

Making the SDI concept relevant to Asia-Pacific countries – the PCGIAP experience

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SUMMARY

Development of regional spatial data infrastructures (SDI) is one of the distinctive features of the last decade. This is mainly due to the need for seamless consistent spatial data beyond national boundaries to support decision-making at a multi-national level. The development of these regional initiatives began with the creation of regional SDI coordination groups such as the Permanent Committee for GIS Infrastructure for Asia and the Pacific (PCGIAP), formed in 1995 under the auspices of the United Nations Regional Cartographic Conference for Asia and the Pacific (UNRCC-AP).

The aims of the PCGIAP are to maximise the economic, social and environmental benefits of geographic information in accordance with Agenda 21 by providing a forum for nations from the Asia and Pacific region (the largest region in the world) to:

- Share experiences and cooperate in the development of a regional SDI;
- Contribute to the development of the global SDI; and,
- Participate in any other form of activity such as education, training, and technology transfer at different jurisdictional levels.

Over the past ten years, the PCGIAP has confronted a number of issues associated with building a regional SDI. The group has also assisted member nations in their national SDI initiatives.

This paper describes some of the experiences of the PCGIAP, in particular:

- The establishment of a new geodetic datum for the region;
- The benchmarking of cadastral systems;
- The conceptualization of a framework for marine zone administration in the future; and,
- The strategic issues confronting the PCGIAP at the start of its 2nd decade of operation.

The paper is based on a similar presentation at the FIG Working Week 2005 and GSDI-8 Conference, Cairo, Egypt April 16-21, 2005.

1. Introduction

The PCGIAP was established by resolution of the UNRCC-AP at its meeting in Beijing, China in 1994. It met for the first time in 1995.

The aims of the PCGIAP are to maximise the economic, social and environmental benefits of geographic information in accordance with Agenda 21 by providing a forum for nations from Asia and the Pacific to:

- Cooperate in the development of a regional geographic information infrastructure;
- Contribute to the development of the global geographic information infrastructure; and,
- Share experiences and consult on matters of common interest; and participate in any other form of activity such as education, training, and technology transfer. (PCGIAP, 1994)

Members of the PCGIAP are directorates of national survey and mapping organizations, or equivalent national agencies, of the 55 members and associate members of the United Nations Economic and Social Commission for Asia and the Pacific. The committee meets annually and reports every three years to the UNRCC-AP. An executive board comprising president, vice-president, secretary, and up to 9 other members, administers the PCGIAP. Committee business is performed through four working groups – regional geodesy (WG1), regional fundamental data (WG2), cadastre (WG3) and institutional strengthening (WG4).

The concept of a SDI of the Asia and Pacific region (the APSDI) was developed early by the PCGIAP (PCGIAP, 1998). Most of the activity of the PCGIAP and its working groups at present is directed towards developing and implementing the components of the APSDI. For example, WG2 of the PCGIAP has developed a policy for sharing fundamental data (PCGIAP, 2000). The policy applies to:

- Specific fundamental spatial data;
- The collection, management and use of fundamental spatial data in the regional interest, whether its application is at national, regional or international levels; and,
- The use of fundamental spatial data by governments, industry and the community.

WG2 has also developed specifications for an administrative boundary dataset of the region and is currently implementing a spatial data clearinghouse for Asia and the Pacific. WG4, for example, has facilitated a number of SDI-related training courses in the region.

The PCGIAP maintains a comprehensive internet site (<http://www.pcgiap.org>) that contains information on the:

- Statutes of the committee;
- Composition of the executive board;
- Names and contact details of members;
- Activities of each working group;
- Reports and resolutions of each meeting;
- Technical papers and publications; and,
- Resolutions of each UNRCC-AP since 1991.

2. Regional Geodesy Working Group

A fundamental requirement of a regional SDI is a common underpinning geodetic layer. To establish this underpinning geodetic layer as a common link to the various local datums in use in member countries, a regional geodesy working group was formed. The primary objective of the working group has been to facilitate cooperation in geodesy amongst national agencies in order to build a common geodetic framework across the region.

The inaugural business meeting of the working group was held in Sydney, Australia in 1996 and the initial goal was to establish a single regional horizontal geodetic datum and provide linkages for individual country datums to this regional datum. With this in mind a number of geodetic observation campaigns were arranged to connect local geodetic networks to the global datum in the International Terrestrial Reference Frame (ITRF). This was subsequently adopted by PCGIAP as the preferred regional datum to connect the national SDI's.

The first PCGIAP regional geodetic campaign was undertaken in October 1997. It included very long baseline interferometry, satellite laser ranging and global positioning system (GPS) geodetic techniques. There have now been eight regional campaigns undertaken, one each year, since 1997. The aim of the recent campaigns has been to build a primary network of sites with known location and movement velocities. In addition to the permanent GPS sites (which supply continuous GPS data to the International GPS Service - IGS) countries who have supplied GPS campaign observation data

include Australia, Bahrain, Brunei, Cambodia, Cook Islands, Fiji, Hong Kong (China), Japan, Kiribati, Indonesia, India, Indonesia, Iran, Laos, Macau (China), Malaysia, Republic of Maldives, Mongolia, New Caledonia, New Zealand, Papua New Guinea, Philippines, Samoa, South Korea, Tonga, Thailand, Tuvalu, Vanuatu and Vietnam, and some other Pacific island sites.

The success of the regional geodetic field campaigns and the technology transfer to many nations has been evidenced by their ability to process and analyse regional geodetic networks at a high levels of accuracy. To maintain group contact and to present the results from the annual geodetic observation campaigns, eight face-to-face meetings or regional workshops have been held since 1996. Regional solutions using these data have been processed by Australia, Japan, Malaysia, and China and a combined solution is available from Geoscience Australia which has combined GPS data from the campaigns. This includes a data set of 437 points and site movement velocities for all points with multi occupations. Solutions from these campaigns provide primary ITRF 2000 values.

Australia has also processed and submitted regional GPS vertical solutions to the global sea level project (TIGA) of the IGS to monitor the vertical motion of land at GPS base stations collocated with tide gauges. All data and solutions are available from Geoscience Australia.

With the establishment of a regional geodetic reference infrastructure, guidelines for preparation of transformation parameters have been posted on the PCGIAP web site. These will assist countries to readjust their geodetic network directly into the regional datum or to develop transformation parameters to facilitate the shift of dependent spatial data onto a regional datum.

Other immediate activities include a collaborative project between China and Japan to establish a network of primary FG5 gravity reference sites through the region. Several sites in Australia, Malaysia and Indonesia have been occupied as well as joint observations in China (Tibet) and Japan. The regional geodetic framework continues to be developed through integration of national geodetic networks and through appropriate linkages to global reference frames.

A current project work plan is operational with identified responsibilities and milestones for the period 2003 –2006. Now that the basic regional geodetic framework is well in hand, the time has come for the regional geodesy working group to expand its geodetic referencing into the activities of the other PCGIAP working groups to enhance the building of an integrated spatial data infrastructure on a common geodetic base. Geo-referencing connections need to be carried from the regional geodetic framework to the cadastral frameworks, to the statistical (census) information and a greater emphasis placed on participation in institutional strengthening.

The recent tsunami disaster places greater emphasis on the wider identification of hazards across the region whilst the provision of material from the regional SDI for regional disaster management across national borders takes on a role of urgency. The impact of tectonic plate collisions, such as on the land earthquake at Bam in Iran on 26th December 2003, and in the sea off Indonesia on 26th December 2004, needs to be more closely monitored using geodetic and geophysical networks and better linked to emergency infrastructures.

A primary achievement of the regional geodesy working group has been to adopt the global ITRF as the regional horizontal and vertical datum reference frame. It has provided high accuracy global values for points on individual country geodetic networks through campaign densification of this network. Status information of individual geodetic datums is posted on the PCGIAP web site .

An increased involvement of West Asian nations and Pacific Island nations still needs to be addressed and better interaction with Russia needs to be developed to facilitate a wider geodetic layer underpinning the Asia Pacific regional Spatial Data Infrastructure. Initial activity on absolute gravity

ties between countries is beginning to show progress but more work on the development of a gravimetric geoid for the region is required, using new global gravity models from the new wave of gravity satellites.

The next regional geodesy workshop will be held in Cairns, Australia in August 2005 immediately before the International Association of Geodesy (IAG) General Assembly. The workshop will be held in conjunction with the IAG sub-commission on the Asia-Pacific reference frame and the IAG Southeast Asia regional sub commission of the geoid chaired by Australia.

3. Cadastre Working Group

PCGIAP WG3 was established in 2000 based on a resolution from the 15th UNRCC-AP held in Kuala Lumpur, Malaysia. Through that resolution, it has been recommended that the United Nations, within available resources, and in cooperation with the working group on the cadastre under the PCGIAP, and with the expert assistance of relevant organisations such as the International Federation of Surveyors and the International Hydrographic Office, undertake work into and facilitate discussion on:

- Development of the Asia-Pacific Spatial Data Infrastructure;
- Development of regional marine cadastral infrastructure;
- Realisation of economic, social and environmental benefits for the region; and
- The implementation of the United Nations Conference on Environment and Development (UNCED) Agenda 21; and that

WG3 also has an objective to explore the relationship between the operations of the cadastre or land administration system in each member country and the development of their spatial data infrastructures at local, state and national levels.

The major activities of WG3 over the past 3 years include:

- Development of a cadastral template;
- Development of a marine administration template;
- Running an international SDI short course; and
- Hosting two international workshops on the cadastre and marine administration.

3.1 Working Group Activities

3.1.1 Cadastral Template Project

One of the aims of WG3 is to facilitate profile analyses of countries within the Asia-Pacific region describing the status of their cadastre and land administration systems and the need for improvements, which will facilitate benchmarking and the development of performance indicators. In order to achieve this, a cadastral template has been developed. The cadastral template is a standardised generic template that enables review of cadastral activities in the region through the discovery of information, including matters concerned with member countries' land policy, laws and regulations, land tenure, land administration and cadastre, institutional arrangements, spatial data infrastructures, technology as well as human resources and capacity building.

The cadastral template project has received a United Nations mandate through resolution 4 of the 16th UNRCC-AP held in Okinawa, Japan in July 2003. This is an important step for the project in order to improve the efficiency and effectiveness of cadastral systems worldwide including a focus on the role of cadastral systems in national spatial data infrastructures. In simple terms the cadastral template provides a standard format to collect both descriptive and statistical data of the cadastral system of a specific country. This is a world first and an important strategic initiative in the Asia-Pacific region. The

importance of successfully implementing the cadastral template initiative under a United Nations mandate cannot be over emphasised. The WG3 research team are now analysing the results of the cadastral template project and are considering the publication of a booklet.

Data from the cadastral template is available at a dedicated website (www.cadastraltemplate.org), coordinated through the Centre for SDIs and Land Administration, Department of Geomatics, The University of Melbourne, Australia. Currently 36 country reports on cadastral systems have been placed in this website.

3.1.2 SDI and Cadastral Issues in Administering the Spatial Dimensions of the Marine Environment

The second component of the WG3 three year workplan is to support research into the spatial dimensions of administering the marine environment in the Asia-Pacific region. There has been a recent push by some countries to include the marine environment within the sphere of a nation's SDI and it is important to understand the factors driving the development of such SDI's in the marine environment. The current systems in place to manage marine boundaries and rights need to be assessed, in order to identify technical, legal and institutional issues and arrangements that are hindering the coordination and effective management of the marine environment. International perspectives also need to be considered, if the ability to create a marine SDI concept that crosses jurisdictional boundaries is to be successful.

There is also a need to understand the spatial dimensions of the marine environment across the Asia and the Pacific region. Common problems, issues, similarities and differences in SDI, institutional arrangements and in the administration of rights, restrictions and responsibilities need to be documented, in order for best practice to be established. There are also technology and human resources and capacity building issues effecting the establishment of a marine SDI which need to be taken into consideration. Perhaps the most important in creating an effective marine SDI is investigating and solving institutional and cultural issues which often hinder SDI development long after the technical problems have been solved, as seen in the terrestrial environment. With this in mind and based on PCGIAP WG3 workplan and the strategy, WG3 organised a very successful four-day workshop in May 2004 on Administering the Marine Environment – The Spatial Dimensions in Kuala Lumpur, Malaysia which was supported and hosted by the Department of Survey and Mapping Malaysia. The objective of the workshop was to better understand the spatial dimensions of administering marine environment in the Asia and the Pacific region and particularly to facilitate:

- An understanding of the needs of an SDI in the marine context;
- Better understanding and appreciation of the administration of marine rights, restrictions and responsibilities; and
- The documentation of issues in establishing a marine dimension as a key component of national SDIs.

The Workshop reviewed national administration of marine environments of countries in the Asia and Pacific region based on a common template to identify problems, issues, similarities and differences in spatial data infrastructures; institutional arrangements; the administration of rights, restrictions and responsibilities; technology and human resource and capacity building in the marine environment. 102 people from 11 countries attended the workshop.

3.1.3 International SDI Short Course - Melbourne

In order to improve capacity building for SDI an international SDI short course was run by WG3, supported by resolution 5 of the 16th UNRCC-AP. The SDI concept continues to evolve as it becomes core infrastructure supporting economic development, environmental management and social stability

in developed and developing countries alike. Due to its dynamic and complex nature it is still a fuzzy concept to many, with practitioners, researchers and governments adopting different perspectives, depending on their needs and circumstances.

The course introduced the concepts, organizational models and progress made on SDI developments and the cross-jurisdictional relationships of these developments, for those participating in and managing SDI implementation. The focus of the course was on problem-solving to increase management capacity for the spatial industry in the context of SDI development. Although directed at spatial scientists, technologists, professionals, managers, policy makers, students and researchers, the course had broader applications for other disciplines as the concept of SDI continues to adapt in response to user needs.

3.2 WG3 Future Plan -Integration of Built (cadastral) and Natural (topographic) Environmental Datasets within National SDI Initiatives

One of the projects that WG3 has aimed and proposed to work on next three years is the relationship between cadastres and SDI's and particularly the relationship and integration of cadastral and topographic datasets.

Amongst spatial data, cadastral and topographic datasets are the most important for describing the built and natural environment. These datasets are the 'foundation data' in modern market economies. In all countries, the two foundation datasets were developed to serve different purposes and are usually managed separately. This separation is recognised as a barrier to implementation of sustainable development. Duplication imposes unjustifiable costs on data collection and maintenance. The datasets should adopt the same overarching philosophy and data model to achieve multi-purpose data integration, both vertically and horizontally.

Merging of these datasets at a local level has been achieved to some degree, however, attempts to integrate the datasets at a national level, even where SDI's are well developed, has been difficult and problematic internationally.

National SDI initiatives for better coordination cannot overcome the institutional or data incompatibility barriers despite needs to maximise benefits from investment in data collection and to better inform land management decisions. Technological opportunities for data sharing alone cannot facilitate holistic comprehension of land as a composite of its built and natural components.

Therefore, the aim of WG3 through this project is to better understand and describe the technical, jurisdictional, institutional, legal and land policy perspective surrounding the two foundation datasets (cadastral and topographic) in a national SDI. The project will investigate the justification for integrating these two forms of spatial data in support of sustainable development (figure 1) and develop a model and framework capable of being used in diverse jurisdictions.

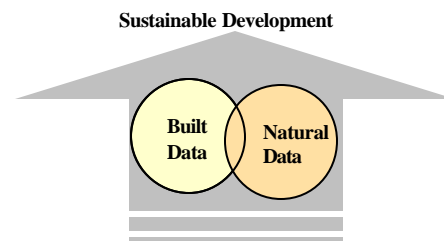


Figure 1: Integration of datasets to facilitate sustainable development

4. Strategic issues

The PCGIAP has faced many challenges during its short life. It has attempted to confront the more strategic of these challenges by reviewing its role and operation of two occasions. Several of these strategic issues are described below.

The PCGIAP was created by the United Nations. It reports to the United Nations. It therefore needs to continue to be relevant to the United Nations, as represented by those who participate in triennial meetings of the UNRCC-AP, and those who are responsible for administering the UNRCC-AP in the United Nations. Insofar as participants at UNRCC-AP are concerned, these parties are mainly members of PCGIAP itself. Therefore providing PCGIAP is relevant to its members it is likely to be relevant to participants at the UNRCC-AP. Relevance to the administrators of the UNRCC-AP is more problematic. There is an emerging sense within the PCGIAP that these administrators, bound by the protocols of United Nations operations, have difficulty accommodating PCGIAP requirements within the prescribed structure of a United Nations conference. The formal link between the PCGIAP and the United Nations is crucial. It provides the much of the justification for member countries to participate in activities of the PCGIAP. It is therefore a high priority for the PCGIAP to ensure proper alignment with the expectations of the United Nations.

The aims of the PCGIAP are still considered valid by its stakeholders. Generally speaking, the PCGIAP has been successful in addressing these aims. However, the needs of users of spatial information in the Asia-Pacific region are very dynamic. The recent human catastrophe caused by the tsunami that struck Indian Ocean countries on 26 December 2004, and the urgent need for relief and reconstruction support is an example. Spatial information and services to support disaster management and natural hazard research are likely to be a much higher priority for the PCGIAP in the future. The stakeholder environment is also reasonably dynamic. The PCGIAP needs to ensure that its activities complement, and do not duplicate, the efforts of similar groups.

A corollary of the previous point is that the activities of the PCGIAP must continue to address its aims, in essence the creation of the APSDI. Outputs must also be achievable in the context of the capacity of PCGIAP. Over the years there has been robust debate in the PCGIAP about whether or not a particular activity is relevant to the aim of the body. Experience has shown that there is a risk in being too narrow or prescriptive about what is meant by the APSDI. If a narrow interpretation is adopted then some participants may lose interest or the outputs may not have wide relevance. The different operating processes in the regional geodetic network and cadastre working groups, for example, both very effective, demonstrate there is room for flexibility in deciding what is a relevant APSDI activity. The more useful the PCGIAP activity is to national SDI activity the more chance there is it will be viewed positively and supported by participants. In regard to the latter point there is a definite international trend now towards the concept of interoperability in SDI implementation. There is also a trend in some countries to put more effort into trying to solve some of the problems of key groups of users. These realities are likely to impact on the work program of the PCGIAP in the future.

Working groups are the engine-room of the PCGIAP. Significant outputs have been generated by all working groups. Yet the PCGIAP continues to have difficulty in effectively mobilizing these groups, particularly in maintaining enthusiasm and activity levels. Much of the reason for this problem lies in the voluntary nature of working group efforts. The solution lies in part in ensuring working group activities are relevant, not just to the PCGIAP, but also to member organisations. Additionally, working groups need to leverage off the efforts of others, particularly other working groups in the PCGIAP.

On a similar note, the PCGIAP has difficulty attracting all of its 55 members to annual meetings. If the PCGIAP is to be able to claim credibility as a body truly representative of the region then the majority of the countries in the region must be involved in its activities. Much of the difficulty arises because of the sheer size of the Asia-Pacific region and the limited funds available for people to travel to meetings. Some of the difficulty can be attributed to the lack of a comprehensive and current database of key agencies in the region. The PCGIAP has endeavored to address this problem by

holding its meetings in different locations each year, by obtaining funding support for a small number of people to travel to meetings, and by recognizing sub-regional groups (for example, a Pacific-Island group of countries, and a Commonwealth of Independent States group of countries). However, the issue of member participations needs continual attention.

5. Conclusion

The mission of the PCGIAP is to establish a SDI across the Asia-Pacific region. This cannot be fully achieved without the active involvement and support of the countries in the region. The PCGIAP has found that it is most effective when its activities not only address its own mission, but also address the problems faced by the individual countries in the region. The establishment of a regional geodetic network, the benchmarking of cadastral systems, and the discussions on administration of the marine zone, are examples of activities that benefit individual countries and the region as a whole.

The tragedy of the tsunami event that struck Indian Ocean countries on 26 December 2004, and the crucial need for support in re-building infrastructure (particularly spatial data infrastructure) in affected countries, is likely to have an enduring influence on the role of the PCGIAP in the future. Experience has shown that there will always be events, some large and some small, that span national boundaries somewhere in the Asia-Pacific region, and which generate calls for assistance from regional bodies like the PCGIAP. The challenge for the PCGIAP is to respond in ways that are relevant to the needs of member countries.

The recognition of the United Nations is vital to the ongoing success of the PCGIAP and its ability to operate effectively. Countries by and large are much better able to contribute to PCGIAP activities in the knowledge that their contributions fall under a United Nations umbrella. An ongoing challenge for the PCGIAP is to maintain United Nations recognition.

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Peter Holland is General Manager of the Spatial Information Industry Advice and Facilitation, Geospatial and Earth Monitoring Division in Geoscience Australia. He has more than 30 years experience of working in the spatial information industry in Australia. Peter is currently President of the PCGIAP, Vice Chairman and Australian delegate to the International Steering Committee for Global Mapping, Past Chairman of the Global Spatial Data Infrastructure initiative, and is a Foundation Member of the Spatial Sciences institute of Australia. He has published papers on SDI, cartography and remote sensing.

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