TOWARDS COOPERATIVE SDI IN SMALL ISLAND NATIONS: THE EXPERIENCE IN BERMUDA

David Atwood, Director
Department of E-Government, Government of Bermuda
P.O. Box HM 101, Hamilton, HM HX, Bermuda
datwood@gov.bm

Kevin Mayall, President
AG Research (Bermuda) Ltd
33 Second Avenue, Devonshire, HM 20, Bermuda
kmayall@agresearch.bm

Robert Ryerson, CMS, FASPRS, President
Kim Geomatics Corporation
Box 1125, Manotick, Ontario, K4M 1A9, Canada
bryerson@kimgeomatics.com

ABSTRACT

Small island nations face unique challenges when contemplating the development of a Spatial Data Infrastructure (SDI). First, they must deal with national issues - usually including a significant maritime responsibility. Second they must acquire data and work at the most basic local level as would a municipality in a larger country. Third, they generally lack expertise in one or more elements of the supporting technology as well as in data policy. Fourth, and further complicating the problem, they are usually operating with limited budgets - and there is no higher tier of government offering support or data.

At the same time, the local scale leads to small groups of participants which can be highly affected by socio-political dynamics. The island of Bermuda is a case in point and in this paper we discuss recent developments to secure Bermuda's geospatial assets in a strategic management and policy environment. We describe results of an approach to overcome the limitations of implementing an SDI in a small island nation. Our collaborative needs-based approach began with fact-finding through a questionnaire and interviews. This was followed by workshops that developed a common language and understanding. On this basis we identified strategic data assets and a better collective understanding of the environment in which they are managed.

Bermuda has made significant progress in developing its geospatial data infrastructure using its voluntary and collaborative approach. However, further growth requires policy additions and improvements to data accessibility.

Key Words: SDI, island, Bermuda

INTRODUCTION

Bermuda, like other small island states, has faced a series of interesting and unique challenges with respect to the use of geospatial information and the construction of a spatial data infrastructure. This paper documents these challenges and presents a case study showing how Bermuda has met these challenges. At the heart of the success was a collaborative approach to strategic planning that led to a "made-in-Bermuda" solution facilitated by an international consulting group. The lessons learned should be widely applicable to the many other small island states facing similar challenges in effectively using geospatial information in development, resource management and environmental monitoring.

SMALL NATIONS AND SDI

Small nations (often island nations) face some particular challenges for the implementation of geospatial data infrastructure. It must first be recognized that these nations face the national myriad of issues that geospatial data and technology needs to address. These issues can include housing provision, regulation of commercial

development, encouragement of economic development, protection and enhancement of natural resources, census management, public safety, border/coastal security, hazard assessment and management, marine resource management (e.g. mangroves, coral and fisheries), transportation infrastructure development, and utilities/telecommunications infrastructure. Even beyond their terrestrial borders, small island nations have further responsibility for monitoring, policing and managing extensive ocean resources.

Perhaps paradoxically, small nations must address and manage their national issues at a *local* level. Data must be collected to a local scale and efforts carried out on the ground. When a national agency is effectively a local agency, it must deal with not only legislation and policy matters, but also workforce supply, skills development, technology implementation, and successful project management. There is often no other tier of government to which such duties can be allocated. Furthermore, small nations must sometimes engage in burdensome legislative procedures in order to bring local geospatial policy solutions into effect.

In addition, in order to carry out changes in legislation, policy, operations and administration, such countries require human capital. However, in countries with a limited population base, the talent pool is frequently inadequate and existing human resources must fulfil multiple roles. In order to gain much needed skills in geospatial data management, overseas travel is required for training and professional development opportunities.

All of the above factors place a strain on financial budgets for geospatial work in small nations. Local government-sized budgets can be inappropriate for addressing national issues. Sometimes this is assisted with foreign aid, but such projects can leave the country's geospatial program in limbo if funding dries up or is redirected to other projects.

Finally, it should be noted that, in the geospatial data and technology management circles of small nations, the performance or direction of a group can be particularly sensitive to the influence of individuals. The socio-political forces in small group dynamics can play out on national issues influencing how and where geospatial resources develop within the country.

BERMUDA CASE STUDY

Bermuda, an island community of 65,000 people and 13,000 acres, enjoys a relatively high standard of living with an associated high cost of living. The economy is based on international business and tourism. According to a recent survey by the Department of E-Commerce (Government of Bermuda, 2008), 90% of Bermuda's households own a computer and 81% of households and over 90% of businesses make use of high-speed internet. Bermuda can be characterized, therefore, as a small island nation with relatively high degrees of affluence and information technology penetration.

The Government of Bermuda approached GIS first in 1990 during a strategic planning exercise coordinated by the Computer Services Department, the exercise identified key strategic areas where development and coordination of technology should occur, one of these was Land and Property. As a result of this initiative a group of interested individuals from various departments formed a committee to pursue GIS development. This began a four-year period of pilot testing by these individuals followed by another four-year period pursuing the official development of Bermuda's first comprehensive digital base mapping. From 1998, certain motivated departments (Planning, Surveys, and Environmental Health) adopted the new GIS data and built central business applications around them. Further development involved applications in other departments and expansion of specialized GIS data layers by departments. A research-based review of this history is provided in Atwood and Mayall (2005).

The Government's GIS Committee (its most recent name) first served as a catalyst and a think-tank to break ground on initial GIS development. During development of the first digital map data set, led by the Surveys Section, the GIS Committee members from other departments aided the quality testing of GIS data as it emerged. Later, the Committee continued to develop as a sharing and coordinating body, including the sharing of member experiences in developing GIS-enabled business applications, interest in particular data sets that were not yet developed, expert advice on using GIS for specific applications, and introductory advice for departments wishing to adopt GIS technology. While the Committee has been chaired and funded by a central services department (first the IT Office, later the E-Government Department), it has been a coordinating rather than a controlling body. This grass roots approach was emergent in the beginnings of the Committee and has continued as a persistent thread in the years since (Atwood and Mayall, 2005).

The grass roots approach has resulted in some benefits over a centralized office. Individual departments have developed in-house GIS expertise that, with guidance from other Committee members or a local consultant, has resulted in the incorporation of geospatial technology neatly into their business activities. Departments have also been able to set up their own data sets that reflect their line of business, while still utilizing the topographic map data

and orthophotography provided by the Surveys Section. The strengthening of several departments in geospatial technology, as opposed to having just one centre of geospatial expertise, has meant that business risk has been spread across the Government enterprise and geospatial technology development as a whole is less likely to fail. It has also meant that a single department is not as severely overwhelmed with routine requests for GIS-derived map products. This decentralization of effort also led to the formation of a local GIS consultancy by a former civil servant and therefore the initiation of a nascent local geospatial industry.

The Committee has also successfully served a role in avoiding duplication of effort. There are very few examples of duplication of geospatial data collected by disparate agencies. Similarly, the core addressing data has been adopted by several agencies as a master reference, rather than maintaining their own address lists. Of course, while diverse groups are subject to power struggles, Bermuda has managed for the most part to avoid this, due in part to the leadership and funding from a central service department, which is not a GIS provider per se. This has provided a "third party" oversight of common funding and resources for the overall good of the group.

However, in recent years, it has been believed that this operating model was not fully providing for GIS development in the Bermuda Government. As departments proceeded busily with their geospatial projects, the Committee had reduced itself to a information sharing role and such departments were not able to contribute to strengthening the core GIS resources. Consequently, the increased activity at the department level led to a lack of momentum at the centre, which has led to reduced security of funding and staff resources for base imagery and mapping. Also, accessibility of data outside the Government has been low, partially due to a lack of clarity on packaging of data, licensing and pricing terms for the Government's existing geospatial data. This has primarily focused on the standard topographic map and orthophotography data sets, but neither have other departments released their data under terms, other than through their own web interfaces.

The emerging neglect to the centre of GIS development and resources was identified by the GIS Committee as an indication of the need for a more formal spatial data infrastructure (SDI) around which resources and senior level support could be rallied. The addition of this infrastructure would allow the Government to protect, maintain and grow its geospatial resources. While Bermuda utilizes a British-style legislative system, the Committee did not want to necessarily adopt a highly centralized GIS data infrastructure. Seeking input from a wider perspective, the Committee initiated a request for proposals to internationally qualified consultants in order to re-examine its data, policy and administrative infrastructure around geospatial management. This resulted in the introduction of Kim Geomatics of Canada to the Bermuda geospatial community.

A COLLABORATIVE NEEDS-BASED APPROACH TO SDI

The Approach
The consulting team and those involved in Bermuda worked on the basis that a unique Bermuda-focused approach to an SDI's development would result in the best possible outcome for the Island and its people. We would not attempt to apply a "recipe." This implied developing an approach that fit Bermuda – not an approach into which Bermuda had to be fit. This important distinction allowed the development of an approach that will, in the end, cost less, and be better suited to the needs of Bermuda, and can serve as a model for other small island states.

We therefore used what can be described as a collaborative needs-based approach to the development of the Spatial Data Infrastructure strategy for Bermuda. In short, working with the local players the consulting team determined the needs of Bermuda, and then the stakeholders in Bermuda carried out a strategic planning exercise facilitated by the consulting team. The approach used has evolved over the past two decades through the completion of a number of previous studies (Ryerson and Peanvijarnpong, 2007; Ryerson and Quiroga, 2000; and He et al, 1991). The work involved pre-visit fact finding, administration of a questionnaire, assembly of supporting materials, a Strengths, Weaknesses, Opportunities and Threats (SWOT) Analysis, on-site interviews, a strategic planning workshop, and finally a report that brings together the findings.

Pre-visit Activity
The study began with a multifaceted pre-visit fact-finding activity that included the study of published materials on Bermuda and geospatial, assessment of recent major policy statements from the Government of Bermuda (including Speeches from the Throne), web searches for relevant comparative material, and assessment of materials on the organizations involved including key issues driving them, and the core values of the various organizations involved. Another aspect addressed in the on-line questionnaire as well as in the interviews conducted on site was the identification of strategic data assets and data layers.

This material assembled before visiting Bermuda was then used to frame a detailed questionnaire which was administered using an on-line survey tool. All of this was then brought together to begin to build an idea of what would constitute basic and required information (framework data) to meet Bermuda's needs, begin a SWOT analysis, and inform the site visit to make the most of the limited time "on the ground." An important component of the pre-visit work was the development of an understanding of the data management environment which in turn allowed the technical members of the consulting team to begin to provide an analysis of the technical limits of an SDI in Bermuda. This information played an important role in the eventual strategic plan.

On-Site Meetings and Interviews

The next phase consisted of "on-site" meetings with the Bermuda stakeholders, final specification of the clarification questions that remained to be answered, development of the questions for the interviews to be administered on site, and conduct of the interviews. The team carried out a total of 15 interviews and two meetings involving 27 people. This included one Minister, four Permanent Secretaries (the highest rank of Public Servants in Bermuda), a number of department heads, and most of the senior technical people involved in geospatial information in Bermuda. Many of these were with individuals or groups of individuals who had previously completed the on-line questionnaire referenced above.

As the interviews were conducted additional material was sought – and some was found in a serendipitous fashion. For example a mission statement on the role of the public service found on the wall of one Government department played heavily in the development of the wording of the vision – leading to something that was both familiar and accepted. As another example, a department that had not completed the on-line questionnaire was involved in the interview process and saw the link between some of their major problems in offering better service to the public and an SDI: they became a major supporter.

Strategic Planning Workshop: Vision and Mission Statements

The next stage was the workshop where one of the foci was to develop a common language and understanding of what was needed and what an SDI might do for Bermuda. At the workshop the core values that provided some of the context for the strategy were modified and accepted, and the strategic drivers that had been developed were refined and accepted.

Table 1. Core Values

People and Their Work Environment – 3 main Core Values	**Valued Activities** – 4 main Valued Activities
1. **Positive Working Relationships** • Trust • Integrity • Professionalism • Confidence • Accuracy • Others could include: Accountability, Respect, Recognition, …… 2. **Innovation** • Find opportunities to perform innovative solutions and new methods 3. **Collaboration** • With other government departments, industry, GI users, and stakeholders • Find win-win relationships	1. **Conservation of Bermuda's natural resources and heritage** • Sustainable use of natural resources • Preserve and restore threatened species and habitats • Encourage community responsibilities for home gardens, farming, fishing, diving, horticulture 2. **Proactive education** • Deliver educational materials and exhibits to promote appreciation and care of Bermuda's natural heritage • Encourage community engagement 3. **Delivery of High Quality Services and Infrastructure Management** • Monitor infrastructure and housing stock • Produce high quality data sets and high customer service ethos • Provide both Public and Private sector deliverables – public service • Pay the bills 4. **Promote Safety and Security** • Keep Bermuda safe

Table 2. Strategic Drivers

1. **Focus on Effective Capture of and Access to Geographic and Geospatial Data to Support Decision Making in Bermuda** - The spatial data base; - Access; - Availability; - Policy and Standards; - Infrastructure; and - Management and support. 2. **Build a Sustainable, Relevant and Responsive Organization** - Facilities and Capabilities; - Skills and Resources; - Institutional framework; and - Policies, Procedures and Guidelines.	3. **Promote Collaboration between Government Departments and with Industry** - Sharing technology and resources; - Harnessing industry partners to create value; and - Extend to NGOs, public, supplies, other countries. 4. **Increase Education and Awareness Related to Geospatial Data and its Value** - Government, user, other agencies and civil servant awareness; - Youth awareness; - Educational interfaces; - Promotional events; - Use of the web; and - Community awareness.

The SWOT analysis was presented and discussed. For each strategic driver identified, participants identified the "current state" - what it looks like now, as well as the future state. The future state of each of these drivers gave participants enough information about how they saw the future of SDI in Bermuda and this allowed them to derive Vision Statements from breakout sessions. Participants then determined what needs to be done in a broad sense to get from the Current State to the Future State. For each the local participants identified strategies for how to achieve the Vision. (Things to do.); identified business environmental factors that would help or hinder implementation of the strategic vision, and defined measurable success criteria – key performance indicators.

The vision statement arrived at was: The Bermuda Government will be, and will be recognized as, a world class provider and user of geographic information and services. With our collaborative, accessible and reliable spatial data infrastructure, we will enhance efficiency and promote integrated decision making to positively impact Bermuda's society, environment and economy.

The draft mission statement of the GIS Committee of Bermuda was: The GIS Committee is a government driven partnership that encourages the development and use of quality geospatial information resources, coordinates GIS activities to reduce duplication of effort, and provides GIS advice and implementation assistance, for the benefit of the Government & Bermudian public.

The future vision for GI in Bermuda has been based on: what is going well now and should be continued (current); what the organization wants to do in the future (desired); from information gathered during the interviews, questionnaire responses; the core organizational values; and the SWOT analysis. The vision for GI in Bermuda is described in the following strategy framework:

1. Plan the Evolution for GI Capabilities – Defining a New Approach for how to do Business.
2. Build a National Geo Data Base Available to Everyone.
3. Expand and Institutionalize Mandated Activities of the GIS Committee.

The Future View

The future view of geospatial in Bermuda including the national geo data base, or portal to Bermuda's geo information, has been shaped by information from the interviews, questionnaire responses, and the strategic planning workshop. It was from these inputs that a master data base and geospatial portal to allow tiered access for different user communities was proposed. It is portrayed below in Figure 1.

Figure 1 shows the data that could be accessible through a portal. The concept of the "web portal" here is as the entry point to access geospatial data, both framework and non-framework data. Multiple user groups will access this "web portal" and have different access, rights, and privileges. One option would be for the Broker level to maintain only the metadata and provide pointers to the information resident in each ministry. This assumes that each Ministry can maintain and present their data in a suitable form. This may not be possible since it may not be cost effective for a small government to maintain server technologies in each department. Another option would be for the Ministry

or Departmental staff to upload to the Broker all data which would then be maintained in accessible formats - the Broker would only manage the format of the information that it was sent. In either situation each Ministry or Department would be responsible for the accuracy and currency of their information, while the broker would provide the "geo" expertise. One of the recommended next steps would be to establish what form the organization of the spatial data infrastructure would take. This is now under discussion as is one of the key drivers - the business analysis done by a system architect and subsidiary architects for data, infrastructure, and security. Such a discussion is beyond the scope of this paper.

From a combination of the results of the questionnaire, interviews, and the Strategic Planning Workshop an organizational concept for geo-information for Bermuda emerged and is captured in the following figure.
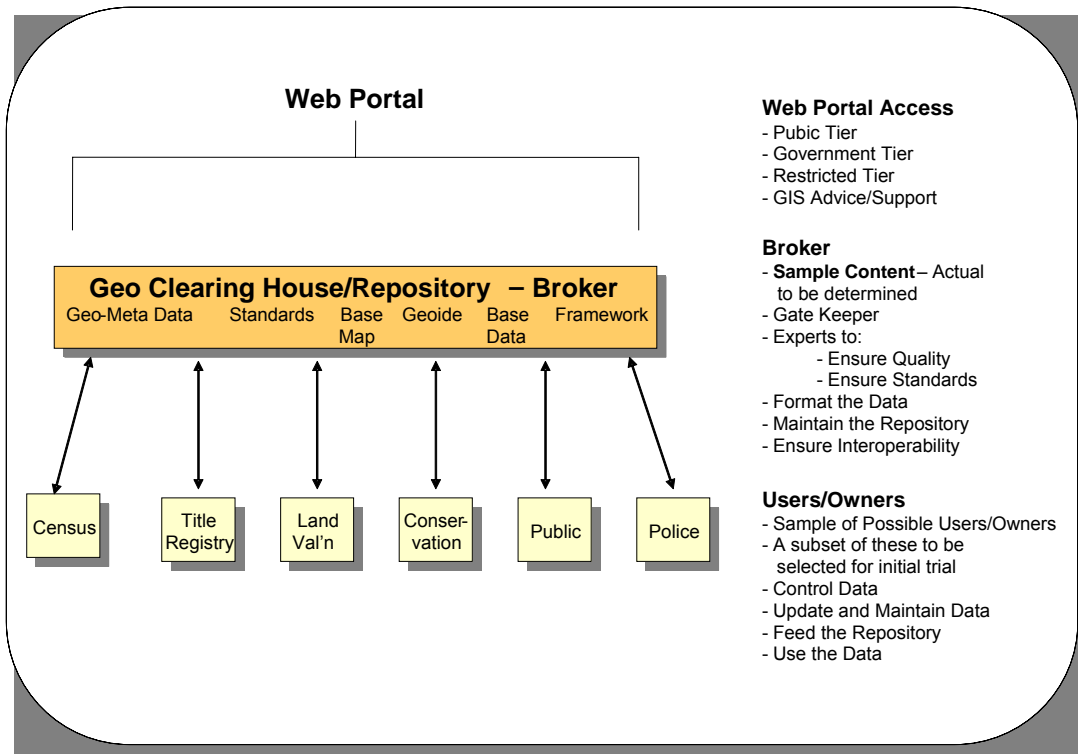

Figure 1. Central Portal Concept.

While the portal concept is one future-looking outcome of the consultancy, far more benefits have resulted. The interviews and workshops identified strategic issues that must be resolved for the Committee to move forward (e.g. address management, identification of framework data, and the need for a marine SDI special interest group, etc.). The interviews also stimulated interest in geospatial technology among affected but unengaged departments – such departments galvanized with the already enabled group in the workshops and have since rallied around geospatial technology as a cause. Lastly, the exercise provided the Committee with a focus around which to pursue the securing of core geospatial data with funding and policy. These outcomes have helped provide some direction for future efforts and have now gained support from the Cabinet.

MOVING AHEAD

Bermuda's GIS Committee has spent several years focused on producing geospatial data and technology that works and that gets applied to specific departmental lines of business. It does not appear that momentum in that area will wane or be threatened. Going forward, the Committee is now focused on a vision that it can rally around and build a consistent and targeted message on the value and utility of geospatial data. In order to secure funding and resources for the core geospatial data on which many applications depend, that message is now being carried upwards in the Government hierarchy, particularly to Cabinet. At the same time, in order to broaden the base of

applications and the community and to recruit further interested civil service employees to the geospatial cause, the message is being carried out to the peripheral departments that have good GIS potential but are not yet geospatially enabled.

While members get the message out, particular key strategic issues are also being investigated. These include a process review of address management, further workshops to decide on data policy licensing and pricing options, and reviewing technical infrastructure to underpin a geo-portal and increase data accessibility. In addition, the planning of a new aerial survey of the island is underway and a broad spectrum of stakeholders has been included.

CONCLUSION

Small island states face unique and in some cases daunting challenges when it comes to effectively using geospatial information and technology for development, environmental monitoring, and resource management. We have demonstrated an approach to facing these challenges that can be used in other small island states as well as in smaller countries. The approach, which focuses on a clear analysis of the needs and requirements of the government and citizens, should be applicable elsewhere in jurisdictions ranging from the most sophisticated to those just beginning to understand and use geospatial information.

ACKNOWLEDGMENTS

REFERENCES

Atwood, D. and K. Mayall, 2005. A grass-roots approach to GIS development in Bermuda, *ESRI 2005 International User Conference Proceedings*, San Diego, California.

Government of Bermuda, Department of E-Commerce, 2008. The State of Information Communication Technology in Bermuda 2008, www.gov.bm

He, C.C., R.A. Ryerson and B.N. Haack. 1991. The Regional Remote Sensing Program in Asia and the Pacific: Technology Transfer that Works, *American Society for Photogrammetry and Remote Sensing Annual Meeting*, Baltimore, MD.

Ryerson, RA. and C. Peanvijarnpong, 2007. Comparative Analysis of Thailand's Successful National Program in Remote Sensing: Government Policy, Applied Research, Commercialization, and Operationalization, Opening Plenary Session Paper *Asian Conference on Remote Sensing*. Kuala Lumpur, Malaysia.

Ryerson, R.A. and E. Quiroga, 2000. Taking Remote Sensing from Development Projects to Operational Use: Some Common Attributes of Successful Projects. Session Keynote Paper *Geo Asia Pacific Conference*, Bangkok, Thailand, October 2000, also presented at the *23rd. Canadian Symposium on Remote Sensing*, St. Foy, Quebec, August 2001, 58.