Geomatics Networking – *Credo nos in fluctu eodem esse*

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Summary

The recent development of national spatial data infrastructures has given rise to experiments in organisational and institutional linking mechanisms. These mechanisms are conceptual, regional, political and economic; they seek out standards, attempt to rationalise technology, adopt access policies and create arrangements which cross-jurisdictional borders. They explore relationships within the public sector, between the public and private sector and between academia and industry. Some of those linkages are, as yet, immature but certain characteristics of success and failure are already becoming evident.

Introduction

In developing 'institutional linkages' within and between jurisdictions, nations and regions many complex issues are raised. These are evident across a wide spectrum and can have drivers which are often subtle and not obvious to all participants. The success or otherwise of such linkages provides an excellent learning opportunity for 'would-be' participants interested in establishing spatial data infrastructures.

There are several existing models available at various levels from which experiences can be drawn. The papers included in this session on 'institutional linkages' provide case studies addressing issues at a regional and national level. These include the Meeting of Officials on Land Administration (MOLA) which, as we know, aims to facilitate cooperation between land administration institutions in Europe. At the Regional level there is MEGRIN (Multipurpose European Ground-Related Information Network) a European body developed as a result of the need to develop a commercial body for CERCO (Comité Européen des Responsables de la Cartographie Officielle).

At a national level, a case study will be made of the Canadian Geospatial Data Infrastructure (CGDI). This paper takes account of these alliances to raise some of the broader issues facing the development of linkages and visits several case studies, including the Australian Public Sector Mapping Agencies (PSMA), to draw some broad conclusions.

Institutional linkages – *raison d'etre*

'No man is an Island, entire of itself'. John Donne

It seems appropriate in the first instance to consider the character of organisational linkages in order to recognise some of the pitfalls which they face. Institutional linkages are those unions of effort caused by at least two catalysts:

- the inability of individuals or individual agencies to achieve discrete goals without the support of others; or
- the inability of achieving a pan-agency objective without the sharing of individual agencies' resources.

The first could be seen perhaps as a business system – such as a national address file. The second encompasses more of an infrastructural approach and is therefore dependent upon widespread resource contribution like, perhaps, the assessment of sea warming or climate change on a global basis.

Whatever the linkage form, it usually starts in the human world (interestingly, packs of animals also come together for the corporate purpose of hunting) by the development of a concept, discussion and the leadership of a few. It is during this embryonic stage that the objectives are stated and even to some extent an evangelical energy is generated to convince others of the worth of the linkage mechanism. The next stage usually spawns committees and is to do with process. It is here that the pedants may multiply and the commendable goals of the original concept run the risk of being bureaucratised and buried deep in process. This stage is well loved by some public servants and is satirised in the now classic BBC series 'Yes, Minister'. If the concept successfully runs the process gauntlet and emerges as a fully developed organisation still with its objectives intact, there is usually a high level of satisfaction, and even surprise, on the part of the genealogical parents.

The corporate or welded group usually advances well in its formative period – it is new and exciting! As the early leaders tire of the formality and new intellectual baggage is accumulated, any institutional linkage risks becoming irrelevant – certainly as to its origins. Periodic monitoring mechanisms should be used to assess just how germane the organisational creature continues to be. This is of course not to say that the character and even intent of an organisation should not change over time. However, whatever change occurs should be recognised by the stakeholders. The original charter should be made sufficiently flexible to ensure that any metamorphosis is embodied in the evolved organisational mutation. If this surveillance and, where necessary, purging of the old or adoption of the new is not responsibly performed, an organisation is likely to atrophy. Organisations, large and small, run this risk – from the United Nations, to World religions, to the FIG to the local swimming club.

Why do we need institutional linkages?

Institutional linkages in the geomatics framework provide a mechanism for sharing georeferenced information at a range of levels. On a global scale, the need for this information is realised when assessing global issues such as environmental change, promotion of political stability and strengthening world economics. A global geospatial framework would not only provide a tool for planning and implementation of changes but would also provide a baseline of information to assess the temporal impacts and changes in the global environment. It would enable and encourage governments, business and industry to operate more efficiently and responsibly to meet the challenges of the environment and development as set out in The Earth Summit Agenda 21. In a Special Session of the United Nations General Assembly on the implementation of Agenda 21 in 1997, 'the Santa Barbara Declaration', a bracket of recommendations encouraged international cooperation in global mapping and endorsed the development of a global mapping forum to bring together data users and providers to facilitate the creation of a Global Spatial Data Infrastructure (GSDI). It was recommended that the International Steering Committee for Global Mapping (ISCGM) should create such a forum and determine the responsibilities of the various participants.

The need for an accurate global spatial infrastructure is now widely accepted and identified in the international agreement known as Agenda 21. This was signed in Rio de Janeiro by most of the world's governments in 1992. Policy makers need an SDI to assist with the decision making process when facing global environmental problems such as global warming, deforestation, loss of biodiversity, drift-net fishing, desertification and over population. However, the resolution and currency of available data does not meet the standards required to meet the challenge of Agenda 21.

To overcome this shortfall, one initiative has been instigated by Japan's Global Spatial Institute (GSI) – the major government organisation for surveying and mapping. The GSI is involved in multiple initiatives including an international 'Global Map' project to facilitate global change studies and large scale regional development planning.

Discussions at other conferences such as the Global Spatial Data Infrastructure Conferences held in Bonn Germany, North Carolina US and Canberra Australia have led to the setting of international standards, attempts to rationalise technology, development of access policies and the creation of arrangements which span jurisdictional borders. These discussions have also addressed the linkages between the public and private sector and between academia and industry.

Nationally, there have been many efforts to establish strong linkages between many parties including the public and private sector, the community, industry and educational institutions to provide a common, consistent, and accessible national infrastructure which can be used for development and planning purposes.

Spatial data infrastructures and institutional linkages seem to be interdependent if for no other reason than the appearance of the same people on the stage of each forum. The national players in the SDI arena are limited in number but the forums, committees and conferences are many. So the faces are similar and in many cases the attitudes of the players are well known in SDI circles. This should facilitate, rather than hinder the linkages.

The development of an SDI will ensure:

- the availability of fundamental datasets, thus enabling the full potential of geospatial information technologies to be realised;
- recognition and management of spatial data as a national resource;
- setting of common standards for efficient data collection, storage, distribution and use;
- the development of a consultative framework with the user community determining specifications, priorities for fundamental datasets, and avoiding duplication;
- reduction in costs through removal of duplication in data collection;
- consistent cross-jurisdictional decision making;
- improved customer satisfaction through the development of quality datasets;
- more timely and efficient development of applications because datasets already exist;
- access to experienced technical information and people;
- reduction in developmental effort by using framework data standards, standardised data, guidelines and tools; and
- removal of problems created by conflicting data.

(Baker and Irwin, 1996; and the Federal Geographic Data Committee, 1997).

Due to the cost of generating, maintaining and integrating data, it is difficult for any organisation to meet the specific needs of every client. Many organisations need the same fundamental datasets for business and therefore use valuable resources collecting the same information. Additionally, if issues cross jurisdictional boundaries, it is often difficult to find consistent existing applicable datasets. An effective SDI overcomes these issues by providing a reliable standardised source of fundamental datasets plus Metadata that permits users to compare and contrast datasets.

By creating an infrastructure and relevant linkages, positive results can emerge. Using these methods we establish clear responsibility for data maintenance and upgrade, reduce duplication and improve analysis. Decision making processes are developed for federal, state and local governments, and valuable information is created for academic institutions, the private sector and the community. Throughout this environment, there is a general community expectation for the public sector to play a coordinating role in developing the spatial data infrastructures and for governments to instigate survey and mapping programmes ‘for public good.’

Robert Barr (1999[1]) refers to the need for cooperation between the public and the private sectors to ensure the success of a national spatial data infrastructure – both have a role to play. Barr suggests that despite all the reforms introduced in the past 30 years there have not necessarily been significant changes to the way the public and the private sector operate. Accordingly, the private sector still has certain expectations of the role the public sector has to play which includes coordinating and/or building infrastructures. Therefore, there is still the expectation that it is the responsibility of governments to support the spatial data infrastructures. The level of support is the issue which continues to confound government agencies, the users and in particular the many treasuries which have to respond to calls on funding for ‘public good.’

It is this level and the role of each sector within it which both offers opportunities and creates obstacles to the creation of linkages. The inherent difficulty of information ownership, custodianship, the technology for maintenance and the fusion of public and private sector information for e-commerce applications continues to obstruct global access to georeferenced information. Despite these obstructions, enormous datasets are being created. In Australia, a national address file task is currently being scoped. The users are myriad and the value is significant but the contributions could be represented by over eight hundred local government authorities and eight State or Territory jurisdictions. The institutional linkages for this task alone are complex. There are many such large databases.

The Vice-President of the United States of America, Al Gore, suggests that the majority of these huge databases of information have never fired a single neuron in a single human brain. He goes on to state that there is a direct correlation between the availability of information and knowledge, and a progressive society. Despite this understanding and wide acceptance, few people have access to the information as it is being squirrelled away in electronic silos of information, to use another analogy of Gore's. It has been estimated that the volume of these silos is increasing five fold, annually. Why is this highly valuable information never accessed? Are the linkages adequate? Are they relevant? Do they indeed exist?

Environmental issues are threatening the sustainable development, perhaps even the sustainable civilisation, of the world. There have been some excellent case studies which raise issues such as booming population and city size growing at a rate of approximately 50% every 10 years. This sort of population explosion highlights the demand for an effective spatial information infrastructure. The availability of such a tool would enable smart business decisions to be made on issues such as town planning, environmental monitoring, pollution, and deforestation. To develop an understanding of the impact of these issues and the outcomes of any development is important; particularly to aid organisations such as the World Bank and the International Monetary Fund, where grants and loans run to the order of hundreds of millions or even billions of dollars.

One current project constrained by the absence of a global spatial data infrastructure is a project conducted by the University of Otago addressing 'The Economic Impacts of Transboundary Plant Pests and Animal Diseases'. This is supported by the Food and Agriculture Organisation (FAO). The project aims to globally display the spatial distribution, occurrence and absence of particular migratory pests such as tsetse fly, blight, foot and mouth disease and army worm. It is proposed that the data should be displayed at, at least, an FAO standard pixel size for clear sub-regional extent. However, the spatial data is not commonly available in this form and may need to be translated or transformed. The final outcome of the project will be to assess the economic impact of the pests and diseases on affected areas. One of the major barriers, or shortcomings, in the project is the absence of accurate spatial data infrastructures to support the mapping.

How do we create institutional linkages?

The framework of an SDI is built by coordinating the activities of relevant organisations. The Federal Geographic Data Committee (1997) describes two possibilities:

- firstly, identify a starting point for sharing geographic base information. This enables organisations/bodies to add unique information for business needs – value added reselling; and
- secondly, establishment of the framework to provide a starting point for a database and the data generalised from it. This provides organisations with current and consistent data for decision making.

Challenges to creating institutional linakages

Some of the challenges facing the development of successful linkages include the fragmentation of data, different mapping objectives, data sources, mapping units, time dimension, multiple uses, hierarchical structures, reliability, core datasets, understanding of cadastral concepts, data formatting, lack of political understanding, international accountability, defence/security, price of data, access, lack of operational coordination, and who funds data acquisition and maintenance. The writer regrets to say that this list is not exhaustive! Several of these challenges will be discussed further in this paper, others in the papers following in this session.

Who is involved in institutional linkages?

The linkages or partnerships involved in developing SDI's are considered key elements for the building and implementation of a successful framework. Instrumental stakeholders may include: the public sector; not-for-profit organisations; non government organisations; research and educational institutions; international aid/development organisations; the private sector; and the community. Each party views SDI's from a different perspective and usually has a different agenda in mind. For example, in the US alone, obtaining consensus on issues of ownership and control, the role of government versus industry suppliers, standard formats and practices and even the definition of 'core' datasets has been controversial.

As identified by Brand (1998[1]) each of these groups will have its own perspective and understanding of what needs to be included in a GSDI. Each will be influenced by whether or not they come from an institutional, technological, applications or commercial background. Nevertheless, through the linkages, these stakeholders bring data, technology, expertise and facilities – all elements of a successful SDI.

To ensure the development of successful partnerships, there are several elements to be considered. These were identified by the Federal Geographic Data Committee (1997) as:

- sharing and formalising of responsibilities;
- sharing the cost of commitment;
- sharing of benefit and cost recovery;
- shared decision making;
- incentives;
- benefits to organisations beyond the initial partnership, thus ensuring framework development;

- known quality of data being shared;
- data stewardship; and
- commitment to supporting the ongoing programme.

There are several operational linkages initiated to support local, national, regional or global initiatives. These have the aim of creating widely accessible datasets of fundamental information that is accurate and current, to assist with operations and decision making processes.

1 Global

The only real success, to date, of a Global Spatial Data Infrastructure was the establishment of the Digital Chart of the World (DCW). Barr (1999) describes it as 'vastly ambitious and successful'. The data were provided at a consistent standard through the surprising collaboration of military authorities, thus demonstrating that many barriers to institutional linkages can be overcome. The first version was a huge success and was sold for not more than the cost of establishment. However, the National Mapping Organisations described it as 'unfair competition' and blocked the release of a second edition. A curious attitude considering that the mapping agencies could not meet the demand for such digital information in their own countries (Barr[2], 1999).

GSDI Conferences

Over the past five years there has been a push to further establish a GSDI to ensure sustainable development in both the developed and developing countries of the world. Accordingly, several conferences have been specifically conducted to identify a future direction for the global spatial data infrastructures, including: Bonn Germany, 1996; North Carolina USA in 1997; and Canberra Australia in 1998. The first two GSDI meetings highlighted the need for a GSDI and discussed current regional and national spatial data infrastructures. This provided the opportunity to discuss issues and to learn from the experiences of others involved in the development of spatial data infrastructures. The third GSDI Conference in Canberra in November 1998 operated in a manner consistent with the principles described in the theme paper *'GSDI: Policies and Organisational Issues'* by Mr Michael Brand (1998[1]). The decision was made to establish an umbrella organisation. As a result, there have been many discussions and much debate over the various issues facing the development of a Global Spatial Data Infrastructure (GSDI). To successfully establish a GSDI, close consideration needs to be given to the issues associated with organisational and institutional linkages.

In attempting to bring some clarity to the GSDI, the following definition was determined in North Carolina:

> 'A Global Spatial Data Infrastructure is one that encompasses the policies, organisational remits, data, technologies, standards, delivery mechanisms and financial and human resources necessary to ensure that those working at the global or regional scale are not impeded in meeting their objective.'

There was a decision at the second GSDI Conference, held in Chapel Hill, North Carolina, to develop 'an organisational nucleus to encourage the creation, development and linkage of local, national, regional and global geospatial data infrastructures and in particular to encourage the establishment of permanent committees in regions where they currently do not exist, such as the Americas, Africa and the Middle East'. Such an international committee was deemed necessary to ensure a successful and united approach to the development of global spatial data infrastructures, ensuring sustainable economic, environmental and social development into the next century.

'Finding 1' from North Carolina states that 'the GSDI… is critical to the attainment of substantial and sustainable development in both the developed and developing countries of the world.'

'Finding 2' states that 'the GSDI is of vital importance to implementation of AGENDA 21 of the Rio Summit and to the multinational environmental conventions, and should be placed as central support for decision making before the meeting of the UN Commission on Sustainable Development in 2001.'

FAO and World Bank initiatives

When considering the objectives of organisations like the FAO and the World Bank it is evident that the availability of a GSDI would improve the quality and effectiveness of their decision making.

A priority of the FAO is to encourage sustainable agriculture and rural development through programmes that do not degrade the environment and which are technically appropriate, economically viable and socially acceptable. To develop sustainable agriculture projects FAO provides practical assistance to developing countries through numerous technical assistance projects. These integrate environmental, economic and social considerations and overall they tie in closely with the objectives of Agenda 21.

FAO encourages the direct transfer of skills and technology to locals through field projects. Additionally, the FAO provides a variety of information and support services, such as digital databases on a variety of topics; from fish marketing information to trade and production statistics and records of current agricultural research. The FAO's Geographic Information System provides information on land use issues including soils and vegetation cover. Satellite imagery is used by the Global Information and Early Warning System to monitor conditions affecting food production and to alert governments and donors to any potential threats. The value of a digital spatial infrastructure of the World is evident for organisations such as the FAO, and other similar aid organisations.

Notwithstanding the extent of the FAO operations the writer, in a recent discussion with FAO officials, learnt of a proposed study in an African country – a study which he had been engaged to perform two years earlier, at the cost of about $300 000. The officials were unaware of his work. One conversation, one project, one country. Even this one example focuses on the need for an effective institutional linkage to at least register the availability of feasibility or scoping studies.

2 Regional

In October 1997, at the GSDI 2 Conference in North Carolina, Resolution 1 identified the need to encourage the establishment of permanent committees where they do not exist. The Permanent Regional Committees for Geographic Information in the Asia and the Pacific (PCGIAP) and the European Umbrella Organisation for Geographic Information (EUROGI) have been identified as important to the success of the GSDI. If these are not established in other areas such as the Americas, Africa and the Middle East how do we create a global spatial data infrastructure with these glaring holes in the picture? Should there not be an approach that ensures rather than merely encourages the creation of regional permanent committees? Without global coverage surely the benefits so well defined will continue to elude us? Within the South East Asian area, a number of initiatives have been taken. Since they are not covered elsewhere in this sessions, a brief coverage follows.

The Permanent Committee on GIS Infrastructure for Asia and the Pacific (PCGIAP)

The Permanent Committee on GIS Infrastructure for Asia and the Pacific is primarily working towards developing a Global Spatial Data Infrastructure (GSDI) by initiating a regional Spatial Data Infrastructure in Asia and the Pacific, called the Asia Pacific Spatial Data Infrastructure (APSDI). It is proposed that the APSDI will comprise of a network of distributed databases containing fundamental spatial data such as geodetic, topographic, hydrographic, cadastral and geographic names data. It is felt by Godfrey et al (1997) that this would provide a fundamental building block in the development of a global infrastructure and would provide a model which other countries/regions could consider for implementation.

The aims of the committee are to maximise the economic, social and environmental benefits of geographic information in accordance with Agenda 21. These will be realised 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;
- share experiences and consult on matters of common interest; and
- participate in any other form of activity such as education, training, and technology transfer.

The work implemented by the Permanent Committee as part of the APSDI, also has an influence at the global level through its link to the United Nations Regional Cartographic Conference for Asia and the Pacific and also through its links with other global organisations that have an interest in spatial data.

The presence of a spatial data infrastructure in the Asia Pacific region is vital to ensure the economic and social development and environmental management both at a local, regional and global level.

Objectives of the Permanent Committee are to:

- develop guidelines for the legislative and administrative procedures and orders appropriate to the acquisition and sharing of spatial data;
- define the nature of a regional geographic information infrastructure so that it meets the requirements of the country and the global mapping requirements, principally; a regional geodetic framework, topographic features and geographic names;
- define a framework for the documentation of the status of fundamental datasets and key agencies in each member nation, and for the exchange of this information;
- design a strategy for the development of a geodetic framework and topographic databases as the basis for regional GIS activity;
- prepare guidelines and strategies to assist member nations in the development of digital cadastral databases and where necessary implement cadastral reform to meet individual nations needs; and
- determine the need for research, training and technology exchange in relation to the beneficial impact of geographic information on the social, environmental and economic objectives of the member nations of the Asia Pacific region.

The PCGIAP is at the process stage of development and is busy with committee workings and the development of relevant networks.

Australia and New Zealand Land Information Council (ANZLIC)

The Australia and New Zealand Land Information Council (ANZLIC) brings together senior land information management executives from the Australian Territories, States and Commonwealth and New Zealand.

In the late 1970s, all jurisdictions in Australia and New Zealand were faced with similar administrative and technical issues associated with their computerised land information databases. This highlighted the need to develop a national approach to land information management by means of a coordinating body.

Origin and Vision of ANZLIC

ANZLIC was established in January 1986 as the Australian Land Information Council (ALIC) to:

- coordinate the collection and transfer of land-related information across and between the different levels of government; and
- to promote information to assist decision making processes.

A national coordinating council was established in March 1986 with representatives from Commonwealth, State and Territory governments. The key objective of the Council was to promote and develop a cost-effective national strategy to facilitate the exchange of land information.

The vision of the ANZLIC is to ensure that Australia and New Zealand have the relevant land and geographic information required to support economic growth, and support their social and environmental interests.

To achieve this, ANZLIC provides:

- a national focus for strategic spatial information initiatives;
- a strategic organisational framework;
- a spatial data infrastructure for Australia; and
- better decision making processes.

(ANZLIC, 1998).

Importance of data standards

ANZLIC is working closely with the Intergovernmental Committee on Surveying and Mapping (ICSM) in supporting the development and implementation of the Australian Spatial Data Infrastructure (ASDI). The ASDI aims to collate data to develop a consistent national data framework. ANZLIC will provide the structure and the guidelines, the Commonwealth will provide the administrative support and the data will be provided by the States, collated through ANZLIC, to create a national infrastructure. At an ANZLIC meeting in October 1996, all sectors including the private sector agreed on the ASDI standards. These standards are expected to be implemented during 1999.

The ASDI will provide a common, consistent, and accessible national infrastructure which government, the private sector and the community can use to develop and plan. Data to be collected as part of this National infrastructure includes: topography, transportation, utilities, flora, fauna, hydrology, climate, land use, administrative boundaries and many other datasets. Currently, fundamental spatial datasets have been established by government for major road and telecommunications networks, and basic health and education facilities.

Reduction of duplication

One of the major objectives of the ASDI is to remove the random collation of spatial information. It can be collected at a national, regional and local level. However, currently there are few guidelines in place to ensure quality control or consistency of formatting (existing information can not necessarily be integrated with other datasets and used for spatial modelling or analysis). This becomes an issue where the need exists to integrate the datasets across jurisdictions. The datasets have been collected for specific business purposes within the individual jurisdictions, with interstate standards rarely established. This problem can also occur within a jurisdiction where different government agencies collect data in an uncoordinated approach. It makes datasets difficult to integrate with otherwise similar datasets.

Another objective of a national spatial data infrastructure is to ensure that the users of land and geographic data who require national coverage, will be able to acquire complete and consistent datasets, even if the data is collected and maintained by different jurisdictions. Therefore, the issue for ANZLIC is to determine what is required of the jurisdictions and their datasets and define consistent and workable guidelines to meet national requirements.

Information collation can be duplicated, thereby wasting valuable resources with limited quality control. To eliminate this, ANZLIC proposes that the community reach an agreement on the fundamental datasets required in the national interests, to what standard the datasets should be collected and maintained, which agencies maintain ownership of data and what are the national priorities for collection. By coordinating a national approach, ANZLIC will remove excessive costs of data collection, inefficiencies of data collection, confusion and decision making based on poor information. By establishing a much more comprehensive and efficient approach, Australia and New Zealand's ability to compete in the international marketplace should also improve.

ANZLIC believes that New Zealand and Australia will benefit from better management of spatial information through assisting the community to define, establish and implement the national spatial infrastructure.

ANZLIC has developed a model for the ASDI that is comprised of four key components:

- **institutional framework** comprising policy and administrative arrangements for building, maintaining, accessing and applying the standards and datasets;
- **technical standards** defining the technical characteristics of the spatial (or geographic) datasets;
- **fundamental datasets**, the essential component of the ASDI, produced within the institutional framework and complying with the technical standards; and
- **distribution networks** through which spatial datasets are made accessible to the community, in accordance with the agreed policy and standards.

(ANZLIC, 1998).

ANZLIC proposes that by better management of spatial information it will achieve:

- an increased understanding of the importance for having good, consistent information readily available;
- A better understanding for the need to manage information in a consistent, multi-purpose usage form;
- better and wider scale access to the information for a broad range of users; and
- wider understanding of important and relevant information, appropriate standards, who is responsible for collection of data, to what precision and what the priorities are for that information.

ANZLIC has entered a phase of self assessment to ensure its original goals are still relevant and achievable. This will result in a new committee framework and perhaps a new hierarchical reporting system.

3 National

There are many national spatial data infrastructure initiatives throughout the world including the AGI in United Kingdom, the SOGI in Switzerland and the Public Sector Mapping Agencies (PSMA) in Australia. Such infrastructures provide the models and the schemas to understanding many of the issues facing the development of a GSDI.

The first two initiatives will be dealt with in the session papers and therefore the PSMA evolution and function is now described briefly.

Public Sector Mapping Agencies

In 1993, the public mapping agencies of the Commonwealth, the States and the Territories of Australia agreed to cooperate as a consortium, to be known as the Public Sector Mapping Agencies (PSMA) in response to the Australian Bureau of Statistics' 1996 Census Mapping Tender. For historical reasons, there was no complete digital map coverage of Australia available from any agency at the scales required. Once the need, or the market, was identified, it was possible to develop a national seamless dataset. This is now being hailed in Australia as the first major step to integrating data from individual jurisdictions, thereby building the foundations of a national data infrastructure for Australia. Accordingly, the Public Sector Mapping Agencies (PSMA) has adopted all ASDI standards, where available, for content, description, feature identification and transfer. Where, however, a national client funds or invests in a data set to be created by PSMA the result may, whilst being client specific, not be standards compliant for financial reasons.

The PSMA won the data supply portion of the ABS tender in 1993 and developed a digital map dataset to meet the needs of the ABS. The dataset is a multi-resolution dataset sourced from the Territories, the States and the Commonwealth, incorporating high resolution topographic and cadastral information into one detailed, accurate and authoritative national spatial database. It was considered as a realistic start to the data component of the ASDI.

The PSMA dataset is an excellent demonstration of sustainable and successful linkages between the public and private sector. In developing the PSMA dataset, there were 32 private firms involved in the development of the PSMA dataset generating approximately $5.5 million within the private sector. This included an arrangement with a private sector consortium of Candata, Intergraph, Navigate, and DMR who supplied the hardware and system development.

One of the major challenges faced by the PSMA was the inconsistency between the various datasets. The States and Territories did not hold their data in the same system, format or specification, and not all jurisdictions held equivalent map coverage. Data description tables were adopted to characterise PSMA data by jurisdiction, highlight differences between data, indicate compliance with ABS requirements, and provide the Client with a working specification upon which to design the mapping system. The differences created a complex situation and highlighted the need to identify a uniform national approach to the collection and storage of digital data. This would enable all parties to maximise benefits and utilise all resources available. As the lead agency, the Surveyor-General's Department of New South Wales examined and documented all the disparate specifications and defined one common specification. Guidelines have been set for the dataset.

Three categories were delineated across Australia. The categories were described as:

1 **urban** – covering capital cities and major populations. Data was sourced principally from digital cadastral databases and other large scale coverage provided by the States and Territories;

2 **rural** – States and Territories provided digitised topographic map data at scales between 1:25 000 and 1:100 000, augmented by Digital Cadastral Database (DCDB) sourced data within townships having a defined street pattern; and

3 **remote** – the principal source of data in this zone was an established GIS product known as GEODATA TOPO 250K, which was augmented by large scale topographic data and DCDB data within townships having a defined street pattern.

In each data category, data quality attribute tables were compiled to indicate completeness, positional accuracy, logical consistency, label accuracy and source.

Another of the major challenges of the PSMA was to coordinate data delivery according to the strict schedule set by the ABS, coping with changes to the schedule, sorting out technical difficulties and maintaining liaison between all the organisations involved. The orchestration of nine agencies providing spatial data of varying quality over the Australian landscape was a major logistical undertaking.

Australia cannot lay claim to being the first to see its census collection agency drawn towards the vortex of GIS activity. David Rhind has provided an excellent overview of British and American efforts in this regard. Australia can claim however, that it has one of the most difficult and challenging census collection environments, representing formidable difficulties for census mapping. This environment and the distribution of population across it, has always biased Australian mapping programmes and continues to do so. In the case of the 1996 Census Mapping Project it has influenced a solution that is probably unique.

The quality and value of the new census dataset has enabled the PSMA to subsequently commercialise and license its use to numerous Value Added Resellers (VAR). In September 1998 alone, the PSMA was approached by over fifteen valued added resellers, including banks and agricultural suppliers with a view to using the database as the foundation for overlaying other information to support business applications. The more unusual applications were for psychometric mapping, agricultural produce tracking and intelligent transportation systems. In the future, it is expected that business applications will be the primary marketing area of the PSMA. Joint Ventures creating additional datasets are also being developed with telcoms, the Electoral Commission of Australia and Australia Post.

As ABS census designers have become familiar with PSMA data the value of this project to the ABS is apparent because of the time savings achieved and a reduction in the cost per head of population made possible by the new mapping environment. The value of the project for creating Edition 1 of the national geospatial framework is also evident through the successful business negotiations with telecommunications carriers, national transport operators, the Sydney Organising Committee for the Olympic Games (SOCOG) and the Electoral Commission of Australia. Commercial organisations have also recognised that this product, which has the socio-economic data from the ABS aligned to it, is the de facto authoritative national dataset.

The database not only represents the first edition of a seamless national topographic database but could also be the basis of a national cadastral database and a national digital road network. In itself, the creation of the national datasets for the Census Mapping Project (CMP) was a major achievement. However, the architects of the scheme believed it would become the foundation for a national spatial data infrastructure. It is accepted that the datasets which comprise the CMP do not constitute all the fundamental information layers needed for sound and comprehensive national decision making.

What is known, however, is that the existence and value of the CMP is enabling additional layers to be built, including urban and rural addressing for emergency dispatch and property taxation mapping. A warning from PSMA experience to the policy makers and standards creators: ‘all the proselytising in the world will not produce a SDI!’ Whilst policy and standards are essential to create the envelope into which an SDI will fit, it will not happen without sustained and quality leadership, sound management and a funding source.

4 Jurisdictional

All states in Australia have a coordinating mechanism across government agencies which also provides a working relationship between all sectors of the geospatial industry. There have been some excellent results from most jurisdictions but perhaps the most mature is the Western Australian Land Information System (WALIS).

WALIS was established in the late 1970s and is a complex system involving 25 representatives from both the public and private sector, educational institutions and the community. It comprises a network of agencies that maintain standards, policies and cooperative arrangements to enable the sharing and integration of a range of land and geographic information held by individual government agencies. It is founded on the principle that more can be achieved by a cooperative and pooled effort than through individual efforts. It is an excellent example of operational institutional linkages cooperating and managing the state's land and geographic information. The success of WALIS is dependent upon a high level of collaboration and cooperation by all participants.

Clearly, there are significant benefits to be gained by sharing land information. Since each agency collects specific information for which it has specific expertise, it is more effective and efficient to share this information so reducing the cost of duplication and minimising inconsistent data. Each WALIS member agency has defined the standards for each of the strategic datasets.

WALIS is not a single centralised database, but is being developed as a network of systems and databases to provide users with access to data held by all WALIS participants.

Other States have also adopted a networking approach. The recently introduced internet access facility for the Digital Cadastral Database in New South Wales provides the ability to spatially enable the many separate agency data sets already in existence. This has been achieved through a concept of spatial information partnering.

Conclusion

If there is one characteristic which will cause failure in the creation and life of institutional linkages it is relevance. If the linkage is no longer relevant it will fail to function. The other principal and essential characteristic for survival is the ability for ease of access to the data created by the institutional linkage. Access deals not only with technology but with ownership. Over emphasis on communication by the peak body to the market place can alienate the members, but without an adequate source of funding, any institutional linkage will wither and become ineffective.

A leading article in the Times of London on 14 October 1992 referred to the contribution which maps have made to our society. It claimed that 'Mankind has invented three great forms of communication: language, music and mapping'. It was fifty years before that article appeared in 1943, in the dark days of World War II, that Churchill prophesised that 'the empires of the future are the empires of the mind'.

Many of us have been involved in georeferenced information for several decades. We were 20 or 30 years on from Churchill but did we predict the world of Bill Gates, the Internet, volumes of data racing down wires, electronic silos of information, electronic commerce replacing grubby banknotes and the ability to, as if by some magical and unseen forces, integrate layer upon layer of information? Certainly we had ideas and dreams and ambitions and perhaps an unseemly or barbaric faith in technology, but some of us – certainly me – were long on dreams but short on detail. Some would suggest that, in that regard, nothing has changed. But in justification it was George Bernard Shaw who said *'You see things; and you say "Why". But I dream things that never were and I say "Why Not?" '*.

In a recent book by Davidson and Rees-Mogg (1997) entitled 'The Sovereign Individual' the authors take another leap of prediction and paint a picture of society and the individual in the international context and suggest that the world will be a place where loyalty to any one nation will disappear as the 'international' virus spreads inexorably throughout business, academia and the professions; where we will become a society of nation hoppers, where those fortunate enough to have access to the web will have no geographical roots, where we will negotiate with jurisdictions as to where we will live based on agreed taxation rates and where the cognitive elite will become insulated from the turbulence of the real world.

All this in a spatially enabled information world, a virtual world, made possible by our integrated national look-alike spatial data infrastructures.

A 'Brave New World' indeed!

References

ANZLIC, 1998. *Spatial Data Infrastructure for Australia and New Zealand*, discussion paper: http://www.anzlic.org.au/anzdiscu.htm

BAKER, G. and IRWIN, B., 1996. A Geographic Information Framework for Managing our Nation. *In: Proceedings of Mapping Sciences '96 Conference of the Mapping Sciences Institute*, Australia, 22–26 Sep.

BARR, R., 1999[1]. 'I had a dream….'. *In: GISEurope*, issue 1, Jan.

BARR, R., 1999[2]. A private matter. *In: GISEurope*, issue 2, Feb.

BRAND, M.,1998[1]. *Global Spatial Data Infrastructure: Policy and Organisational Issues*, Theme paper for GSDI3 Conference*,* Canberra, 17–19 Nov.

BRAND, M., 1998[2]. Global Spatial Data Infrastructure: Current Developments. *In: The Australian Surveyor*, vol. 43, no. 3, pp. 174–177.

COLEMAN, D. and MCLAUGHLIN, J., 1994. Building a Global Spatial Data Infrastructure: Usage Paradigms and Market Influences, *Geomatica*, vol. 48, no. 3, pp. 225–236.

COLEMAN, D. and MCLAUGHLIN, J., 1997. Defining Global Spatial Data Infrastructure (GGDI): Components, Stakeholders and Interfaces, *Theme paper 1 North Carolina GSDI Conference Proceedings,* Chapel Hill.

DAVIDSON, J. and REES-MOGG, W., 1997. *The Sovereign Individual*, New York: Simon & Schuster Inc.

FEDERAL GEOGRAPHIC DATA COMMITTEE, 1997. *Framework Introduction and Guide*, Washington, DC.

3rd GLOBAL SPATIAL DATA INFRASTRUCTURE CONFERENCE, 17–19 Nov. 1998, Canberra, Australia: http://www.percom.apgis.gov.au/gsdi3/gsdi3res.htm

GODFREY, B., HOLLAND, P., BAKER, G. and Irwin, B., 1997. The Contribution of the Permanent Committee on GIS Infrastructure for Asia and the Pacific to a Global Spatial Data Infrastructure. *In: Global Spatial Data Infrastructure Conference,* Chapel Hill*,* North Carolina, 19–21 Oct.

GORE, A., (unknown) *The Digital Earth Understanding our planet in the 21st Century*.

GRANT, D. and MOONEY, D., 1995. National Spatial Data Infrastructure. *In: Conference for National Mapping Organisations,* Cambridge UK, 25 Jul–1 Aug.

GRANT, D., 1996. *New South Wales Cadastral Systems Reform and Issues Report*, presented at: Permanent Committee on GIS Infrastructure for Asia and the Pacific Working Group 2, Sydney Australia, 1–2 Oct. 1999.

GRANT, D., 1998. *Dancing of the Digits*, presented at:10th Annual Conference Spatial Information Research Centre, Otago, New Zealand, 16–19 Nov. 1998.

MOONEY, D., and GRANT, D., 1997. The Australian National Spatial Data Infrastructure. In: *Framework for the World*, ed. Rhind, D., Cambridge: Pearson Professional Ltd.

ONSRUD, H., and RUSHTON, G., 1995. *Sharing Geographic Information*, New Jersey: Rutgers.

RHIND, D., 1997. Implementing a Global Geospatial Data Infrastructure (GGDI), *Theme paper 2 North Carolina GSDI Conference Proceedings*, Chapel Hill, North Carolina.

RIDDELL, J.C., 1998. *Contemporary Thinking on Land Reform*, discussion paper, Rome: FAO.

UNITED NATIONS, 1992. AGENDA 21: *Programme of Action for Sustainable Development, Rio Declaration on Environment and Development; Statement of Forest Principles*, New York: United Nations Department of Public Information.

UNIVERSITY OF OTAGO, 1999. *The Economic Impacts of Transboundary Plant Pests and Animal Diseases*, brief: Spatial Information Research Centre.

WORLD COMMISSION ON ENVIRONMENT AND DEVELOPMENT, 1987 *Our Common Future*, Oxford University Press, UK.