innovation within the spatial industry. On the other hand, the involvement of IDA in both e-government implementation and geospatial data management in Singapore has been able to bridge the gap between the two areas, a condition that may reduce siloing of data, processes and systems within the government. At this point, high level coordination and support from the existing mature institutions from the e-government has supported the national spatial strategy, clearly demonstrating that institutional arrangement, in addition to the technical aspects, is highly important. The presence of one agency from the top of government specifically responsible for geospatial data management will be able to provide a clear direction and reference to the whole government based on the created geospatial data strategy. The inclusion of spatial components in e-government strategies can, to some extent, enforce its national recognition as reflected heretofore in the example of Australia, whereas the involvement of e-government in leading agencies in spatial based projects can support its implementation even greater as seen in Singapore. Moreover, the United Nations has also recognised geospatial data as critically important in decision making by adopting it in its Sustainable Development Goals (Cpauka, 2015)

The current trending of open access to geospatial data promotes participation from various sectors which can create more innovations, products and businesses in the government and private sectors. In addition, it can also stimulate more research in the academic sector. The platform can take the form of either using the national open data website, an agency's individual website, utilizing any number national applications or other websites. Ideally, there should be no duplication to the data

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published in the web which may cause confusion to the users, and the whole-of-government approach has to be considered. Opening data or information must be in a readable format with details attached as metadata. The geocoded address database or address point, has high potential in attracting more participation based on its capability to include location into any information. To illustrate, the G-NAF in Australia has recently opened and can be accessed freely on the web whereas Singapore requires a license to access its address point. Apart from participation, there is also need for inter-agency and multi-disciplinary coordination.

A clear example reflecting the whole-of-government approach is through implementation of NationalMap and OneMap for interactive online access to government geospatial data in Australia and Singapore, respectively. In NationalMap, geospatial data are accessed directly from data custodians, whereas in OneMap highlights their geocoded datasets. The SG-Space, Singapore national spatial data infrastructure has geocoded its business data and population statistics. However, there is not much information or updates on the clearinghouse for either countries (i.e., FIND and Geospace for Australia and Singapore, respectively.)

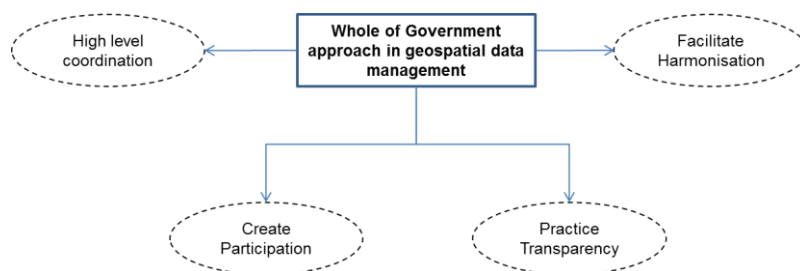


Figure 2: Principles in development of Whole-of-Government geospatial data Management

Table 3 : Elements included in the four principles of geospatial data management

Principles	Elements included
High Level coordination	There should be a top government agency that will lead the development of geospatial data community. It could be the extension to an e-government executive group.
Create participation	There should be a mechanism to promote participation. One way is by opening the geocoded address or address point to be able to spatially reference information which currently attracts many sectors.
Practice transparency	In the whole of government approach, all government agencies must be aware of any existing geospatial data within the government agencies. One of the best approaches is to register any new, existing and future (if already plan) geospatial datasets by respective agencies. The leading agency stated in the first principle may instruct group members to create suitable data models to reflect any relationship between datasets
Facilitate harmonisation	Sharing and integrating datasets need harmonisation in the datasets attributes and values in reducing or avoiding any technical issues. In order to avoid any confusion from the perspective of data users and providers, geospatial data policies must be consistent among agencies.

The continuous evolution of geospatial data may requires reviews on existing policies and guidelines. The council in ANZLIC has agreed to adopt the Victorian spatial strategy guidelines and geospatial data management as the national policy development (ANZLIC, 2014), whereas in Singapore, the spatial data sharing principles formulated by SLA will be used by all government agencies when deciding to share their geospatial data. At this point, it is not unusual to review

policies based on current needs or trends, or in unstable situation. Unstable situation means presence of a high number of issues. Registration of geospatial data and documenting all data models will ensure both transparency and consistency within the whole of government. Hence Figure 2 below shows four principles required to support the development of spatial industry which reflect the ‘whole-of-government’ approach; elements included in each principle are highlighted in Table 3. The report in Tasman (2008) highlighted the impact of modern geospatial data technologies on the Australian economy from the perspective of the whole-of-government.

In the geospatial data management, it is important to highlight benefits for each principles categorising from institutional, social, economic and technical aspects, where issues may differ from places. However, these principles may be implemented in phases based on priority. In formulating strategy for Bruneian geospatial data management, some obvious issues pertaining to the development of geospatial data were as follows:

- Siloed processes based on individual interests
- Opacity of available geospatial data
- Lack of whole-of-government approach to the use of geospatial data
- Absent geospatial data policy, metadata or clearinghouse
- Scarcity of geospatial data providers
- Disparate ration between desire to use vs, willingness to contribute to geospatial data
- Geocoded address database not yet available

Brunei seems to have a very loose structure supporting its geospatial data community. The first two principles, can strengthen the framework for the institutional arrangement. High level coordination will be able to direct the spatial community and formulate the national spatial strategy, whereas increasing participation will be able to broaden the current structure and increase needs and importance of geospatial data within the government. The last two principles can be achieved once the first two become stable and support their implementation (practice transparency and facilitate harmonisation).

The recommendations for Brunei government in preparing strategy for its national geospatial data management highlighting the four principles are as given in Table 4 and some benefits are summarised in Table 5. The proposal includes the current SDI Data flow in Figure 1 to be changed as in Figure 3. With the changes, some workload of the Department of Surveying in handling other geospatial data will be transferred to the new geospatial data centre. Figure 3 shows Departments such as ‘DEP1A’ and ‘DEP1B’, will submit their geospatial data to be shared through their Ministry gateway ‘Min 1’ to Geospatial Data Centre before published in EGNC database/server.

Table 4: Recommendation for Brunei Geospatial data management strategy

Principles	Recommendation	Reason
High level coordination	To establish top government agency within the Prime Minister Office as leading	The geospatial data centre will act as a national centre for managing development of geospatial data. Responsible in the whole of government

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	agency for geospatial data management with Survey department, the national mapping agency, as the main secretariat. The agency will be referred as 'geospatial data centre' in this paper.	<p>approach that includes</p> <ul style="list-style-type: none"> - Formulate strategy and create direction for geospatial data community - Identify roles and responsibility of created group members - Identify and access needs and priorities - Coordinate collaboration between government agencies - Identify benefits and risks by both data providers and data users - Identify provision required and access regular status for any spatial based projects - To support the other principles - To plan for capacity building
Create participation	Development of national geocoded address database	As a mechanism to promote more innovation using geospatial data.
Practice transparency	<p>To register existing, new and future geospatial data in one platform including metadata and clearinghouse</p> <p>To create data model for Brunei geospatial datasets</p>	<p>To reduce silos and duplications of data, system and process. More understanding on the geospatial dataset from other agencies</p> <p>The model will be able to show relationship between dataset through common attribute keys and others. This can be part of whole of government approach.</p>
Facilitate harmonisation	To prepare geospatial data policy and review other related policies such as the digital data pricing from various agencies	To ensure consistency of some elements when looking at whole of government approach. Interoperability and standards may need to be highlighted in policies. Another example is the location to share geospatial data need to be stated as in Singapore. Based on study by Abdul Hamid et al. (2016), the lot number has to be mandatory attribute in national address database, and it can harmonise common keys between datasets.

Table 5: Summary of benefits in implementing strategy for geospatial data management

Principles	Institutional	Social	Economy	Technical
High level coordination	Reduce own interest		Reduce cost	
Create participation	Connect institutions	Smart nation	Create more business	
Practice transparency	Awareness on individual's assets	Increase confidence	Reduce duplication	
Facilitate harmonisation	Share common guidelines	Reduce confusion	Reduce duplication	Easy integration

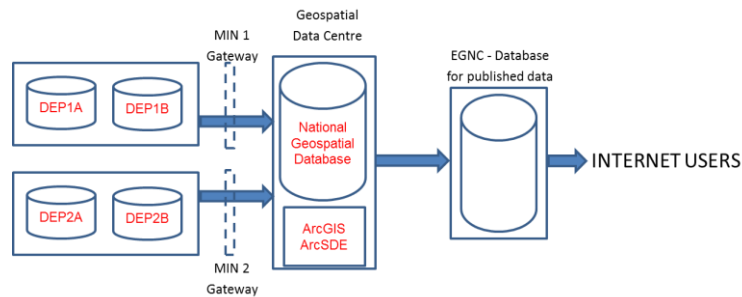


Figure 3: Proposal for New Brunei SDI Data Flow

It was observed that there was no specific trend in e-government implementation towards the development of spatial industry. However, e-government implementation has initiated involvement and linkage among government agencies through technology which can further expand in exploring and discovering geospatial data together as whole-of-government. From this study, the whole-of-government approach is required in formulating the strategy for national geospatial data management highlighting the four principles which can further lead the government to be “Modern and Smart Geospatial Government”. These findings to some extent validate the aforementioned hypothesis. The mentioned strategies in this study can be usable to countries with similar situation with Brunei that are in an infancy stage of SDI and e-government infrastructure.

9. CONCLUDING REMARKS

The use of technology in a government leads to e-government with intention to create a modern and smart government. On the other side, the spatial industry will not be developed without technology, and the spatial industry has contributed to a government in improving services and deliveries within and beyond the government agencies. The combination of using technology and geospatial data can create a “Modern and Smart Geospatial Government”. The geoportal is a clear example that illustrates the common strategy in a geospatial government which should be addressed as the whole-of-government approach in ensuring consistency and harmonisation between agencies in using geospatial data. The geospatial data have contributed to the government in managing natural and building resources, a other well as public resources. The national geospatial data are mainly held in government agencies.

In many cases, the e-government’s implementation is more matured when compared with the geospatial data development. In fact, the latter can be the extension to the former. Hence, a few principles from the e-government can be reused by the geospatial data community : High level coordination, Create participation, Practice transparency and Facilitated harmonisation. However, the level of importance for each principle may vary between places depending on the current national issues. As for Brunei, with greater issues on siloed interests and slow progress on some government projects, prioritization is mostly on high level coordination and creation of participation. These two principles can strengthen the existing institutional arrangement within the geospatial data community; (1) to have a specific agency from the top level in the government as the leader in monitoring development and management of geospatial data will be able to create respect and trust among the geospatial data community, (2) to have the geocoded address database as a mechanism to spatially reference information within the government will be able to promote

more participation from the government, private and public sectors for more innovations, creativities and businesses. Even though practicing transparency and facilitating harmonisation are considered as the least priority, they are also important in the long-term process. (3) Documenting and sharing all important details within government agencies that may have individual geospatial data including purposes, locations, custodianship, updates, and others; (4) on general overview of all geospatial data including data models that show relationships, common keys, and others. Further, with the distribution of geospatial data among government agencies in light of the need to share and integrate, some standards and consistent rules need to be formulated as national policies to be referred among all geospatial data communities. As a summary, the e-government implementation, to some extent, has a great impact on the formulation of geospatial data management strategy, although there is no specific trend showing this situation which varies depending on place.

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BIOGRAPHICAL NOTES

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